ANNUAL DANISH INFORMATIVE INVENTORY REPORT TO UNECE

Emission inventories from the base year of the protocols to year 2007

NERI Technical Report no. 716 2009

NATIONAL ENVIRONMENTAL RESEARCH INSTITUTE
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Abstract: This report is a documentation report on the emission inventories for Denmark as reported to the UNECE Secretariat under the Convention on Long Range Transboundary Air Pollution due by 15 February 2009. The report contains information on Denmark's emission inventories regarding emissions of (1) SO_X for the years 1980-2007, (2) NO_X, CO, NMVOC and NH_3 for the years 1985-2007, (3) Particulate matter: TSP, PM_{10}, $PM_{2.5}$ for the years 2000-2007, (4) Heavy Metals: Pb, Cd, Hg, As, Cr, Cu, Ni, Se and Zn for the years 1990-2007, (5) Polyaromatic hydrocarbons (PAH): Benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene and indeno(1,2,3-cd)pyrene for the years 1990-2007 and (6) Dioxin and HCB. Further, the report contains information on background data for emissions inventory.

Keywords: Emission Inventory; Emissions; Projections; UNECE; EMEP; NO_X; CO; NMVOC; SO_X; NH_3; TSP; PM_{10}; $PM_{2.5}$; Pb; Cd; Hg; As; Cr; Cu; Ni; Se; Zn; Polyaromatic hydrocarbons; Benzo(a)pyrene, Benzo(b)fluoranthene.

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Summary

I Background information on emission inventories

Annual report

This report is Denmark's Annual Informative Inventory Report (IIR) due March 15, 2009 to the UNECE-Convention on Long-Range Transboundary Air Pollution (LRTAP). The report contains information on Denmark's inventories for all years from the base years of the protocols to 2007.

The gases reported under the LRTAP Convention are SO_2, NO_X, NMVOC, CO, NH_3, As, Cd, Cr, Cu, Hg, Ni, Pb, Se, Zn, dioxins/furans, HCB, PAHs, TSP, PM_{10} and $PM_{2.5}$.

The annual emission inventory for Denmark is reported in the Nomenclature for Reporting (NFR) format as requested in the reporting guidelines.

The issues addressed in this report are: trends in emissions, description of each NFR category, uncertainty estimates, recalculations, planned improvements and procedures for quality assurance and control. The structure of the report is, as far as possible, the same as the National Inventory Report to UNFCCC.

This report and NFR tables are available to the public on NERI's homepage: http://www.dmu.dk/Luft/Emissioner/Home+of+Inventory/

and on the Eionet central data repository:

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

Responsible institute

The National Environmental Research Institute (NERI), Aarhus University, is responsible for the annual preparation and submission to the UNECE-LRTAP Convention of the Annual Danish Emissions Report and the inventories in the NFR format in accordance with the guidelines. NERI participates in meetings under the UNECE Task Force on Emission Inventories and Projections and the related expert panels, where parties to the convention prepare the guidelines and methodologies on inventories.

II Trends in emissions

Acidifying gases

Figure S.1 shows the emission of acidifying gases in terms of acid equivalents. In 1990, the relative contribution in acid equivalents was almost equal for the three gases. In 2007, the most important acidification factor in Denmark was ammonia nitrogen and the relative contributions for SO_2, NO_X and NH_3 were 8.3 %, 41.3 % and 50.4 %, respectively. However, regarding long-range transport of air pollution, SO_2 and NO_X are still the most important pollutants.

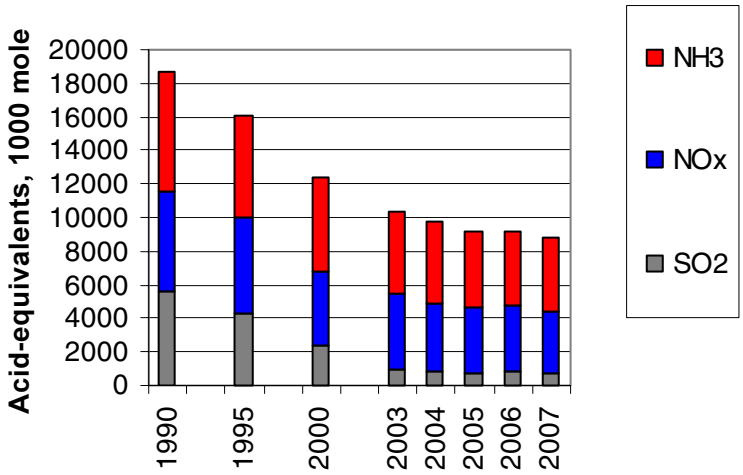


Figure S.1 Emissions of NH_3, NO_X and SO_2 in acid equivalents.

SO_2

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

NO_X

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

of low-NO_X burners and denitrifying units in power and district heating plants.

NH_3

Almost all atmospheric emissions of NH_3 result from agricultural activities. Only a minor part originates from road transport. This part is, however, increasing due to increasing use of catalyst cars. In 2007 the major part of the emission from agriculture stems from livestock manure (87 %) and the largest losses of ammonia occur during the handling of the manure in stables and in field application. Other contributions come from crops (7 %), use of mineral fertilisers (6 %) and sewage sludge used as fertiliser (less than 1 %). The total ammonia emission decreased by 41 % from 1985 to 2007. This is due to the active national environmental policy efforts of the past twenty years.

Other air pollutants

NMVOC

The emissions of NMVOC originate from many different sources and can be divided into two main groups: incomplete combustion and evaporation. Road vehicles and other mobile sources such as national navigation vessels and off-road machinery are the main sources of NMVOC emissions from incomplete combustion processes. Road transportation vehicles are still the main contributor, 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 48 % from 1985 to 2007, largely due to the increased use of catalyst cars and reduced emissions from use of solvents.

CO

Transport is responsible for the dominant share of the total CO emission. Also other mobile sources and non-industrial combustion plants contribute significantly to the total emission of this pollutant. The drop in the emissions from 1989 to 1990 was a consequence of a law banning the burning of agricultural crop residues on fields. The emission decreased further by 38 % from 1990 to 2007, largely because of decreasing emissions from road transportation.

PAHs

The present emission inventory for PAH (poly aromatic hydrocarbons) includes the four PAHs reported to UNECE: benzo(a)pyrene, benzo(b)-fluoranthene, benzo(k)fluoranthene and indeno-(1,2,3-cd) pyrene. The most important sources of the PAH emission are combustion of wood in the residential sector and road transportation. The increasing emission trend is due to increasing combustion of wood in the residential sector.

Particulate Matter

The particulate matter (PM) emission inventory has been reported for the years 2000-2007. The inventory includes the total emission of particles

TSP (Total Suspended Particles), emission of particles smaller than 10 µm (PM_{10}) and emission of particles smaller than 2.5 µm ($PM_{2.5}$).

The largest $PM_{2.5}$ emission sources are the residential sector (70 %), road traffic (16 %) and other mobile sources (6 %). For the latter, the most important source is off-road vehicles and machinery in the industrial sector and the agricultural-/forestry sector (39 and 37 % respectively). For the road transport sector, exhaust emissions account for the major part (75 %) of the emissions.

The largest TSP emission sources are the residential sector and the agricultural sector. The TSP emissions from transport are also important and include both exhaust emissions and the non-exhaust emissions from brake and tyre wear and road abrasion. The non-exhaust emissions account for 49 % of the TSP emission from road transport.

Heavy metals

In general, the most important sources of heavy metal emissions are combustion of fossil fuels and waste. The heavy metal emissions have decreased substantially in recent years. The reductions span from 2 % to 95 % for Cu and Pb, respectively. The reason for the reduced emissions is mainly increased use of gas cleaning devices at power and district heating plants (including waste incineration plants). The large reduction in the Pb emission is due to a gradual shift towards unleaded gasoline.

III Recalculations and Improvements

In general, considerable work is being carried out to improve the inventories. New investigations and research carried out in Denmark and abroad are, as far as possible, included as the basis for the emission estimates and included as data in the inventory databases. Furthermore, the updates of the EMEP/CORINAIR guidebook and the work in the Task Force on Emission Inventories and Projections and its expert panels are followed closely in order to be able to incorporate the best scientific information as the basis for the inventories. Further important references in this regard are the IPCC guidelines and IPCC good practice guidance.

Implementation of new results in inventories is made in a way so that improvements better reflect Danish conditions and circumstances. In improving the inventories, care is taken to consider implementation of improvements for the whole time-series of inventories, to promote consistency. Such efforts lead to recalculation of previously submitted inventories.

The most important recalculations for the various sectors are mentioned below.

Energy

Stationary Combustion

The national energy statistics has been updated for the years 1980-2006. This has primarily resulted in small differences, however a larger recal-

culation of the residential wood consumption was made by the DEA resulting in higher emissions of a number of air pollutants in 2006.

The NMVOC emission factor for cereal straw in residential plants has been updated to reflect the value provided in the EMEP/Corinair Guidebook. The emission factor was reduced from 600 g pr GJ to 400 g pr GJ. This change was made for the whole time-series.

The emission factor for CO for residential wood combustion was updated based on the technology distribution of stoves and boilers together with default emission factors from the EMEP/Corinair Guidebook. This reduced the emissions factor from 6000 g pr GJ to 3441 g pr GJ in 2007. A time-series for the emission factor was elaborated and is included in annex 2A.

HCB emissions were estimated for the first time. Default emission factors from the EMEP/Corinair Guidebook were used in the calculations.

Mobile sources

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

Recalculations have been made from 1985-2006 resulting in minor emission differences between 0 and -1 %, for all emission components other than the fuel related ones. For these latter components, the emissions remain the same.

National sea transport

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

This has caused the fuel consumption and emissions to change from 1996 onwards. Most significantly the emission changes for NO_x are between -3 and -20 %, whereas the emission changes for other components are between -3 and 3 %. The fuel consumption increases are between 0 and 2 % in the period.

Fishery

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

Fishery is a part of the CRF-NFR code 1A4c consisting of agriculture, forestry and fisheries activities, and hence the fuel consumption and emission impacts are somewhat smaller for the sector as a whole.

From 1996-2005 the fuel consumption and emission changes are between 0 and -2 %. For 2006 the emission changes are between -3 and -1 %. For SO_2 though the emission change is -7 %, due to the relatively high sulphur content in marine gas oil.

Military

Emission factors derived from the new road transport simulations have caused minor emission changes from 1985-2006. The emission differences are between -1 and 2 %, for all emission components other than the fuel related ones. For these latter components, the emissions remain the same.

Residential

No changes have been made.

Railways

No changes have been made.

Aviation

No changes have been made.

Industrial processes

No changes have been made.

Solvent

The main improvements in the 2009 submission include the following

- The following chemicals and groups have been removed, compared to the 2006 inventory, due to vapour pressures below 0.01kPa: aminooxygen groups, glycerol, toluendiisocyanate, dioctylphthalate, diethylenglycol.
- Emission factors (EFs) have been adjusted for all chemicals, with most predominant effect for the following chemicals: ethanol, formaldehyde, turpentine, xylene, toluene and ethylenglycol.
- A differentiation of EFs in four different categories has been implemented: 1) chemical industry (lowest EF), 2) other industry, 3) non-industrial activities, 4) domestic and other diffuse use (highest EF). In previous inventories there was only a differentiation in two categories.
- More detailed and reliable information on use amounts and emission factors has been obtained from importers and producers for the following chemicals: methanol, ethanol in windscreen washing agent, naphthalene, propane and butane.
- Acrylic acid has been included in the inventory.

Agriculture

Compared with the previous NH_3 and PM emissions inventory (submission 2007), some changes and updates have been made. These changes cause a decrease in the NH_3 emission (1985 – 2006) and an increase in the PM emission (2004 – 2006), please see chapter 6 on agriculture for more information.

There have been no changes in the methodology. Emission factors for synthetic fertilizers the have been changed to the values given by EMEP/EEA (2009) and recalculations is done for 1985-2006. This results in a decrease in the ammonia emission from synthetic fertilizers of 10-26 %.

The emission factors for crops are lowered from 5 to 2 % for crops and from 3 to 0.5 % for grass based on a literary survey. Recalculations have been done for the years 1985-2006. This results in a decrease in the ammonia emission from crops of 62-64 %.

Updated data from The Danish Environmental Protection Agency for the use of sewage sludge as fertilizers for the years 2004-2006 have been received and therefore recalculations. This results in an increase in the emission from sewage sludge used as fertilizer of 11 – 25 %.

Emission factors for fur farming have been raised from 25 to 36 % in agreement with DJF and recalculation is done for the years 1985-2006.

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

Calculations of nitrogen loss from livestock have partly been adjusted to TAN for the years 2003-2006. This together with the changes in time on pasture is the main cause to the additional decrease in the total NH_3 emission.

Sammenfatning

I Baggrund for emissionsopgørelser

Årlig rapport

Denne rapport er Danmarks årlige rapport om emissionsopgørelser sendt til UNECE-konventionen om langtransporteret grænseoverskridende luftforurening (LRTAP) i marts 2009. Rapporten indeholder oplysninger om Danmarks opgørelser for alle år fra basisårene for protokollerne til 2007.

Gasserne der rapporteres til LRTAP-konventionen er SO_2, NO_x, NMVOC, CO, NH_3, As, Cd, Cr, Cu, HG, Ni, Pb, Se, Zn, dioxiner/furaner, HCB, PAH, TSP, PM_{10} og $PM_{2,5}$.

Den årlige emissionsopgørelse for Danmark rapporteres i det format (NFR) som angivet i retningslinierne for rapportering.

Emnerne behandlet i rapporten er: Udvikling i emissioner, beskrivelse af hver NFR-kategori, usikkerheder, rekalkulationer, planlagte forbedringer og procedure for kvalitetssikring og -kontrol. Strukturen i rapporten er, så vidt muligt, den samme som den nationale emissionsopgørelsesrapport sendt til FN's konvention om klimaændringer (UNFCCC).

Denne rapport og NFR-tabellerne er tilgængelige for offentligheden på DMU's hjemmeside:

http://www.dmu.dk/Luft/Emissioner/Home+of+Inventory/

samt på Eionets hjemmeside:

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

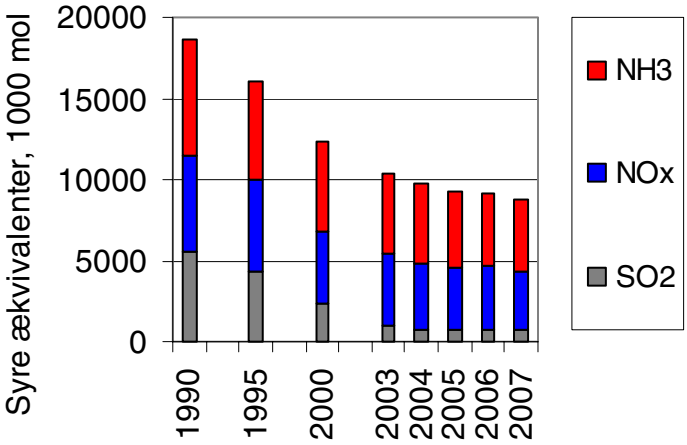
Ansvarlig institution

Danmarks Miljøundersøgelser (DMU), Aarhus Universitet er ansvarlig for udarbejdelse af den årlige danske emissionsrapport og opgørelserne i NFR-format i overensstemmelse med retningslinierne samt rapportering til UNECE-LRTAP-konventionen. DMU deltager i møder under UNECEs arbejdsgruppe for emissionsopgørelser og –fremskrivninger samt ekspertpaneler, hvor parter i konventionen udarbejder retningslinier og metoder for emissionsopgørelserne.

II Udviklingen i emissioner

Forsurende gasser

Figur S.1 viser emissionen af danske forsurende gasser opgjort i syreækvivalenter. I 1990 var det relative bidrag af syreækvivalenter næsten ens for de tre gasarter. I 2007 var ammoniak den vigtigste forsurende faktor i Danmark og de relative bidrag for SO_2, NO_X og NH_3 var på henholdsvis 8,3 %, 41,3 % og 50,4 %. Med hensyn til langtransporteret luftforurening er det dog stadig SO_2 og NO_X, der er de største kilder.



Figur S.1 Emissioner af NH_3, NO_X og SO_2 i syreækvivalenter.

SO_2

Hovedparten af SO_2 emissionerne stammer fra forbrænding af fossile brændsler, dvs. primært kul og olie, på kraftværker, kraftvarmeværker og fjernvarmeværker. Fra 1980 til 2007 er det totale udslip reduceret med 95 %. Den store reduktion er primært opnået gennem installation af afsvovlingsanlæg og brug af brændsler med lavt svovlindhold på kraftværker og fjernvarmeværker. Trods den store reduktion er disse værker kilde til 39 % af det samlede udslip. Også emissioner fra industrielle forbrændingsanlæg, ikke-industrielle forbrændingsanlæg og andre mobile kilder er væsentlige bidragsydere til emissionen. National søfart (sejlads og fiskeri) bidrager med omkring 6 % af den totale SO_2 emission. Dette skyldes brug af fuelolie med et højt svovlindhold.

NO_X

Den største kilder til emissioner af NO_X er transport sektoren efterfulgt af andre mobile kilder og forbrænding i energisektoren (hovedsageligt kraftværker og fjernvarmeværker). Transportsektoren er den sektor, der bidrager mest til udledningen af NO_X og i 2007 stammede 45 % af de danske NO_x emissioner fra vejtransport, national søfart, jernbaner og civil luftfart. Også emissioner fra nationalt fiskeri og off-road køretøjer (entreprenør-, landbrugsmaskiner, m.m.) bidrager betydeligt til NO_x emissionen. For ikke-industrielle forbrændingsanlæg er de primære kilder forbrænding af gasolie, naturgas og træ i husholdninger. Emissionerne fra kraftværker og fjernvarmeværker er faldet med 65 % fra 1985 til 2007. I samme periode er den totale emission faldet med 443 %. Reduktionen skyldes øget brug af katalysatorer i biler og installation af lav-NO_x -brændere og de-NO_x-anlæg på kraftværker og fjernvarmeværker.

NH_3

Stort set alle atmosfæriske emissioner af NH_3 stammer fra aktiviteter i landbruget. Kun en mindre del skyldes vejtransport. Denne del er dog stigende pga. den øgede brug af biler med katalysator. Hovedparten af emissionen fra landbruget stammer fra husdyrgødning (87 %) og de største tab af ammoniak optræder under håndtering af gødningen i stalden og under spredning på marken. Andre bidrag kommer fra afgrøder (7 %), brug af kunstgødning (6 %) og slam fra rensningsanlæg brugt som gødning (mindre end 1 %). Den totale ammoniakemission er faldet 41 % fra 1985-2007. Dette er et resultat af den nationale miljøpolitik, der er ført gennem de seneste 20 år.

Anden luftforurening

NMVOC

Emissionen af NMVOC stammer fra mange forskellige kilder og kan opdeles i to hovedgrupper: Ufuldstændig forbrænding og fordampning. Hovedkilderne til NMVOC emissioner fra ufuldstændig forbrændingsprocesser er vejtrafik og andre mobile kilder, som national sejlads og ikke vejgående maskiner. Køretøjer til vejtransport er fortsat den største bidragsyder, selvom emissionerne er faldet siden introduktionen af biler med katalysator i 1990. Emissionerne fra fordampning stammer hovedsageligt fra brugen af opløsningsmidler. Emissionerne fra energisektoren er steget igennem 90'erne pga. øget brug af stationære gasmotorer, som har meget højere emissioner af NMVOC end konventionelle kedler. De totale menneskeskabte emissioner er faldet med 48 % fra 1985 til 2007, primært som følge af øget brug af biler med katalysator og reducerede emissioner fra brug af opløsningsmidler.

CO

Selvom biler med katalysator blev introduceret i 1990, er vejtransport stadig årsag til den største del af den totale CO emission. Også andre mobile kilder og ikke-industrielle forbrændingsanlæg bidrager betydeligt til den totale emission af denne gas. Faldet i emissioner i 1990 var en konsekvens af loven, der forbyder markafbrænding af halm. Emissionen faldt med 38 % fra 1990 til 2007 hovedsageligt pga. faldende emissioner fra vejtransport.

PAH'er

Den nuværende emissionsopgørelse for PAH (polycycliske aromatiske hydrocarboner) inkluderer de fire PAH'er der rapporteres til LRTAP-konventionen: Benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene og indeno(1,2,3-cd)pyrene. De vigtigste kilder til emission af PAH er forbrænding af træ i husholdningerne samt vejtransport. De stigende emissioner skyldes øget forbrænding af træ i husholdningerne.

Partikler

Emissionsopgørelsen for partikler (Particulate Matter, forkortet PM) er blevet rapporteret for årene 2000-2007. Opgørelsen inkluderer den totale emission af partikler TSP (Total Suspended Particles), emissionen af partikler mindre end 10 µm (PM_{10}) og emissionen af partikler mindre end 2,5 µm ($PM_{2,5}$).

De største kilder til $PM_{2,5}$-emission er husholdninger (70 %), vejtrafik (16 %) og andre mobile kilder (6 %). For den sidstes vedkommende er off-

road køretøjer i industrien samt landbrugs- og skovbrugsmaskiner de vigtigste kilder (henholdsvis 39 og 37 %). I transportsektoren tegner udstødningsemissioner sig for størstedelen (75 %).

De største kilder til TSP-emission er landbrugssektoren og husholdningerne. TSP-emissionen fra transport er også vigtig og inkluderer både udstødningsemissioner og ikke-udstødningsrelaterede emissioner fra slid af bremser, dæk og vej. De ikke-udstødningsrelaterede emissioner udgør 49 % af TSP-emissionen fra transport.

Tungmetaller

Generelt er de vigtigste kilder til emissioner af tungmetaller forbrænding af fossile brændsler og affald. Emissionerne af tungmetaller er faldet betydeligt de seneste år. Reduktionerne spænder fra 2 % til 95 % for henholdsvis Cu og Pb. Årsagen til de reducerede emissioner er hovedsageligt den øgede brug af røggasrensning på kraftværker og fjernvarmeværker (inklusive affaldsforbrændingsanlæg). Den store reduktion i emissionen af Pb skyldes et løbende skift til fordel for blyfri benzin, som er nødvendigt for biler med katalysator.

III Rekalkulationer og forbedringer

Generelt pågår der et betydeligt arbejde med at forbedre emissionsopgørelserne. Nye undersøgelser og forskning fra Danmark og udlandet inkluderes så vidt muligt som basis for emissionsestimaterne. Desuden følges arbejdet med opdateringer af EMEP/CORINAIR-retningslinjerne for emissionsopgørelser nøje med henblik på at indarbejde de bedste videnskabelige informationer som basis for opgørelserne. Andre vigtige kilder er IPCCs retningslinier (IPCC Guidelines og IPCC Good Practice Guidance).

Opgørelserne opdateres løbende med ny viden, således opgørelserne bedst mulig afspejler danske forhold. Ved forbedringer lægges vægt på, at opdateringer omfatter hele tidsserier for at sikre konsistente data. Disse tiltag medfører rekalkulation af tidligere indberettede opgørelser. De vigtigste rekalkulationer for de forskellige sektorer er nævnt i nedenstående.

Stationære forbrændingsanlæg

Den seneste officielle energistatistik er implementeret i opgørelsen. Der er for det meste tale om mindre ændringer. For 2006 er træforbruget i husholdninger dog justeret væsentligt i opadgående retning, hvilket har medført stigende emissioner.

NMVOC emissionsfaktoren for halmfyr i husholdninger blev opdateret i henhold til EMEP/Corinair Guidebook. Emissionsfaktoren blev ændret fra 600 g pr. GJ til 400 g pr. GJ. Ændringen blev foretaget for hele tidsserien.

CO emissionsfaktoren for træfyring i husholdninger blev opdateret på baggrund af teknologifordelingen mellem ovne og kedler sammenholdt med standard emissionsfaktorer fra EMEP/Corinair Guidebook. Emissi-

onsfaktoren blev reduceret fra 6000 g pr. GJ til 3441 g pr. GJ i 2007. En tidsserie kan ses i annex 2A.

For første gang er HCB inkluderet. Beregningen af HCB emissionen benytter standard emissionsfaktorer fra EMEP/Corinair Guidebook.

Transport

Vejtransport

For tunge køretøjer har nye oplysninger fra danske bilimportørers forening muliggjort en mere præcis fordeling af tunge køretøjer på EURO standarder. En mere realistisk udvikling i antallet af kørte kilometre for personbiler fra 2005 til 2006 er blevet implementeret i beregningerne. For 2005 og 2006 har Energistyrelsen ændret den samlede dieselmængde en smule i nedadgående retning.

Rekalkulationerne udført for 1985-2006 har kun medført små ændringer i de samlede emissioner fra sektoren. For alle år er der tale om forskelle på mellem 0 og -1 %.

National søfart

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

Disse ændringer har medført, at brændselsforbrug og emissioner er ændret fra 1996 og fremefter. Mest betydende er ændringen for NO_x, som ligger mellem 3 og -20 %. For andre forureningskomponenter er ændringen mellem -3 og 3 %. Brændselsforbruget stiger mellem 0 og 2 % i perioden.

Fiskeri

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

Fiskeri er en del af NFR sektor 1A4c, som omfatter både landbrug, skovbrug og fiskeri, derfor er indvirkningen mindre på den samlede sektor.

Fra 1996 til 2005 er brændselsforbruget og emissionerne ændret mellem 0 og -2 %. For 2006 er ændringerne i emissionerne mellem -3 og -1 %. For SO_2 er ændringen dog -7 % på grund af det høje svovlindhold i marin diesel.

Militær

Emissionsfaktorer afledt af de nye simulationer for vejtransport har medført mindre ændringer i emissionen fra 1985 til 2006. Ændringerne er på mellem -1 og 2 % for alle forureningskomponenter på nær de rent brændselsrelaterede. For disse komponenter er emissionen uændret.

Husholdninger

Der er ikke foretaget genberegninger i denne sektor.

Landbrugsmaskiner

Der er ikke foretaget genberegninger i denne sektor.

Jernbane

Der er ikke foretaget genberegninger i denne sektor.

Luftfart

Der er ikke foretaget genberegninger i denne sektor.

Industri

Der er ikke foretaget genberegninger i denne sektor.

Opløsningsmidler

De væsentligste forbedringer i 2009 afleveringen omfatter:

- Aminooxygen grupper, glycerol, toluendiisocyanat, dioctylphtalat og diethylenglycol er fjernet fra opgørelsen, da nærmere undersøgelser har vist at damptrykket af disse stoffer er under 0,01 kPa, hvilket gør, at de ikke er omfattet af NMVOC definitionen.
- Emissionsfaktorer er blevet justeret for alle kemikalier baseret på erfaringer fra såvel et nordisk projekt, som et MST projekt, dette har haft størst effekt på emissionerne fra stofferne: ethanol, formaldehyd, terpentin, xylen, toluen og ethylenglycol.
- Der er indført en differentiering af emissionsfaktorerne mellem fire forskellige anvendelsesområder: 1) kemisk industri (lavest emissionsfaktor), 2) anden industri, 3) ikke-industriel anvendelse, 4) anvendelse i husholdninger (højeste emissionsfaktor). I de tidligere opgørelser blev der kun skelnet mellem to områder.
- Mere detaljerede og pålidelige oplysninger om benyttede mængder og emissionsfaktorer er tilvejebragt gennem importører og producenter for følgende kemikalier: methanol, ethanol i sprinklervæske, naphtalen, propan og butan.
- Acrylsyre er blevet inkluderet i opgørelserne.

Landbrug

Sammenlignet med sidste års aflevering er der nogle opdateringer og ændringer. Disse ændringer medfører et fald i NH_3 emissionen (1985-2006) og en stigning i PM emissionen (2004-2006), for mere detaljerede oplysninger se kapitel 6.

Der har ikke været ændringer i metodikken.

Emissionsfaktorer for handelsgødning er blevet opdateret baseret på ny viden fra draft udgaven af den nye EMEP/EEA Guidebook. Genberegninger er foretaget for 1985-2006. Dette har medført en reduktion i NH_3 emissionen fra handelsgødning på mellem 10 og 26 %.

NH_3 emissionsfaktorerne for afgrøder er nedjusteret fra 5 til 2 % og fra 3 til 0,5 % for græsmarker, baseret på et litteraturstudie. Genberegninger er foretaget for 1985-2006. Dette har medført en reduktion i NH_3 emissionen fra afgrøder på mellem 62 og 64 %.

Opdaterede data fra Miljøstyrelsen omkring anvendelsen af spildevandsslam som gødning for årene 2004 til 2006 er blevet tilgængelige. Genberegninger er foretaget for 2004-2006. Dette har medført en stigning i NH_3 emissionen fra anvendelse af spildevandsslam på mellem 11 og 25 %.

NH_3 emissionsfaktorer for pelsdyr er blevet ændret fra 25 % til 36 % på baggrund af dialog med DJF. Genberegninger er foretaget for 1985-2006.

Antallet af græsningsdage for malkekvæg og kvier er blevet nedjusteret med 10 % i 2007. For at forhindre inkonsistens i tidsserien er data interpoleret for årene 2003-2006. Dette er hovedårsagen til ændringen i PM emissioner.

Beregninger af kvælstoftabet fra husdyr er blevet delvist omlagt til TAN for årende 2003-2006. Dette har medført et fald i NH_3 emissionen.

1 Introduction

1.1 Background information on emission inventories

1.1.1 Annual report

According to the Guidelines for Estimating and Reporting Emission Data/2002/7 prepared by the Task Force on Emission Inventories and Projections, countries party to the UNECE-Convention on Long-Range Transboundary Air Pollution are required annually to submit an informative report to the Secretariat. The new reporting Guidelines were accepted at the meeting of the Executive Body in December 2009. Due to the late date, it has not been possible to incorporate all new elements of the new reporting Guidelines in this submission.

This report is Denmark's Annual Informative Inventory Report due March 2009. The report contains information on Denmark's inventories for all years from the base years of the protocols to 2007.

The annual emission inventory for Denmark is reported in the Nomenclature for Reporting (NFR) format as requested in the reporting guidelines. Due to the tight time schedule it has not been possible within the deadline to use the new reporting template as laid out in the new reporting Guidelines.

The issues addressed in this report are: trends in emissions, description of each NFR category, uncertainty estimates, recalculations, planned improvements and procedures for quality assurance and control. The structure of the report is, as far as possible, the same as the National Inventory Report to UNFCCC.

This report and NFR tables are available to the public on NERI's homepage:

http://www.dmu.dk/Luft/Emissioner/Home+of+Inventory/

and on the Eionet central data repository:

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

1.2 A description of the institutional arrangement for inventory preparation

The National Environmental Research Institute (NERI), Aarhus University, is responsible for the annual preparation and submission to the UNECE-LRTAP Convention of the Annual Danish Emissions Report, and the inventories in the NFR Format in accordance with the guidelines. NERI participates in meetings under the UNECE Task Force on Emission Inventories and Projections and the related expert panels

where parties to the convention prepare the guidelines and methodologies on inventories. NERI is also responsible for estimating emissions for reporting to the NEC Directive, but the Danish EPA is responsible for the reporting.

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

Danish Energy Authority, The Ministry 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, agricultural statistics and import/export/production figures for solvents.

The 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. Number of vehicles grouped in categories corresponding to the EU classification, mileage (urban, rural, highway), trip speed (urban, rural, highway).

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

Danish Railways, The Ministry of Transport. 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 7. As part of the QA/QC plan (Chapter 1.5), 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 NFR-reporting format. This material is placed on central institutional servers, which are subject to routine back-up services. Material which has been backed up is archived safely. A further documentation and archiving system is the official journal for NERI, for which obligations apply to NERI, as a governmental institute. 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 UNECE-LRTAP 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 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_AllSectors\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_AllSectors\Level_3b_Processes	(exe + mdb)	manual input and Importer2CRF
3 process	Importer2CRF	Help tool	I:\ROSPROJ\LUFT_EMI\Inventory\AllYears\8_AllSectors\Level_3b_Processes	MS Access	CRF Reporter, CollectEr2CRFand excel files
3 process	CollectER2CRF	Help tool	I:\ROSPROJ\LUFT_EMI\Inventory\AllYears\8_AllSectors\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_AllSectors\Level_2b_Processes	(exe +mdb)	manual input
2 store	dk1972.mdb.dkxxxx.mdb	Datastore	I:\ROSPROJ\LUFT_EMI\Inventory\AllYears\8_AllSectors\Level_2a_Storage	MS Access	CollectER

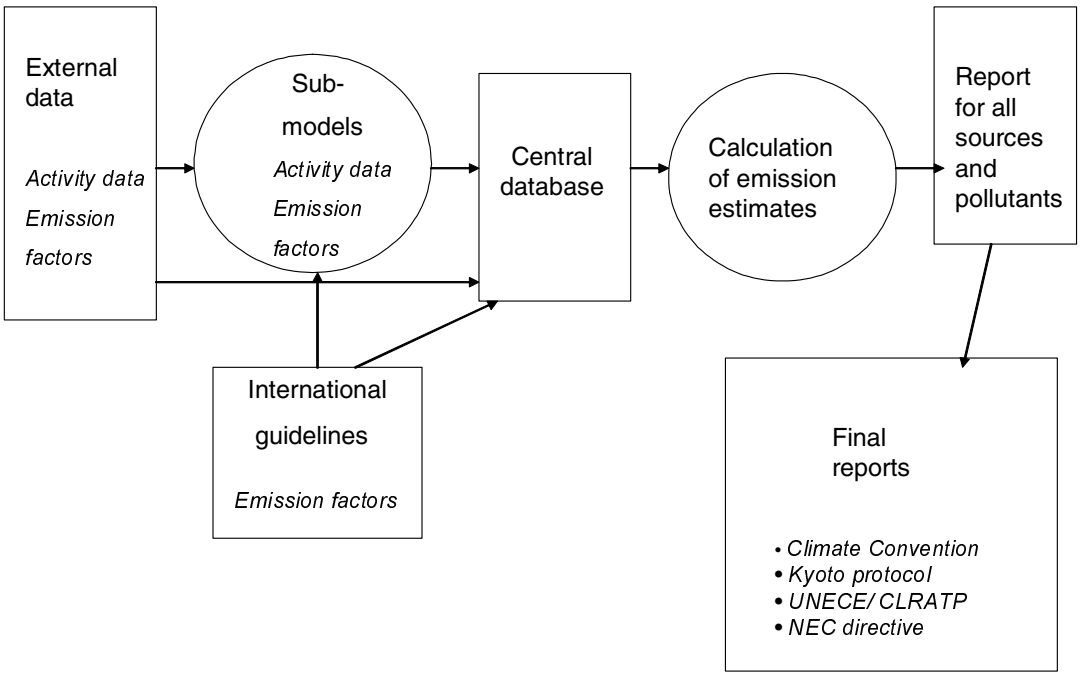


Figure 1.1 Schematic diagram of the process of inventory preparation.

1.4 Brief 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, 2007).

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

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

1.4.1 The specific methodologies regarding 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, 2007). 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.

A number of large plants, 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. Emission factors of SO_2, NO_X, HM and PM are often plant specific.

Please refer to Chapter 3 and Annex 2A for further information on emission inventories for stationary combustion plants.

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

Offshore activities

Emissions from offshore activities are estimated according to the methodology described in the Emission Inventory Guidebook (EMEP/CORINAIR, 2007). The sources include extraction of oil and gas, onshore oil tanks, and onshore and offshore loading of ships. The emission factors are based on the figures given in the guidebook except for in the case of 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 feed stock handling/storage, petroleum products processing, product storage/handling and flaring. SO_2 is also emitted from non-combustion processes and includes emissions from product processing and sulphur-recovery plants. The emission calculations are based on information from the Danish refineries and the energy statistics.

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

Natural gas transmission and distribution

Inventories of NMVOC emission from gas transmission and distribution are based on annual environmental reports from the Danish gas transmission company, DONG, and on a Danish inventory for the years

1999-2007 reported by the Danish gas sector (transmission and distribution companies).

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

1.4.4 Specific methodologies regarding 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. The new emission factors from COPERT IV have been implemented in the Danish 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 type and annual mileage figures with hot emission factors, cold:hot ratios and evaporation factors (Tier 2 approach).

For air traffic, from 2001 onwards 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 and 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).

Please refer to Chapter 3 and Annex 2B for further information on emissions from transport.

1.4.5 Specific methodologies regarding industrial processes

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

Mineral products

The sub-sector includes production of cement, lime, container glass/glass wool, mineral wool, other production (consumption of lime), and roofing and road paving with asphalt. The activity data as well as emission data are primarily based on information from environmental statements termed "Green National Accounts" (In Danish: "Grønne regnskaber") prepared by companies according to obligations under Danish law. The published information is supplemented with information obtained directly from companies or by use of standard emission factors. The distribution of TSP between PM_{10} and $PM_{2.5}$ is based on European average data.

Chemical industry

The sub-sector includes production of nitric acid, catalysts, fertilisers and pesticides. The activity data as well as emission data are based on information from the companies as accounted for and published in the "Green National Accounts" combined with information obtained by contact to the companies. The distribution of TSP between PM_{10} and $PM_{2.5}$ is based on European average data. Production of nitric acid ceased in the middle of 2004.

Metal production

The sub-sector includes production of steel sheets and bars, cast iron, aluminium, lead and lead products and various other metal products. The activity data as well as emission data for the steelworks are based on information from the companies as accounted for and published in the "Green National Accounts", combined with information obtained by contact with the companies. The activity data or the other processes are based on information from Statistics Denmark combined with Danish average emission factors and standard emission factors. The distribution of TSP between PM_{10} and $PM_{2.5}$ is based on European average data.

Other production

The sub-sector includes breweries. The activity data is obtained from Statistics Denmark and the emission factors are obtained from the IPCC guidelines.

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

1.4.6 Specific methodologies regarding solvents

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

The detailed approach in EMEP/CORINAIR (2004) is used. Here all relevant consumption data on all relevant solvents must be inventoried or at least those together representing more than 90 % of the total

NMVOC emission. Simple mass balances for calculating the use and emissions of chemicals are set up 1) use = production + import – export, 2) emission = use · emission factor. Production, import and export figures are extracted from Statistics Denmark, from which a list of 427 single chemicals, a few groups and products is generated. For each of these, a "use" amount in tonnes pr year (from 1995 to 2007) is calculated. For some chemicals and/or products, e.g. propellants used in aerosol cans, use amounts are obtained from the industry as the information from Statistics Denmark does not comply with required specificity. 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 is available in a NACE coding system. The chemicals are also related to specific products according to the Use Category (UCN) system. Emission factors are obtained from regulators, literature 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. Furthermore tidal (annual) trend in NMVOC emissions, expressed as total NMVOC and single chemical, and specified in industrial sectors and households are shown.

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

1.4.7 Specific methodologies regarding agriculture

The emissions from the agricultural sector include emissions of ammonia and particulate matter. The emissions are registered in NFR tables under 4B Manure Management and 4D Agricultural Soils. Table 4F Field Burning of Agricultural Wastes has only been completed until 1989, because burning of plant residue has been prohibited since 1990.

The calculations of the ammonia and PM emissions are based on the Emission Inventory Guidebook (EMEP/CORINAIR, 2007). In Denmark, a model-based system is applied for calculation of ammonia emissions, particulate matter and greenhouse gases. This model is called IAD (Inventory Agriculture Data), and data on activity and emissions are collected, evaluated and discussed in close corporation with the Faculty of Agricultural Sciences, Aarhus University and the Danish Agricultural Advisory Centre.

Livestock numbers and data concerning the land use and crop yield are based on the Agricultural Statistics published by Statistics Denmark. The emission factors used to calculate the emissions are primarily based on information from the Faculty of Agricultural Sciences, Aarhus University and the Danish Agricultural Advisory Centre. Furthermore, activity data from the Danish Environmental Protection Agency and the Danish Plant Directorate are used.

Uncertainties for ammonia emissions from manure management and agricultural soils have been estimated. The estimated emissions for particulate matter are associated with very high uncertainties, which are estimated to be of several hundred percent. To ensure data quality, activity data and data for estimation of emission factors are collected and discussed in corporation with specialists and researchers at different institutes and research departments. This means that the emission inventories are continuously evaluated according to the latest knowledge and information. Furthermore, time-series of both emission factors and activity data are prepared, and considerable variations are checked and revised.

Please refer to Chapter 6 and Appendix 2C for further information on emission inventories for agriculture.

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

In the Danish National Inventory Report to UNFCCC (Nielsen et al., 2008), the plan for Quality Control (QC) and Quality Assurance (QA) for greenhouse gas emission inventories prepared by the Danish National Environmental Research Institute is outlined. 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. The plan also, to some extent, includes the gases reported to the UNECE-LRTAP Convention.

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

The uncertainty estimates are based on the simple Tier 1 approach in the EMEP/CorinAir *Good Practice Guidance for LRTAP Emission Inventories* (Pulles & Aardenne, 2001).

The uncertainty estimates are based on emission data for the base year and year 2007, and on uncertainties for activity rates and emission factors for each of the main SNAP sectors. For particulate matter, the year 2000 is considered as the base year, but for all other pollutants the base year is 1990.

Uncertainty estimates include uncertainty of the total emission as well as uncertainty of the trend. The estimated uncertainties are shown in Table 1.2. The uncertainty estimates include the sectors: stationary combustion, transport, industry and agriculture.

Table 1.2 Danish uncertainty estimates, 2007.

Pollutant	Uncertainty Total emission [%]	Trend[1)] 1990[2)]-2007 [%]	Uncertainty Trend [%-age points]
SO_2	7	-87	±0.7
NO_x	31	-39	±4
NMVOC	22	-46	±9
CO	36	-38	±13
NH_3	27	-41	±14
TSP [1)]	294	+12	±107
As	105	-58	±8
Cd	373	-34	±160
Cr	175	-79	±29
Cu	728	-2	±218
Hg	294	-67	±69
Ni	118	-65	±24
Pb	244	-95	±41
Se	103	-57	±9
Zn	252	-21	±272
Benzo(b)fluoranthene	958	+159	±113
Benzo(k)fluoranthene	956	+174	±200
Benzo(a)pyrene	979	+171	±63
Indeno(1,2,3-c,d)	973	+133	±75

1. Only including the emission sources for which uncertainty estimates have been estimated

2. The base year for PM is 2000

1.7 General assessment of the completeness

The Danish emissions inventory due 15 February 2009 includes all sources identified by the EMEP/CORINAIR guidebook except the following:

1.7.1 Industrial processes

- Mineral products (NFR 2A): The inventory will be improved regarding completion of pollutants included. The methodology used for some of the pollutants from glass production is inconsistent and will be improved.
- Metal production (NFR 2C): For secondary aluminium and zinc production, potential emissions of heavy metals will be investigated.
- Other production (NFR 2D): Production of bread and other food products are planned to be included.

1.7.2 Agriculture

It is planned to include the PM emission from stables for the years 1985 to 1999.

1.7.3 General comment

For the 2009 submission Denmark did not use the new reporting template. The new template and Guidebook contains several new subsec-

tors that will have to be estimated. This process will be described in the 2010 IIR.

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2 Trends in Emissions

2.1 Acidifying gases

Acid deposition of sulphur and nitrogen compounds mainly derives from emissions of SO_2, NO_X and NH_3. The effects of acidification may appear in a number of ways, including defoliation and reduced vitality of trees, and declining fish stocks in acid-sensitive lakes and rivers.

SO_2 and NO_X can be oxidised into sulphate (SO_4^{--}) and nitrate (NO_3^-) - either in the atmosphere or after deposition - resulting in the formation of two and one H^+, respectively. NH_3 may react with H^+ to form ammonium (NH_4^+) and, by nitrification in soil, NH_4^+ is oxidised to NO_3^- and H^+ ions are formed.

Weighting the individual substances according to their acidification effect, total emissions in terms of acid equivalents can be calculated as:

$$Acidification\,index = \frac{m_{SO_2}}{M_{SO_2}} \cdot 2 + \frac{m_{NO_x}}{M_{NO_x}} + \frac{m_{NH_3}}{M_{NH_3}} = \frac{m_{SO_2}}{64} \cdot 2 + \frac{m_{NO_x}}{46} + \frac{m_{NH_3}}{17}$$

where m_i is the emission of pollutant *i* in tonnes

M_i is the mole weight [tonne/Mmole] of pollutant *i*

The actual effect of the acidifying substances depends on a combination of two factors: the amount of acid deposition and the natural capacity of the terrestrial or aquatic ecosystem to counteract the acidification. In areas where the soil minerals easily weather or have a high chalk content, acid deposition will be relatively easily neutralised.

Figure 2.1 shows the emission of Danish acidifying gases in terms of acid equivalents. In 1990, the relative contribution in acid equivalents was almost equal for the three gases. In 2007, the most important acidification factor in Denmark was ammonia nitrogen and the relative contributions for SO_2, NO_X and NH_3 were 8.3 %, 41.3 % and 50.4 %, respectively. However, with regard to long-range transport of air pollution, SO_2 and NO_X are still the most important pollutants.

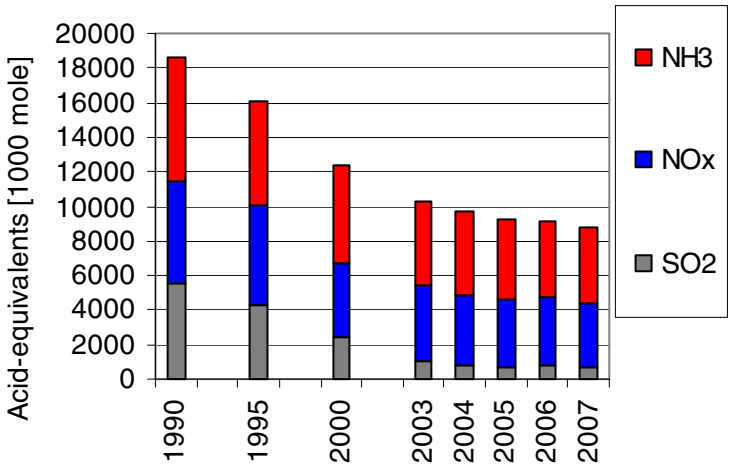


Figure 2.1 Emissions of NH_3, NO_X and SO_2 over time in acid equivalents.

2.2 Description and interpretation of emission trends by gas

2.2.1 SO_2

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

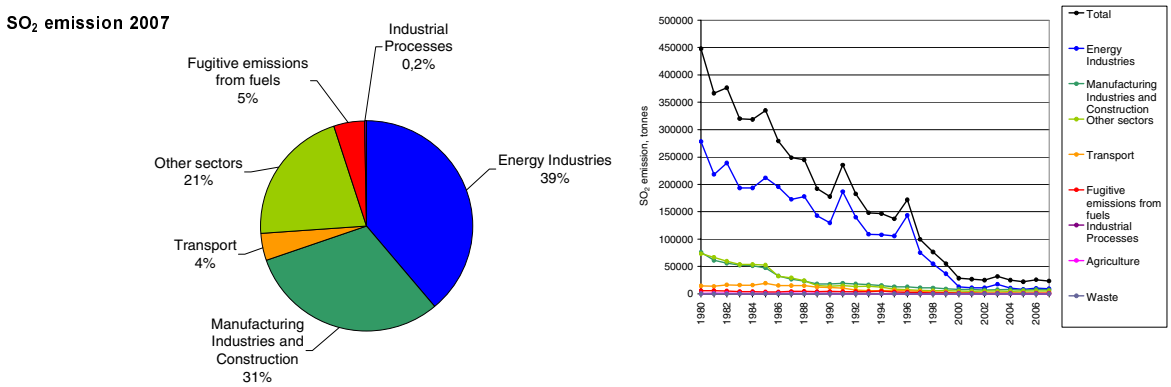


Figure 2.9 SO_2 emissions. Distribution according to the main sectors (2007) and time-series for 1990 to 2007.

2.2.2 NO_X

The largest sources of emissions of NO_X are other mobile sources followed by road transport and combustion in energy industries (mainly public power and district heating plants). The transport sector is the sector contributing the most to the emission of NO_X and, in 2007, 45 % of the Danish emissions of NO_X stems from road transport, national navigation, railways and civil aviation. Also emissions from national

fishing and off-road vehicles contribute significantly to the NO_X emission. For non-industrial combustion plants, the main sources are combustion of gas oil, natural gas and wood in residential plants. The emissions from energy industries have decreased by 65 % from 1985 to 2007. In the same period, the total emission decreased by 43 %. The reduction is due to the increasing use of catalyst cars and installation of low-NO_X burners and denitrifying units in power and district heating plants.

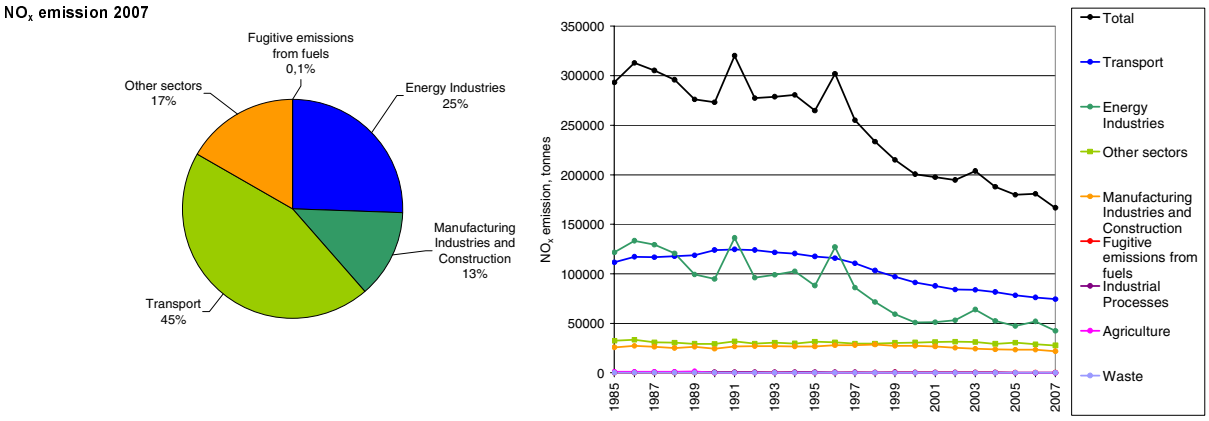


Figure 2.6 NO_X emissions. Distribution according to the main sectors (2007) and time-series for 1990 to 2007.

2.2.3 NH_3

Almost all atmospheric emissions of NH_3 result from agricultural activities. Only a minor fraction originates from road transport. This fraction is, however, increasing due to increasing use of catalyst cars. The major part of the emission from agriculture stems from livestock manure (87 %) and the largest losses of ammonia occur during the handling of the manure in stables and in field application. Other contributions come from crops (7 %), use of mineral fertilisers (6 %), sewage sludge used as fertiliser and ammonia used for straw treatment (less than 1 %). The total ammonia emission decreased by 41 % from 1985 to 2006. This is due to the active national environmental policy efforts over the past twenty years. Due to the action plans for the aquatic environment and the Ammonia Action Plan, a series of measures to prevent loss of nitrogen in agricultural production has been initiated. The measures have included demands for improved utilisation of nitrogen in livestock manure, a ban against application of livestock manure in winter, prohibition of broadspreading of manure is prohibited, requirements for establishment of catch crops, regulation of the number of livestock pr hectare and a ceiling for the supply of nitrogen to crops. As a result, despite an increase in the production of pigs and poultry, the ammonia emission has been reduced considerably. The time-series graph is excluding field burning of agricultural crop residues from 1985 to 1989.

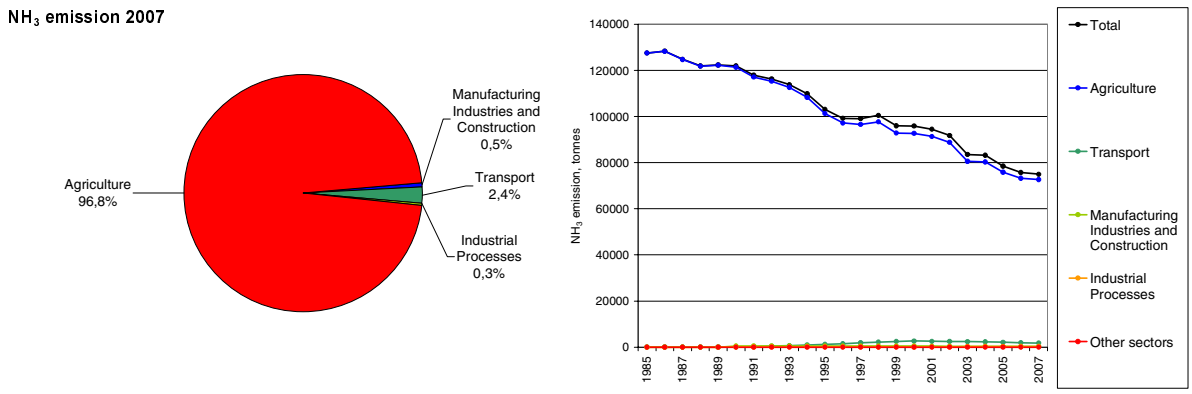


Figure 2.4 NH_3 emissions. Distribution on the main sectors (2007) and time-series for 1985 to 2007.

2.3 Other air pollutants

2.3.1 NMVOC

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

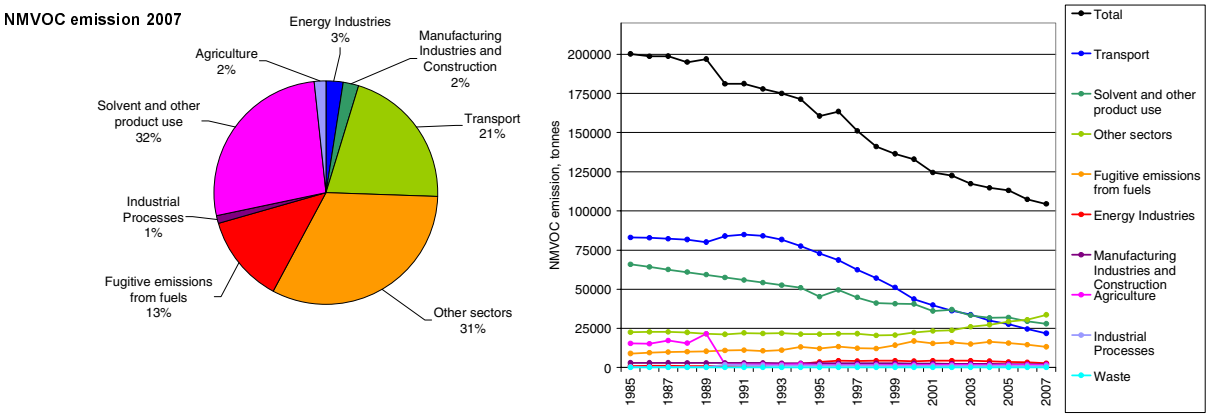


Figure 2.8 NMVOC emissions. Distribution according to the main sectors (2007) and time-series for 1985 to 2007.

2.3.2 CO

Other mobile sources and non-industrial combustion plants contribute significantly to the total emission of this pollutant. Transport is the second largest contributor to the total CO emission. In 1990 a law forbid-

ding the burning of agricultural crop residues on fields was implemented this caused significant reduction in CO emission. The emission decreased further by 38 % from 1990 to 2007, largely because of decreasing emissions from road transportation.

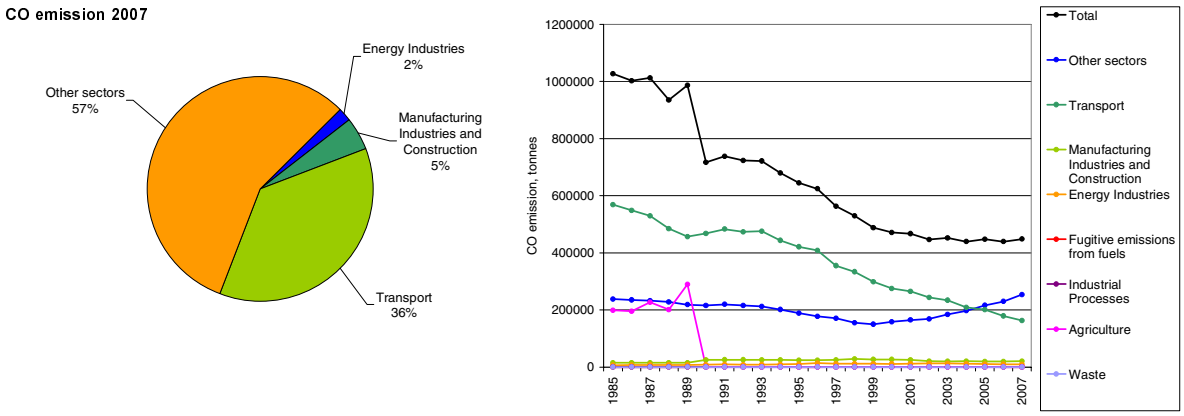


Figure 2.7 CO emissions. Distribution according to the main sectors (2007) and time-series for 1985 to 2007.

2.3.3 PAHs

The present emission inventory for PAH (polyaromatic hydrocarbons) includes the four PAHs reported to UNECE: benzo(a)pyrene, benzo(b)-fluoranthene, benzo(k)fluoranthene and indeno(1,2,3-cd) pyrene. The most important sources of PAH emissions are combustion of wood in the residential sector and road transportation. The increasing emission trend is due to increasing combustion of wood in the residential sector.

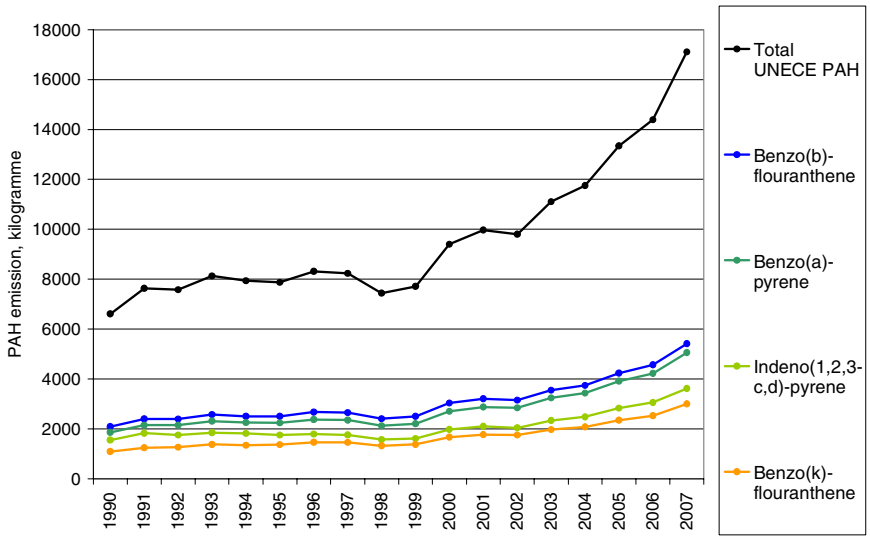


Figure 2.7 PAH emissions. Time-series for 1990 to 2007.

2.3.4 Particulate Matter

The particulate matter (PM) emission inventory has been reported for the years 2000-2007. The inventory includes the total emission of particles TSP (Total Suspended Particles), emission of particles smaller than 10 µm (PM_{10}) and emission of particles smaller than 2.5 µm ($PM_{2.5}$).

The largest $PM_{2.5}$ emission sources are the residential sector (70 %), road traffic (16 %) and other mobile sources (6 %). For the latter, the most important sources are off-road vehicles and machinery in the in-

dustrial sector and in the agricultural/forestry sector (39 and 37 % respectively). For the road transport sector, exhaust emissions account for the major part (75 %) of the emissions.

The largest TSP emission sources are the residential sector and the agricultural sector. The TSP emissions from transport are also important and include both exhaust emissions and the non-exhaust emissions from brake and tyre wear and road abrasion. The non-exhaust emissions account for 49 % of the TSP emission from road transport.

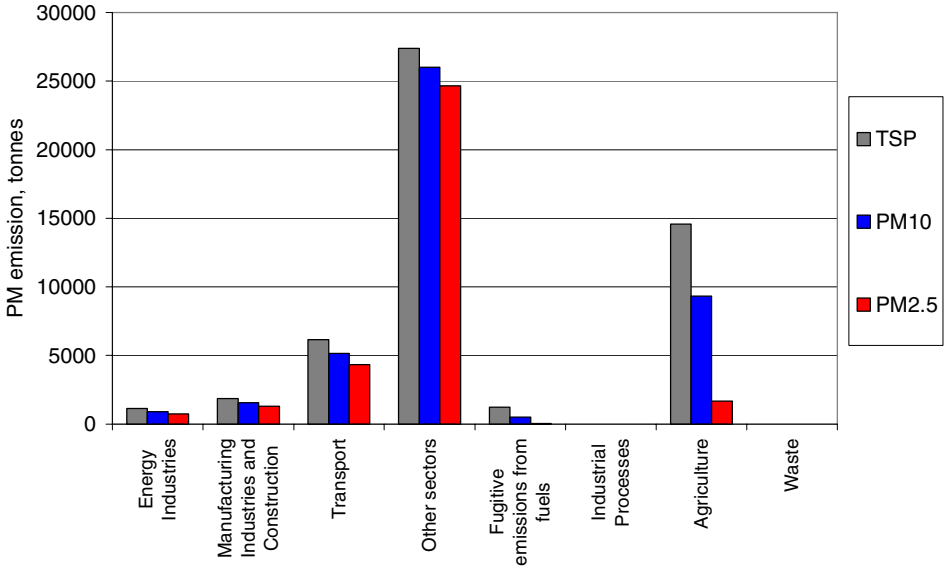


Figure 2.8 PM emissions pr sector for 2007.

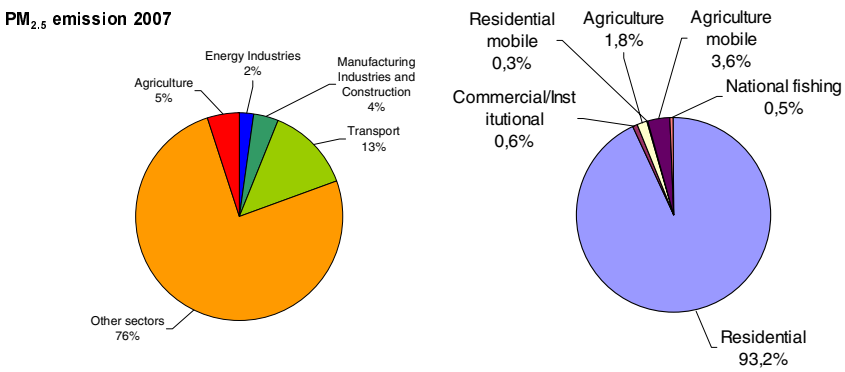


Figure 2.9 $PM_{2.5}$ emissions. Distribution by main sector and on sub-sectors for other fuels combustion for 2007.

Heavy metals

In general, the most important sources of heavy metal emissions are combustion of fossil fuels and waste. The heavy metal emissions have decreased substantially in recent years. The reductions span from 2 % to 95 % for Cu and Pb, respectively. The reason for the reduced emissions is mainly increased use of gas cleaning devices at power and district heating plants (including waste incineration plants). The large reduction in the Pb emission is due to a gradual shift towards unleaded gasoline, the latter being essential for catalyst cars.

Table 2.1 Emissions of heavy metals.

(Kg)	As	Cd	Cr	Cu	Hg	Ni	Pb	Se	Zn
1990	1.504	1.138	6.333	10.243	3.275	24.758	119.780	4.471	29.309
2007	629	747	1.360	9.994	1.119	8.723	6.166	1.990	28.183
Reduction in %	58	34	79	2	66	65	95	55	4

According to the UNECE Heavy Metal Protocol, the priority metals are Pb, Cd and Hg and the objective is to reduce emissions of these heavy metals.

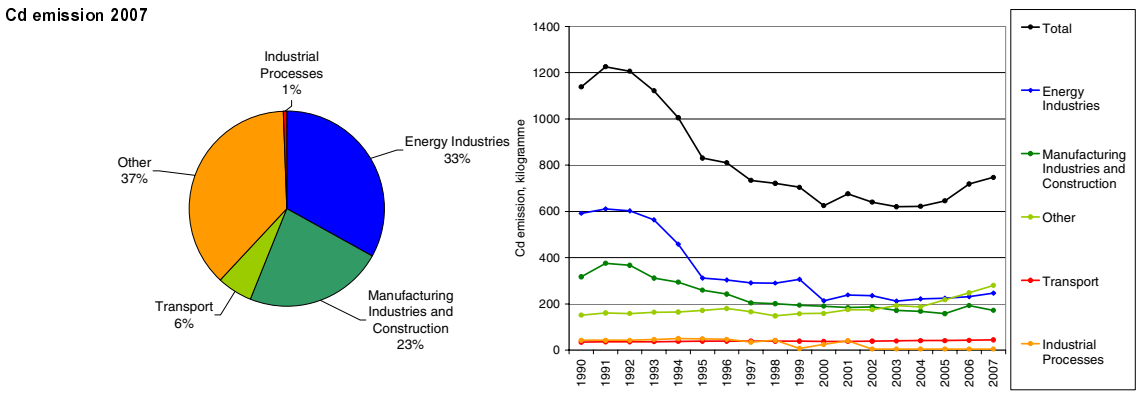


Figure 2.10 Cd emissions. Time-series for 1990 to 2007 and distribution by main sector for 2007.

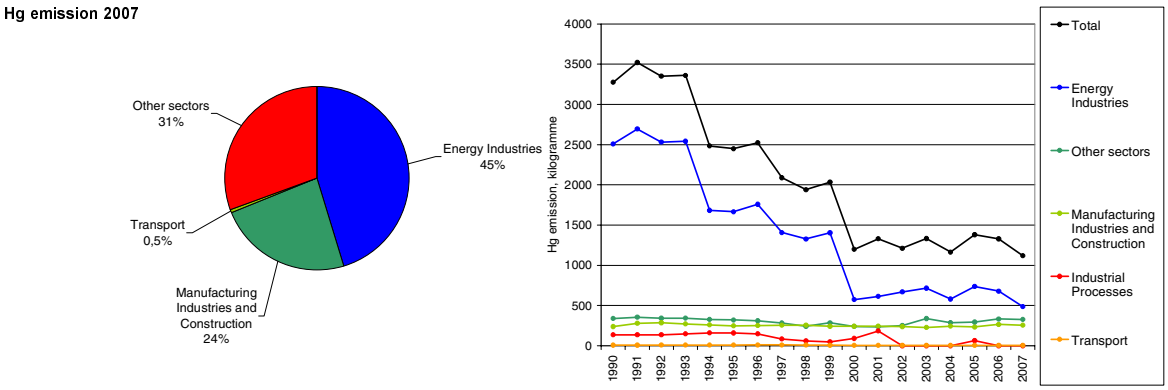


Figure 2.11 Hg emissions. Time-series for 1990 to 2007 and distribution by main sector for 2007.

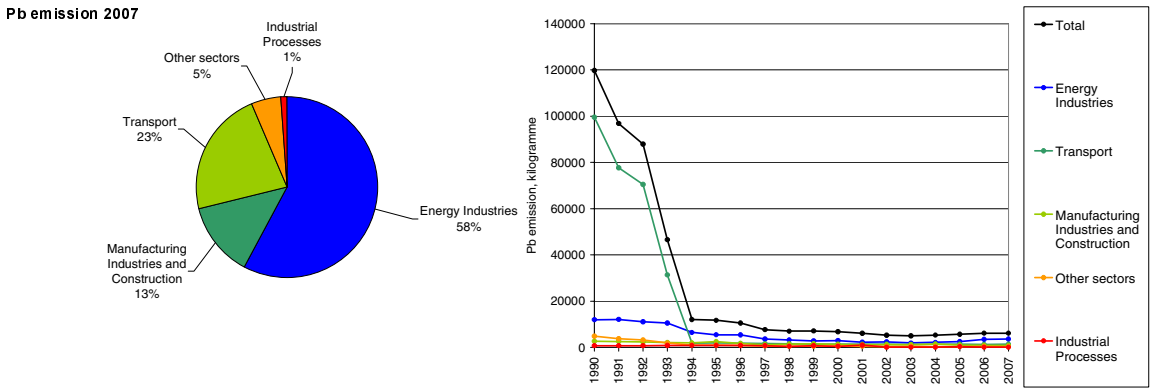


Figure 2.12 Pb emissions. Time-series for 1990 to 2007 and distribution by main sector for 2007.

3 Energy (NFR sector 1)

3.1 Overview of the sector

The energy sector is reported in three main chapters:

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

3.3 Transport (NFR sector 1A2, 1A3, 1A4 and 1A5)

3.4 Fugitive emissions (NFR sector 1B)

Although industrial combustion forms part of stationary combustion, detailed documentation for some of the specific industries is discussed in the industry chapters. The emissions are reported in NFR sector 1A2. Emissions from full fuel consumption in the industrial sector are included in the data presented in Chapter *3.2 Stationary Combustion*.

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 NFR source categories for the energy sector.

NFR id	NFR 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 emissions from the energy sector are shown below.

Table 3.2 SO_2, NO_x, NMVOC, CO and PM emission from the energy sector, 2007.

	NO_x	CO	NMVOC	SO_x	TSP	PM_{10}	$PM_{2.5}$
	Gg NO_2	Gg	Gg	Gg SO_2	Mg	Mg	Mg
1A1 Energy Industries	42.5	9.3	2.7	9.1	1,124	894	742
1A2 Manufacturing industries and Construction	21.8	20.8	2.0	7.2	1,843	1,555	1,289
1A3 Transport	74.5	163.2	21.8	1.0	6,142	5,153	4,322
1A4 Other Sectors	26.9	253.7	33.6	4.9	27,372	25,980	24,637
1A5 Other	0.8	0.5	0.1	0.0	20	20	20
1B1 Fugitive Emissions from fuels, Solid Fuels	NA	NA	NA	NA	1,218	487	49
1B2 Fugitive Emissions from fuels, Oil and Natural gas	0.2	0.2	13.3	1.1	2	2	2
Energy, Total	166.7	447.6	73.5	23.3	37,723	34,091	31,062

Table 3.3 HM emissions from the energy sector, 2007.

	Pb	Cd	Hg	As	Cr	Cu	Ni	Se	Zn
	Mg	Mg	Mg	Mg	Mg	Mg	Mg	Mg	Mg
1A1 Energy Industries	3.57	0.25	0.49	0.36	0.66	0.73	2.33	1.24	15.55
1A2 Manufacturing industries and Construction	0.81	0.17	0.25	0.20	0.39	0.72	4.98	0.54	1.67
1A3 Transport	1.39	0.04	0.01	0.01	0.22	7.32	0.76	0.07	4.36
1A4 Other Sectors	0.25	0.28	0.33	0.05	0.09	1.07	0.66	0.14	5.90
1A5 Other	0.08	0.00	0.00	0.00	0.00	0.09	0.00	0.00	0.06
1B1 Fugitive Emissions from fuels, Solid Fuels	NA	NA	NA	NA	NA	NA	NA	NA	NA
1B2 Fugitive Emissions from fuels, Oil and Natural gas	NA	NA	NA	NA	NA	NA	NA	NA	NA
Energy, Total	6.10	0.74	1.07	0.63	1.36	9.94	8.73	1.99	27.54

Table 3.4 PAH emission from the energy sector, 2007.

	benzo(a)-pyrene	benzo(b)-fluoranthene	benzo(k)-fluoranthene	Indeno-(1,2,3-c,d)-pyrene
	Mg	Mg	Mg	Mg
1A1 Energy Industries	0.007	0.029	0.015	0.006
1A2 Manufacturing industries and Construction	0.034	0.110	0.022	0.012
1A3 Transport	0.060	0.079	0.087	0.069
1A4 Other Sectors	4.962	5.199	2.880	3.534
1A5 Other	0.000	0.000	0.000	0.000
1B1 Fugitive Emissions from fuels, Solid Fuels	NA	NA	NA	NA
1B2 Fugitive Emissions from fuels, Oil and Natural gas	NA	NA	NA	NA
Energy, Total	5.062	5.416	3.004	3.621

Table 3.5 Dioxin and HCB emission from the energy sector, 2007.

	Dioxin g I-Teq	HCB kg
1A1 Energy Industries	1.279	3.785
1A2 Manufacturing industries and Construction	0.187	0.027
1A3 Transport	0.242	0.000
1A4 Other Sectors	19.960	0.155
1A5 Other	0.001	0.000
1B1 Fugitive Emissions from fuels, Solid Fuels	NA	NA
1B2 Fugitive Emissions from fuels, Oil and Natural gas	0.000	NA
Energy, Total	21.669	3.97

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

This chapter includes stationary combustion plants in the NFR sectors 1A1, 1A2 and 1A4. Further details of the inventories for stationary combustion are enclosed in Annex 2A.

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 to the CORINAIR system. The emission inventories are prepared from a complete emission database based on the SNAP sectors. Aggregation to the NFR sector codes is based on a correspondence list between SNAP and NFR enclosed in Annex 2A. 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 and fuel consumption data included in tables and figures in Chapter 3.2 only include emissions originating from stationary combustion plants of a given NFR sector. The NFR sector codes have been applied unchanged, but some sector names have been changed to reflect the stationary combustion element of the source.

Fuel consumption

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

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

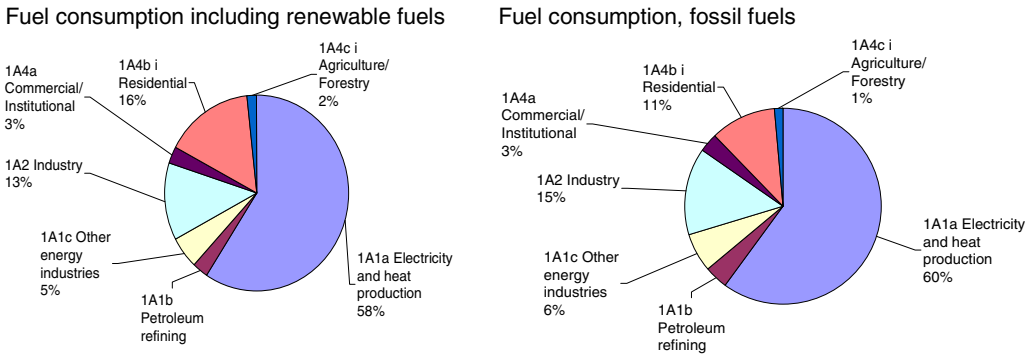


Figure 3.1 Fuel consumption rate of stationary combustion, 2007 (based on DEA 2008a).

Coal and natural gas are the most utilised fuels in 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.

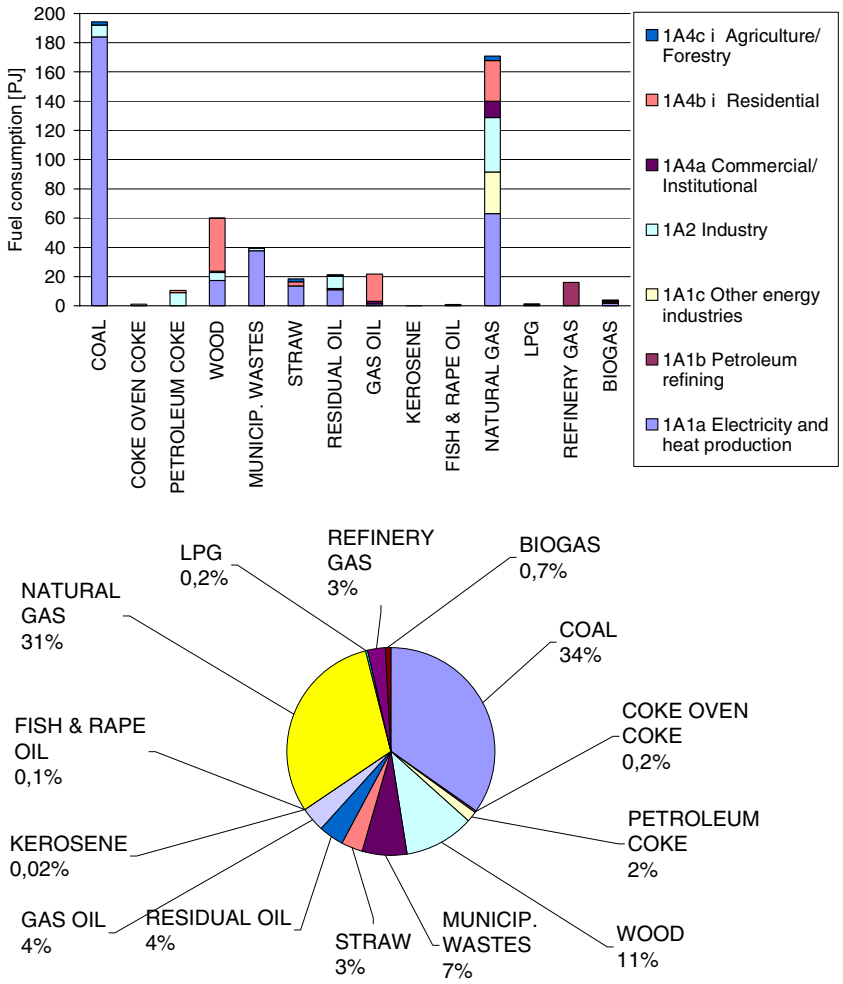


Figure 3.2 Fuel consumption in stationary combustion plants 2007 (based on DEA 2008a).

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

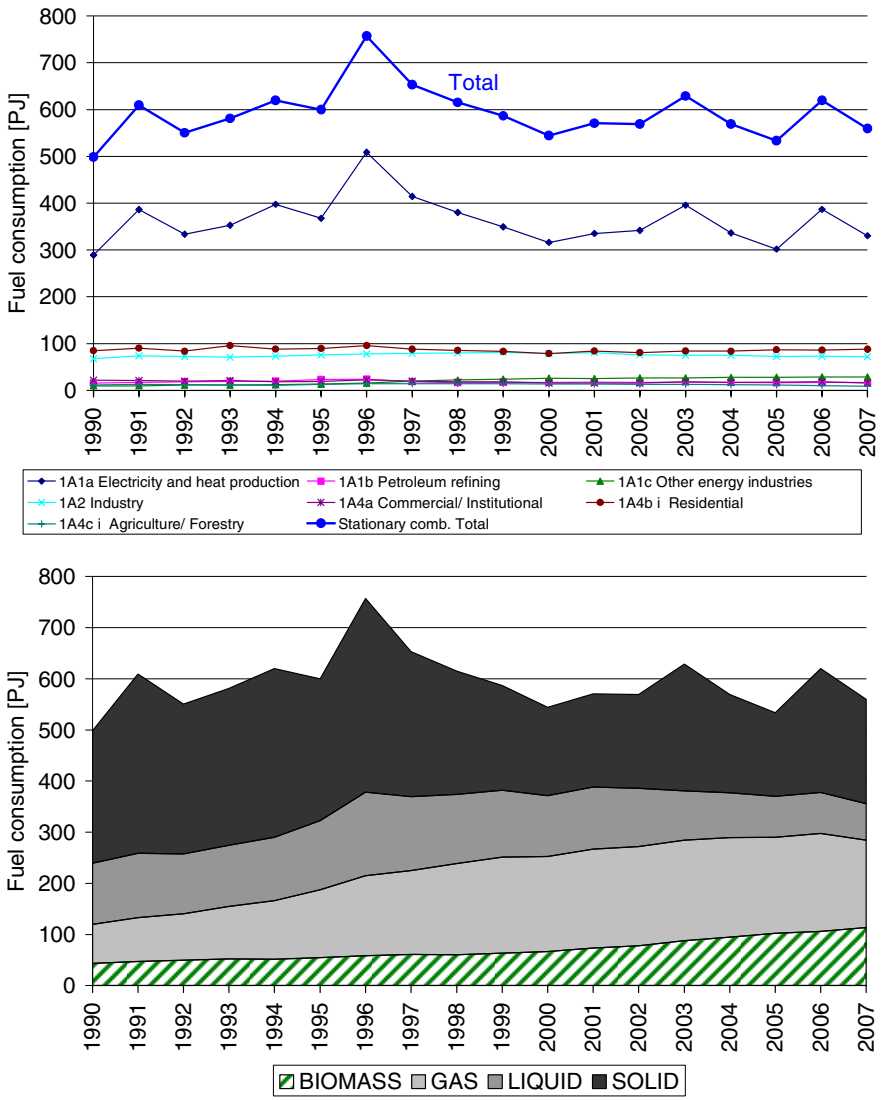


Figure 3.3 Fuel consumption time-series, stationary combustion (based on DEA 2008a).

The fluctuations in the time-series for fuel consumption are mainly a result of electricity import/export activity, 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 emissions are illustrated and compared in Figure 3.4. In 1990 the Danish electricity import was largely causing relatively low fuel consumption in Denmark's stationary combustion plants, whereas the fuel consumption was high in 1996 due to a large electricity export. In 2007 the net electricity export was 3420 TJ which is a lower export rate than in 2006. The large electricity export that occurs some years is a result of low rainfall in Norway and Sweden causing insufficient hydropower production in both countries (see Figure 3.4).

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 3.4. The corrections are included here to explain the fluctuations in the emission time-series.

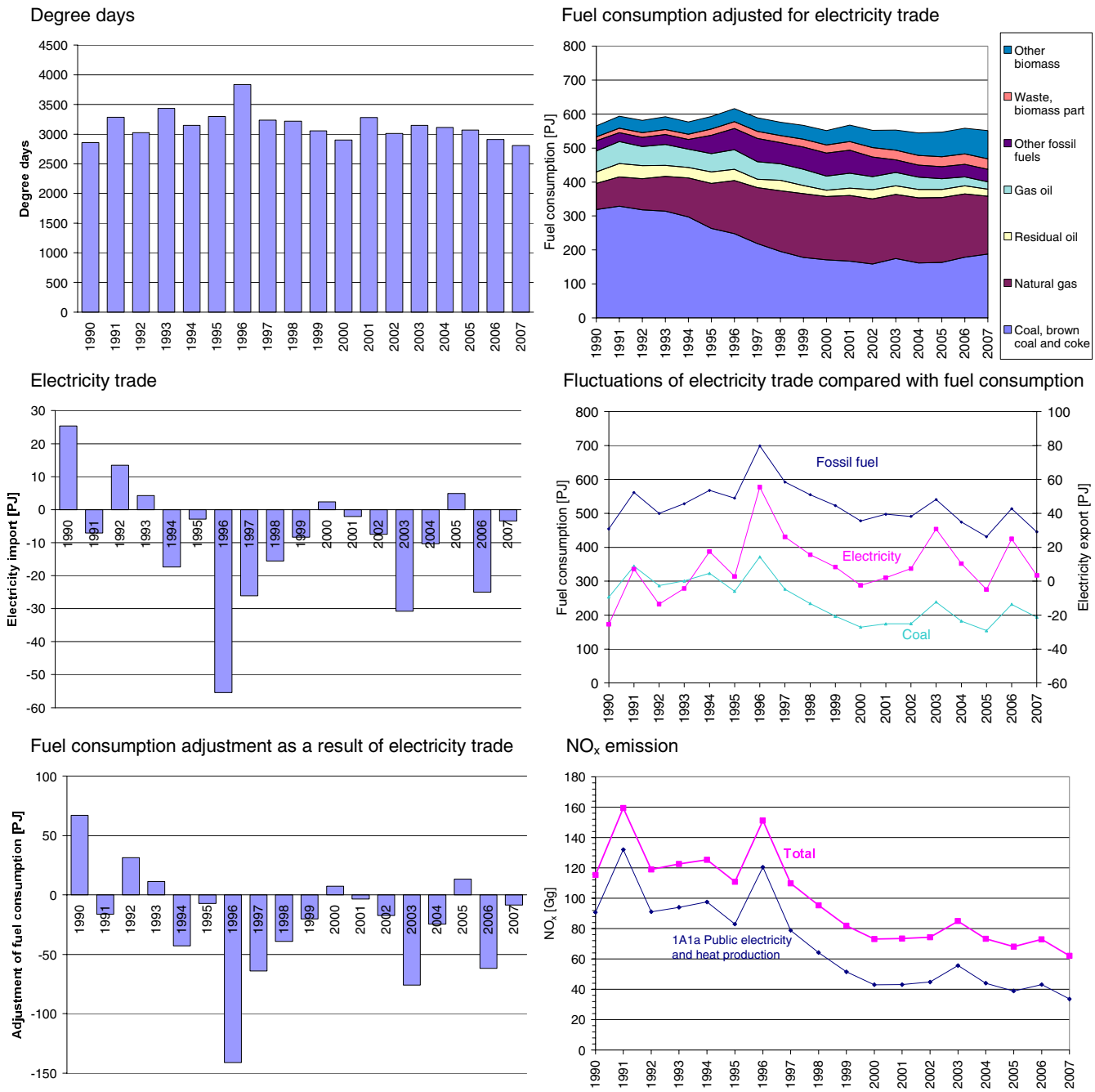


Figure 3.4 Comparison of time-series fluctuations for electricity trade, fuel consumption and NO_x emission (DEA 2008b).

3.2.2 Emissions

SO_2

In the 2007 inventory, stationary combustion is the most important emission source for SO_2 accounting for 88 % of the national emission. Table 3.6 shows the SO_2 emission inventory for the stationary combustion subsectors.

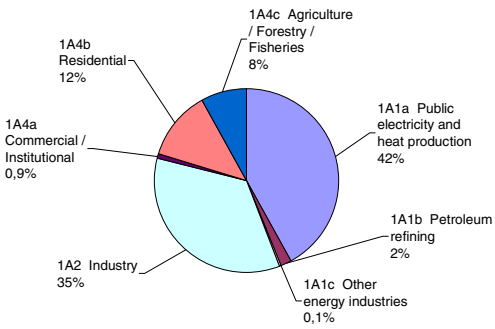
Electricity and heat production is the largest emission source accounting for 42 % of the emission. However, the SO_2 emission share is lower than the fuel consumption share for this sector, which is 59 %. This is a result of effective flue gas desulphurisation equipment installed in power plants combusting coal. The largest part (79 %) of the emission in the subsector originates from power plants >300MW_{th}.

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.

Time-series for the SO_2 emission from stationary combustion are shown in Figure 3.5. The SO_2 emission from stationary combustion plants decreased by 95 % from 1980 and 87 % from 1990. The large emission decrease is mainly a result of the reduced emission from *Electricity and heat production*, made possible due to installation of desulphurisation plant and due to the use of fuels with lower sulphur content.

Table 3.6 SO_2 emission from stationary combustion plants 2007 [1].

SO_2	2007	
1A1a Public electricity and heat production	8641	Mg
1A1b Petroleum refining	423	Mg
1A1c Other energy industries	10	Mg
1A2 Industry	7157	Mg
1A4a Commercial / Institutional	183	Mg
1A4b Residential	2509	Mg
1A4c Agriculture / Forestry / Fisheries	1680	Mg
Total	20604	Mg



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

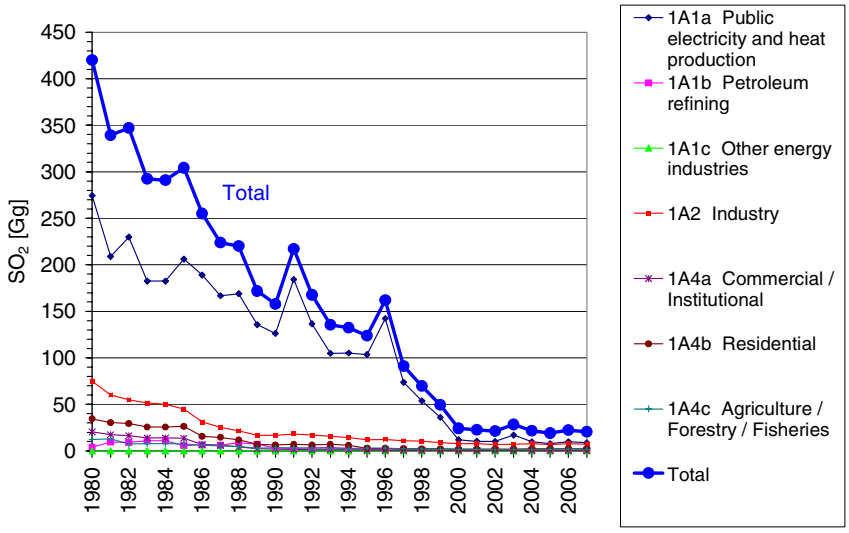


Figure 3.5 SO_2 emission time-series for stationary combustion.

3.2.3 NO_x

Stationary combustion accounts for 37 % of the national NO_x emission. Table 3.7 shows the NO_x emission inventory for stationary combustion subsectors.

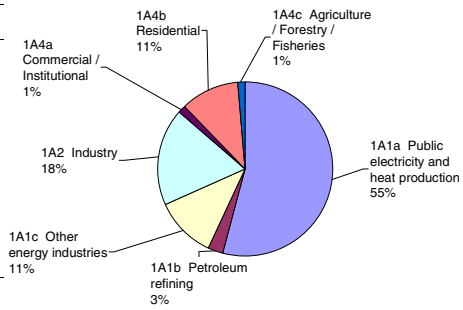
Electricity and heat production is the largest emission source, accounting for 54 % of the emission from stationary combustion plants.

Industrial combustion plants are also an important emission source, accounting for 18 % of the emission. The main industrial emission source is cement production, accounting for 64 % of the emission.

Time-series for the NO_x emission from stationary combustion are shown in Figure 3.6. NO_x emissions from stationary combustion plants decreased by 58 % from 1985 and 46 % from 1990. The reduced emission is mainly 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 3.7 NO_x emission from stationary combustion plants 2007 [1].

	2007	
1A1a Public electricity and heat production	33608	Mg
1A1b Petroleum refining	1754	Mg
1A1c Other energy industries	7120	Mg
1A2 Industry	11136	Mg
1A4a Commercial / Institutional	919	Mg
1A4b Residential	6653	Mg
1A4c Agriculture / Forestry / Fisheries	909	Mg
Total	62100	Mg



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

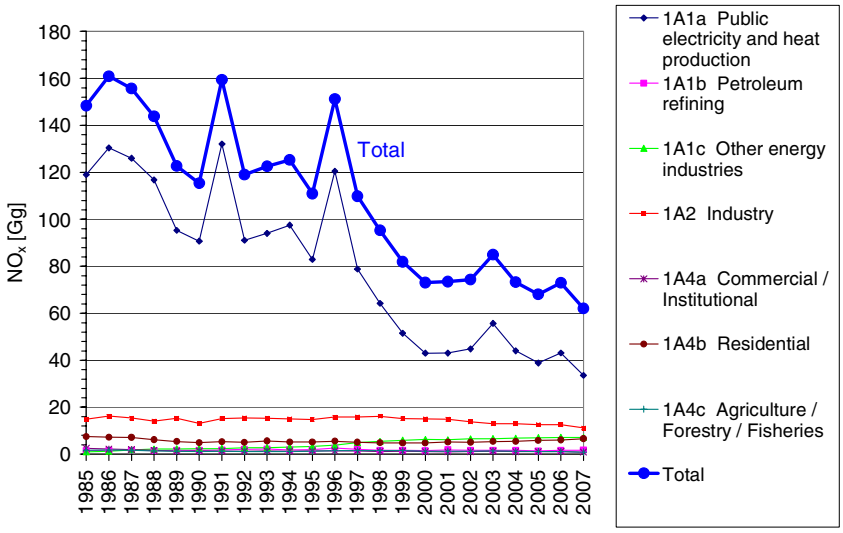


Figure 3.6 NO_x emission time-series for stationary combustion.

3.2.4 NMVOC

Stationary combustion plants account for 25 % of the national NMVOC emission. Table 3.8 shows the NMVOC emission inventory for the stationary combustion subsectors.

Residential plants are the largest emission source accounting for 79 % of the total emission from stationary combustion plants. For residential

plants, NMVOC is mainly emitted from wood and straw combustion, see Figure 3.7.

Electricity and heat production is also a considerable emission source, accounting for 10 % 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. The gas engines are either natural gas or biogas fuelled.

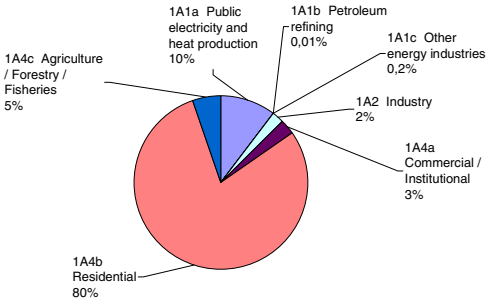
Time-series for the NMVOC emission from stationary combustion are shown in Figure 3.8. The emission has increased by 104 % from 1985 and 109 % from 1990. The increased emission is mainly a result of the increased use of lean-burn gas engines in CHP plants.

The emission from residential plants in 2007 is 2.1 times the 1990 level. The NMVOC emission from wood combustion in 2007 is 3.1 times the 1990 level due to increased wood consumption. However, the emission factor has decreased since 1990. Further the emission from straw combustion in farmhouse boilers has decreased (43 %) over this period.

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

	2007	
1A1a Public electricity and heat production	2698	Mg
1A1b Petroleum refining	3	Mg
1A1c Other energy industries	42	Mg
1A2 Industry	571	Mg
1A4a Commercial / Institutional	732	Mg
1A4b Residential	20957	Mg
1A4c Agriculture / Forestry / Fisheries	1379	Mg
Total	26382	Mg

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



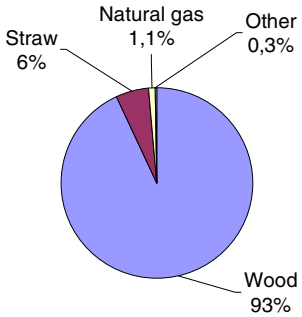


Figure 3.7 NMVOC emission from residential plants, 2007.

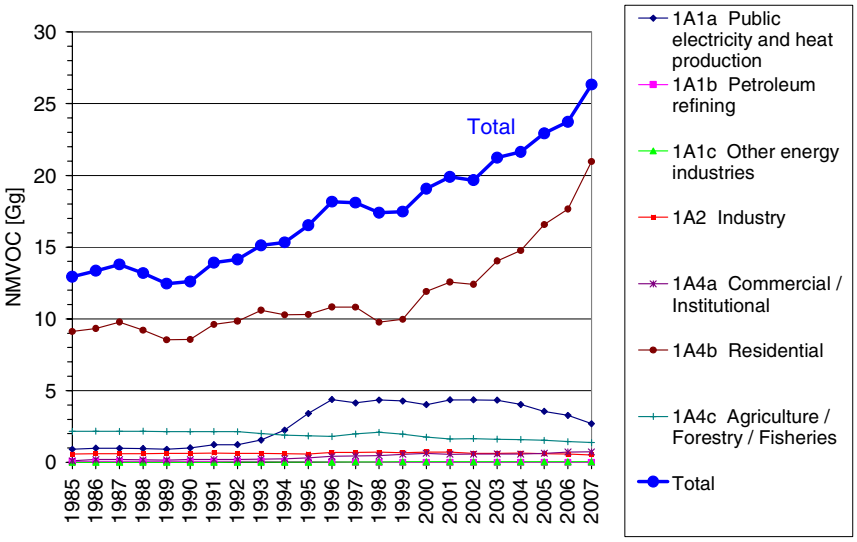


Figure 3.8 NMVOC emission time-series for stationary combustion.

3.2.5 CO

Stationary combustion accounts for 38 % of the national CO emission. Table 3.9 presents the CO emission inventory for stationary combustion subsectors.

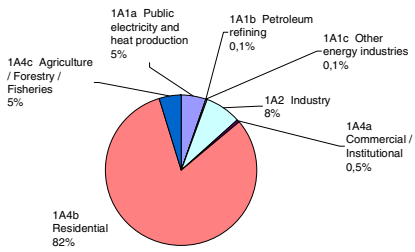
Residential plants represent the largest emission source, accounting for 81 % of the emission. Wood combustion accounts for 90 % of the emission from residential plants, see Figure 3.9. This is in spite of the fact that the fuel consumption share is only 41 %. Combustion of straw also represents a considerable 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 3.10. The emission increased by 27 % from 1985 and increased 22 % from 1990. The time-series for CO from stationary combustion plants follows the time-series for CO emission from residential plants.

The consumption of wood in residential plants for 2007 is 4.1 times the 1990 level. However, the CO emission factor for wood decreased since 1990 causing the CO emission from wood combustion in residential plants for 2007 to be only 3.2 times the 1990 level. Both straw consumption and the CO emission factor for residential plants have decreased since 1990.

Table 3.9 CO emission from stationary combustion plants 2007 [1].

	2007	
1A1a Public electricity and heat production	8854	Mg
1A1b Petroleum refining	225	Mg
1A1c Other energy industries	211	Mg
1A2 Industry	13574	Mg
1A4a Commercial / Institutional	846	Mg
1A4b Residential	138661	Mg
1A4c Agriculture / Forestry / Fisheries	8096	Mg
Total	170467	Mg



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

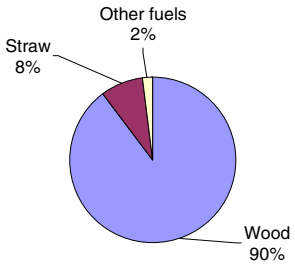


Figure 3.9 CO emission sources, residential plants, 2007.

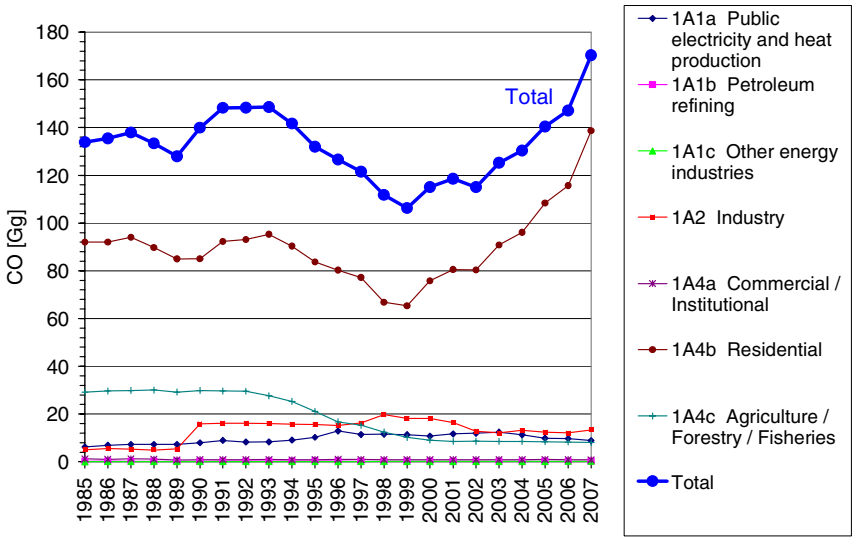


Figure 3.10 CO emission time-series for stationary combustion.

3.2.6 PM

To date, PM emissions from stationary combustion, transport, agriculture and the industrial sector have been included in the Danish inventory. TSP from stationary combustion accounts for 54 % of the national emission. The emission shares for PM_{10} and $PM_{2.5}$ are 61 % and 75 %, respectively.

Table 3.10 shows the PM emission inventory for the stationary combustion subsectors. Residential plants represent the largest emission source, accounting for 93 % of the $PM_{2.5}$ emission from stationary combustion plants.

Table 3.10 PM emission from stationary combustion plants, 2007.

	TSP	PM_{10}	$PM_{2.5}$	
1A1a Public electricity and heat production	1000	779	632	Mg
1A1b Petroleum refining	121	113	108	Mg
1A1c Other energy industries	3	2	1	Mg
1A2 Industry	917	629	361	Mg
1A4a Commercial / Institutional	162	160	150	Mg
1A4b Residential	25604	24253	22954	Mg
1A4c Agriculture / Forestry / Fisheries	512	475	440	Mg
Total	28319	26410	24648	Mg

Note: Only emission from stationary combustion plants in the sectors is included.

The primary sources of PM emissions are:

- Residential boilers, stoves and fireplaces combusting wood
- Farmhouse boilers combusting straw
- Power plants primarily combusting coal
- Coal and residual oil combusted in industrial boilers and processes

Furthermore, there are considerable emissions from:

- Residential boilers using gas oil
- Refineries

The PM emission from wood combusted in residential plants is the predominant source. Thus, 90 % of the $PM_{2.5}$ emission from stationary combustion is emitted from residential wood combustion. This corresponds to 68 % of the national emission.

A literature review (Nielsen et al., 2003) and a Nordic Project (Sternhufvud et al., 2004) have demonstrated that the emission factor uncertainty for residential combustion of wood in stoves and boilers is extremely high.

Emission inventories for PM have only been reported for the years 2000-2007. Time-series for PM emission from stationary combustion are shown in Figure 3.12. The emission of TSP, PM_{10} and $PM_{2.5}$ has uncreased by 68 %, 69 % and 71 % since 2000. The time-series for PM from stationary combustion plants follows the time-series for PM emission from residential plants.

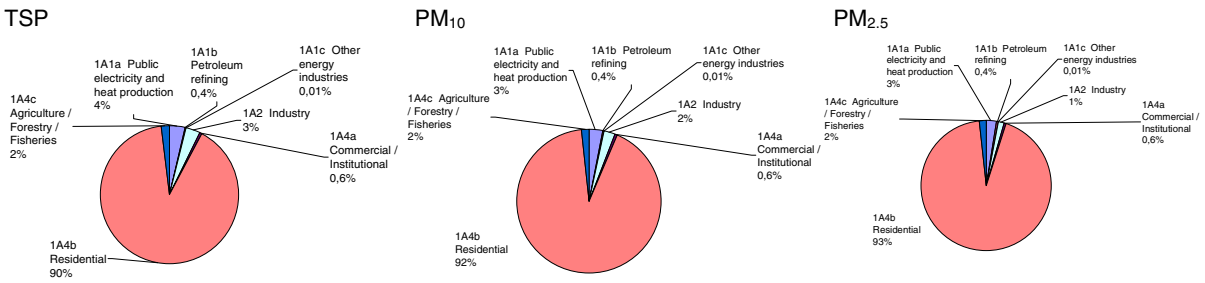


Figure 3.11 PM emission sources, stationary combustion plants, 2007.

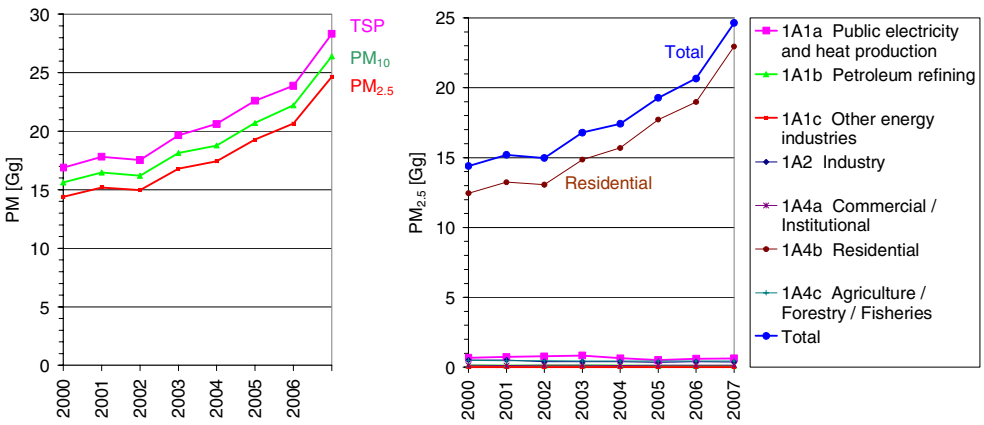


Figure 3.12 PM emission time-series for stationary combustion.

3.2.7 Heavy metals

Emission inventories for nine heavy metals are reported to the LRTAP Convention. Three of the metals are considered priority metals: Pb, Cd and Hg. The 2007 emissions are presented in Table 3.11.

Stationary combustion plants are the most important emission sources for heavy metals. For Cu, the emission share from stationary combustion plants is 12 %, but for all other heavy metals the emission share is more than 75 %.

The sectors *Electricity and heat production* and *Industry* have the highest emission shares. *Electricity and heat production* accounts for 77 %, 34 % and 45 % of the emission of the priority metals Pb, Cd and Hg, respectively. Residential plants accounts for 37 % of the Cd emission. More than 97 % of the emission from residential plants originates from wood combustion[1].

Table 3.11 Heavy metal emission from stationary combustion plants, 2007 [1)].

	As	Cd	Cr	Cu	Hg	Ni	Pb	Se	Zn	
1A1a Public electricity and heat production	348	236	633	723	482	1802	3546	1232	15547	kg
1A1b Petroleum refining	12	11	27	11	4	528	19	10	2	kg
1A1c Other energy industries	0	0	0	0	0	0	0	0	0	kg
1A2 Industry	202	169	371	180	254	4951	812	538	1351	kg
1A4a Commercial / Institutional	6	11	10	13	12	152	14	11	176	kg
1A4b Residential	26	252	23	275	289	27	184	88	5167	kg
1A4c Agriculture / Forestry / Fisheries	16	11	28	18	20	442	35	9	51	kg
Total	610	689	1092	1218	1061	7902	4609	1889	22294	kg

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

Time-series for heavy metal emissions are provided in Figure 3.13. Emissions of all heavy metals except Zn have decreased considerably since 1990. Table 3.12 shows the decrease of each heavy metal since 1990. Emissions have decreased despite increased incineration of muni-

[1] The applied emission factor for Cd is 6.8 mg pr GJ. This is a considerably higher emission factor than suggested in the 2007 EMEP/CORINAIR Emission Inventory Guidebook (1.4 mg pr GJ). HM emission factors from the Guidebook (EEA 2007) might be applied for residential wood combustion in future inventories.

cipal waste. This has been made possible due to installation and improved performance of gas cleaning devices in waste incineration plants and also in large power plants, the latter being a further important emission source. The increasing Zn emission estimated in resent years might be a result of insufficient data2.

Table 3.12 Decrease in heavy metal emission 1990-2007.

Pollutant	Decrease since 1990
As	58 %
Cd	34 %
Cr	82 %
Cu	66 %
Hg	65 %
Ni	63 %
Pb	70 %
Se	56 %
Zn	-15 %

[2] Ongoing work including emission measurements on waste incineration plants will clarify this point.

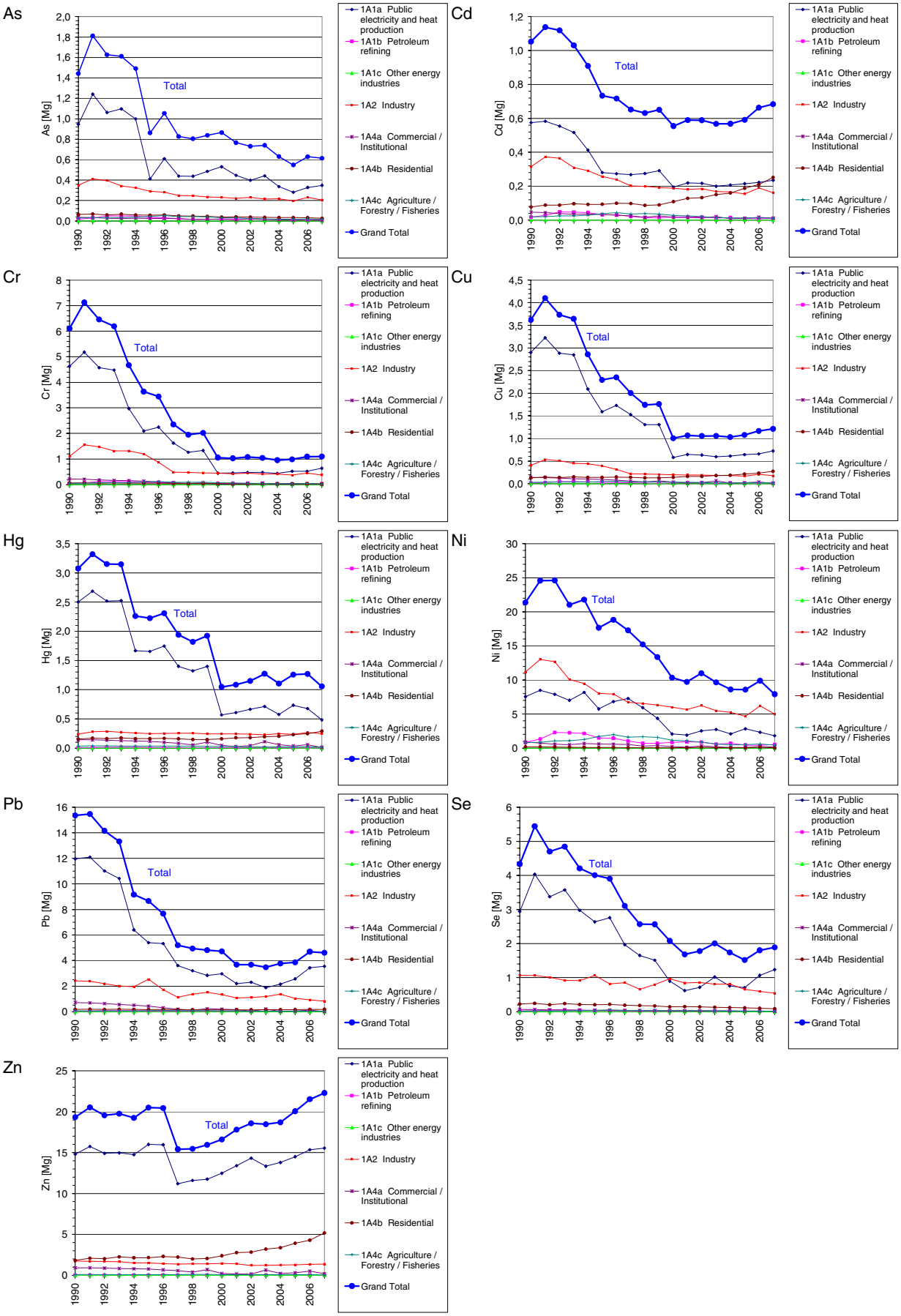


Figure 3.13 Heavy metal emission time-series, stationary combustion plants.

3.2.8 PAH

Emission inventories for 4 PAHs are reported to the LRTAP Convention. Stationary combustion plants account for more than 96 % of the PAH emissions in 2007.

Table 3.13 shows the PAH emission inventory for the stationary combustion subsectors. Residential combustion is the largest emission source for PAH acconting for more than 90 % of the emission. Combustion of wood is the predominant source, accounting for more than 98 % of the PAH emission in residential plants.

The increasing emission trend for PAH is a result of the increased combustion of wood in residential plants. The time-series for wood combustion in residential plants is also provided in Figure 3.15.

Table 3.13 PAH emission from stationary combustion plants, 2007 [1)].

	Benzo(a)-Pyrene (Mg)	Benzo(b)-fluoranthene (Mg)	Benzo(k)-fluoranthene (Mg)	Indeno(1,2,3-c,d)pyrene (Mg)
1A1a Public electricity and heat production	7	28	14	6
1A1b Petroleum refining	0	0	0	0
1A1c Other energy industries	0	0	0	0
1A2 Industry	30	104	16	8
1A4a Commercial / Institutional	171	225	75	122
1A4b Residential	4 623	4 787	2 772	3 139
1A4c Agriculture / Forestry / Fisheries	162	174	24	263
Total	4 994	5 319	2 902	3 538

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

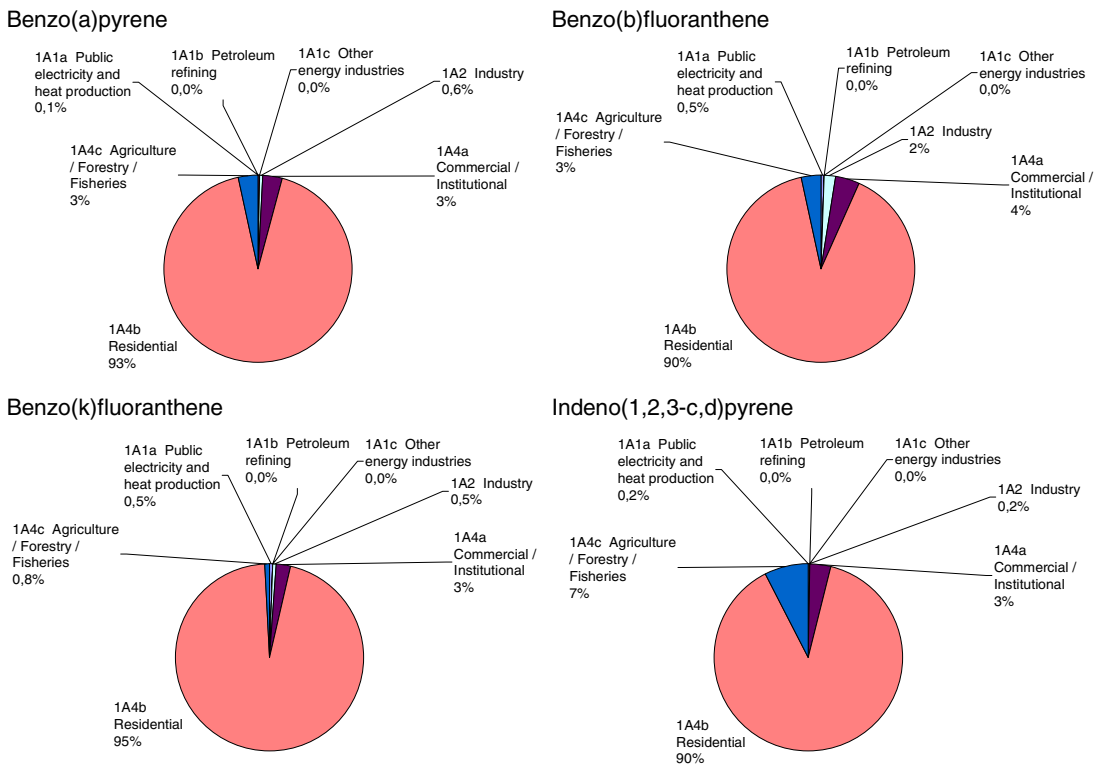


Figure 3.14 PAH emission sources, stationary combustion plants, 2007.

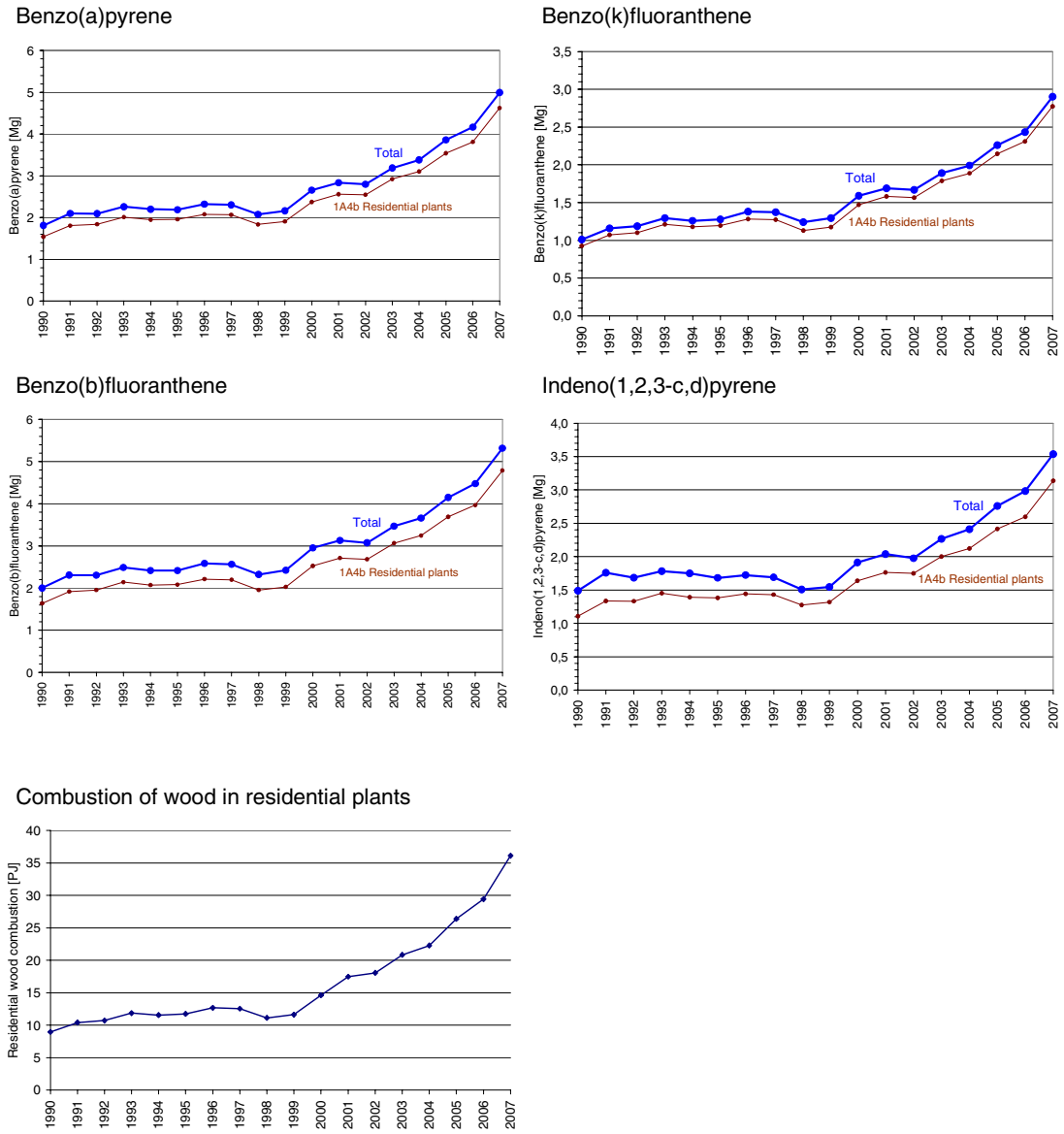


Figure 3.15 PAH emission time-series, stationary combustion plants. Compared to wood consumption in residential plants.

3.2.9 Dioxin

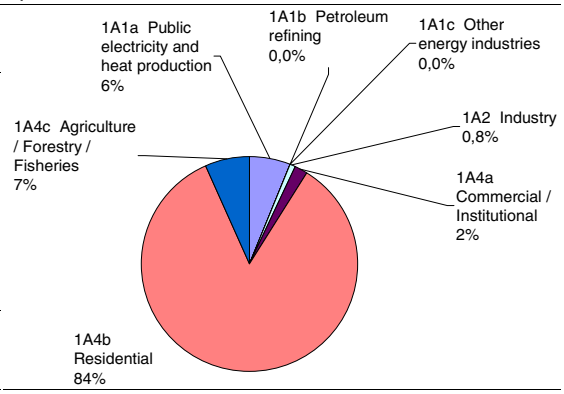
Emission inventories for dioxin are reported to the LRTAP Convention. Stationary combustion plants account for 77 % of the dioxin emission in 2007.

Table 3.14 shows the dioxin emission inventory for the stationary combustion subsectors. Residential combustion is the largest emission source for dioxin. The residential sector accounts for 84 % of the dioxin emission from stationary combustion plants.

Dioxin emission decreased 55 % since 1990 mainly due to installation of dioxin filters in MSW incineration plants. In resent years the dioxin emission has increased as a result of the increased emission from residential plants. The increasing emission is a result of the increased wood consumption in residential plants.

Table 3.14 Dioxin emission from stationary combustion plants, 2007 [1].

	Dioxin, g I-Tec
1A1a Public electricity and heat production	1.28
1A1b Petroleum refining	0.00
1A1c Other energy industries	0.00
1A2 Industry	0.18
1A4a Commercial / Institutional	0.45
1A4b Residential	17.97
1A4c Agriculture / Forestry / Fisheries	1.44
Total	21.32



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

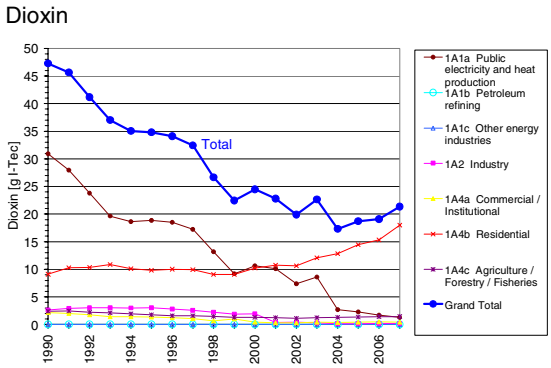


Figure 3.16 Dioxin emission time-series, stationary combustion plants.

3.2.10 HCB

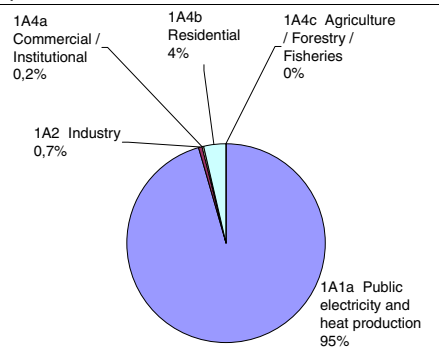
Emission inventories HCB are reported to the LRTAP Convention. In this first inventory for HCB the emission has been estimated only for stationary combustion plants and for cremation. Stationary plants account for more than 99 % of the estimated HCB emission in 2007.

Table 3.15 shows the HCB emission inventory for the stationary combustion subsectors. Public electricity and heat production account for more than 95 % of the emission. The main source is MSW incineration plants.

The increasing emission trend follows the increasing combustion of municipal waste in Denmark. The installation of improved flue gas cleaning devices have not been taken into account in this first inventory for HCB and thus the apparent 132 % increase since 1990 might be misleading. Future inventories will take emission factor time-series for incineration of municipal waste into account.

Table 3.15 HCB emission from stationary combustion plants, 2007 [1].

	HCB, kg
1A1a Public electricity and heat production	3,79
1A1b Petroleum refining	-
1A1c Other energy industries	-
1A2 Industry	0,03
1A4a Commercial / Institutional	0,01
1A4b Residential	0,14
1A4c Agriculture / Forestry / Fisheries	0,00
Total	3,97



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

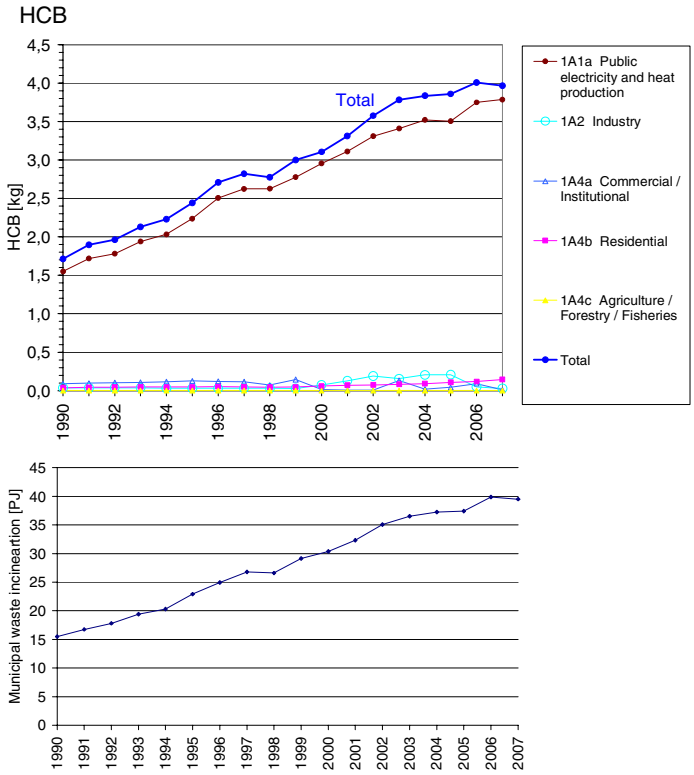


Figure 3.17 HCB emission time-series, stationary combustion plants. Compared to municipal waste incineration.

3.2.11 Methodological issues

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

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

Large point sources

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

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

- Power plants and decentralised CHP plants (combined heat and power plants)
- Municipal waste incineration plants
- Large industrial combustion plants
- Petroleum refining plants

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

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

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

Further details on large point sources are shown in Annex 2A. The number of large point sources registered in the databases increased from 1990 to 2007. In the emission databases for the years before 1990, only one large point source was registered.

If plant-specific emission factors are not available, general area source emission factors are used. 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 a Danish legislatory requirement
- Emission data reported by DONG Energy and Vattenfall, the two major electricity suppliers
- CO_2 data reported under the EU Emission Trading Scheme
- Emission data reported from industrial plants

Annual environmental reports for the plants include a considerable number of emission datasets. Emission data from annual environ-

mental reports are, in general, based on emission measurements, but some emissions have potentially been calculated from general emission factors.

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. The Danish Energy Authority aggregates fuel consumption rates to SNAP sector categories (DEA 2008a). Some fuel types in the official Danish energy statistics are added to obtain a less detailed fuel aggregation level, see Annex 2A. The calorific values on which the energy statistics are based are also enclosed in Annex 2A.

The fuel consumption of the NFR 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. To date, disaggregation into specific industries has only been estimated for reporting to the Climate Convention. Disaggregation for LRTAP Convention reporting is planned in the future.

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

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

Emissions from non-energy use of fuels have been included in other sectors (solvents and industrial processes) of the inventory. The Danish energy statistics include three fuels used for non-energy purposes: bitumen, white spirit and lube oil. The fuels used for non-energy purposes add up to about 2 % of the total fuel consumption in stationary combustion plants in Denmark.

In Denmark, all municipal waste incineration is utilised for heat and power production. Thus, incineration of waste is included as stationary

combustion in the NFR Energy sector (source categories *1A1*, *1A2* and *1A4)*.

Fuel consumption data are 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[3] (EEA 2004) and the IPCC reference manual (IPCC 1997).

A complete list of emission factors for 2007, time-series for emission factors and detailed references are enclosed in Annex 2A. The area source emission factors in 2007 for SO_2, NO_x, NMVOC and CO are shown in Table 3.16.

[3] Several updates of the guidebook have been published since 2004. During the next years the emission factors will be compared to the 2008 update of the guidebook.

Table 3.16 SO_2, NO_x, NMVOC and CO emission factors 2007.

Fuel	NFR sector	SNAP	SO_2, g pr GJ	NO_x, g pr GJ	NMVOC, g pr GJ	CO, g pr GJ
COAL	1A1a	010101, 010102	40	98	1.5	10
COAL	1A1a, 1A2, 1A4c	010202, 030100, 020300	574	95	15	10
COAL	1A4b	020200	574	95	15	2000
COKE OVEN COKE	1A2	030100	574	95	15	10
COKE OVEN COKE	1A4b	020200	574	95	15	2000
PETROLEUM COKE	1A4a, 1A4b	020100, 020200	605	50	1.5	1000
WOOD AND SIMIL.	1A1a	010102, 010103, 010104	1.74	69	3.3	79
WOOD AND SIMIL.	1A1a, 1A2	010202, 010203, 030100, 030102, 030103	25	90	48	240
WOOD AND SIMIL.	1A4a, 1A4c	020100, 020105, 020300	25	90	600	240
WOOD AND SIMIL.	1A4b	020200	25	120	540	3441
MUNICIP. WASTES	1A1a	010102, 010103	23.9	124	0.98	7.4
MUNICIP. WASTES	1A1a, 1A4a	010203, 020103	67	164	9	10
STRAW	1A1a	010101, 010102, 010103, 010104	47.1	131	0.8	63
STRAW	1A1a, 1A4c	010202, 010203, 020302	130	90	50	325
STRAW	1A4c	020300	130	90	600	4000
STRAW	1A4b	020200	130	90	400	4000
RESIDUAL OIL	1A1a	010101, 010102, 010104	206	98	3	15
RESIDUAL OIL	1A1a, 1A4a, 1A4b, 1A4c	010202, 010203, 020100, 020200, 020300, 020302	344	142	3	30
RESIDUAL OIL	1A1b	010306	537	142	3	30
RESIDUAL OIL	1A2	030100, 030102	344	130	3	30
GAS OIL	1A1a	010101, 010102	23	249	1.5	15
GAS OIL	1A1a, 1A2	Gas turbines: 010104, 010204, 030104	23	350	2	15
GAS OIL	1A1a, 1A1c, 1A4a, 1A4c	Engines: 010105, 010205, 010505, 020105, 020304	23	700	100	100
GAS OIL	1A1a	010103	23	65	1.5	15
GAS OIL	1A1a, 1A1b, 1A2f	010201, 010202, 010203, 010306, 030100, 030102	23	65	1.5	30
GAS OIL	1A4a, 1A4c	020100, 020103	23	52	3	30
GAS OIL	1A4b	020200	23	52	3	43
KEROSENE	all	all	5	50	3	20
FISH & RAPE OIL	1A1a	010101, 010102, 010103	1	220	1.5	15
FISH & RAPE OIL	1A1a	010202, 010203	1	65	1.5	15
FISH & RAPE OIL	1A2, 1A4c	030105, 020105	1	700	100	100
NATURAL GAS	1A1a	010100, 010101, 010102	0.3	97	2	15
NATURAL GAS	1A1a, 1A2f, 1A4a, 1A4c	Gas turbines: 010104, 030104, 020104, 020303	0.3	124	1.4	6.2
NATURAL GAS	1A1a, 1A1c, 1A2, 1A4a, 1A4b, 1A4c	Gas engines: 010105, 010205, 010505, 030105, 020105, 020204, 020304	0.3	148	105	115
NATURAL GAS	1A1a, 1A2	010103, 010202, 010203, 030100, 030103	0.3	42	2	28
NATURAL GAS	1A1c	010504	0.3	250	1.4	6.2
NATURAL GAS	1A4a, 1A4c	020100, 020103, 020300	0.3	30	2	28
NATURAL GAS	1A4b	020200, 020202	0.3	30	4	20
LPG	1A2	030100	0.13	96	2	25
LPG	1A4a, 1A4c	020100, 020105, 020300	0.13	71	2	25
LPG	1A4b	020200	0.13	47	2	25
REFINERY GAS	1A1b	010304, 010306	1	170	1.4	6.2
BIOGAS	1A1a, 1A2, 1A4a, 1A4c	010102, 010103, 010203, 030100, 020100, 020103, 020300	25	28	4	36
BIOGAS	1A1a, 1A1c, 1A2, 1A4a, 1A4c	Gas engines: 010105, 010205, 010505, 030105, 020105, 020304	19.2	540	14	273
BIOGAS	1A2	030102	25	59	4	36

Most country-specific emission factors refer to:

- Danish legislation
- A emission measurement programme for decentralised CHP plants (Nielsen & Illerup 2003)
- Other Danish research reports

- Calculations based on plant-specific emissions from a considerable number of power plants
- Calculations based on plant-specific emissions from a considerable number of municipal waste incineration plants

SO_2 and NO_x emissions from large point sources are often plant specific i.e. based on emission measurements. Emissions of CO, NMVOC, PM and heavy metals are also plant specific in some cases.

Some of the area source emission factors for power plants and municipal waste CHP plants take into account that large plants are included in the inventory as large point sources with plant-specific emission data. Thus, some area source emission factors are default values which assume that the remaining fuel consumption is combusted in smaller units with less effective flue gas cleaning. The area source emission factors are, therefore, not necessarily average values for these plant categories.

3.2.12 Uncertainties and time-series consistency

Time-series for fuel consumption and emission are shown and discussed in Chapter 3.2.1.

Methodology

The applied methodology for uncertainty estimates refers to Pulles & Aardenne (2004). The Danish uncertainty estimates are based on the simple Tier 1 approach. Uncertainty estimates have not yet been performed for dioxin and HCB.

The uncertainty estimates are based on emission data for the base year and the year 2007 as well as on uncertainties for fuel consumption and emission factors for each of the main SNAP sectors. For particulate matter, 2000 is considered to be the base year, but for all other pollutants the base year is 1990. The applied uncertainty estimates for activity rates and emission factors are default values referring to Pulles & Aardenne (2004). The uncertainty for PM is, however, estimated by NERI. The default uncertainty estimates for emission factors are given in letter codes representing an uncertainty range. It has been assumed that the uncertainty estimates were in the lower end of the range for all sources and pollutants. The values applied for emission factors are listed in Table 3.17. The uncertainty for fuel consumption in stationary combustion plants was assumed to be 2 %.

Table 3.17 Uncertainty values for emission factors, %.

SNAP sector	SO_2	NO_x	NMVOC	CO	PM	HM	PAH
01	10	20	50	20	50	100	100
02	20	50	50	50	500	1 000	1 000
03	10	20	50	20	50	100	100

Results

Uncertainty estimates include uncertainty regarding the total emission as well as uncertainty relating to the trend. The estimated uncertainties for stationary combustion emission inventories are shown in Table 3.18. Detailed calculation sheets are shown in Annex 2A.

The total emission uncertainty is 7 % for SO_2, 16 % for NO_x, 44 % for NMVOC and 43 % for CO. For PM, most heavy metals and PAH the uncertainty estimate is greater than 100 %.

The SO_2 emission decreased 87 %±0,7 %-age points since 1990. NO_x emission decreased 46 %±3 %-age points.

Table 3.18 Danish uncertainty estimates, 2007.

Pollutant	Uncertainty Total emission, %	Trend 1990-2007, %	Uncertainty Trend, %-age points
SO_2	7,1	-87	±0,7
NO_x	16	-46	±3
NMVOC	44	+109	±6
CO	43	+22	±4
TSP [1)]	464	+61	±48
PM10 [1)]	471	+69	±48
$PM_{2.5}$ [1)]	478	+71	±40
As	104	-58	±7
Cd	400	-34	±171
Cr	89	-82	±4
Cu	258	-66	±57
Hg	307	-65	±69
Ni	105	-63	±6
Pb	94	-70	±3
Se	101	-58	±5
Zn	252	+15	±112
Benzo(b)fluoranthene	975	+166	±40
Benzo(k)fluoranthene	989	+187	±64
Benzo(a)pyrene	993	+176	±11
Indeno(1,2,3-c,d)	996	+138	±23

[1)] The base year for PM is 2000.

3.2.13 Source specific QA/QC and verification

A QA/QC plan is implemented. A thorough description can be found in Denmark's Informative Inventory Report (Nielsen et al. 2008a)

The QC includes:

- Checking of time-series in the IPCC and SNAP source categories. Considerable changes are controlled and explained.
- Comparison with the inventory of the previous year. Any major changes are verified.
- Total emission, when aggregated to IPCC and LRTAP reporting tables, is compared with totals based on SNAP source categories (control of data transfer).
- A manual log table in the emission databases is applied to collect information about recalculations.
- The IPCC reference approach validates the fuel consumption rates and CO_2 emissions of fuel combustion. Fuel consumption rates and CO_2 emissions differ by less than 1.6 % (1990-2007). The reference approach is further discussed in annex 2A.
- 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 factor and plant-specific emissions

    - Check of emission factors for large point sources. Emission factors for pollutants that are not plant-specific should be the same as those defined for area sources.
    - Additional checks on database consistency
- Most emission factor references are now incorporated in the emission database, itself.
- 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 two major power plant owners / operators in Denmark: DONG Energy and Vattenfall both obtained the ISO 14001 certification for an environmental management system. Danish Gas Technology Centre and dk-Teknik[4] both run accredited laboratories for emission measurements.

3.2.14 Source specific recalculations

Improvements and recalculations since the 2008 emission inventory submission include:

- The national energy statistics has been updated for the years 1980-2006. This has primarily resulted in small differences, however a larger recalculation of the residential wood consumption was made by the DEA resulting in higher emissions of a number of air pollutants in 2006.
- The NMVOC emission factor for straw in residential plants has been updated to reflect the value provided in the EMEP/Corinair Guidebook (EEA 2007). The emission factor was reduced from 600 g pr GJ to 400 g pr GJ. This change was made for the whole time-series.
- The emission factor for CO for residential wood combustion was updated based on the technology distribution of stoves and boilers together with default emission factors from the EMEP/Corinair Guidebook (EEA 2007). This reduced the emissions factor from 6000 g pr GJ to 3441 g pr GJ in 2007. A time-series for the emission factor was elaborated and is included in Annex 2A.
- HCB emissions were estimated for the first time. Default emission factors from the EMEP/Corinair Guidebook (EEA 2007) were used in the calculations.

3.2.15 Source specific planned improvements

The planned improvements of the inventory include:

- Improved documentation for emission factors
  Reporting of and references for the applied emission factors will be further developed in future inventories.
- Uncertainty estimates
  Uncertainty estimates are based mainly on default uncertainty levels for activity rates and emission factors. Default uncertainty levels will be updated according to the updated EEA Guidebook (EEA 2008).
- Updated emission factors for CHP plants will be estimated this year and will be applied in the next inventory.

[4] Now FORCE

3.2.16 References for stationary combustion

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

The emission inventory basis for mobile sources is fuel use 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, measurements specific to Denmark are used.

In the Danish emission 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 CFR/NFR classification codes shown in Table 3.16 below (mobile sources only).

Table 3.16 SNAP – NFR correspondence table for transport.

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

Military transport activities (land and air) refer to the CRF/NFR sector Other (1A5), while the Transport-Navigation sector (1A3d) comprises national sea transport (ship movements between two Danish ports) and recreational craft (SNAP code 0803).

For aviation, LTO (Landing and Take Off)[5] refers to the part of flying which is below 1000 m.

The working machinery and equipment in industry (SNAP code 0808) is grouped in Industry-Other (1A2f), while agricultural and forestry non-road machinery (SNAP codes 0806 and 0807) is accounted for in

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

the Agriculture/forestry/fisheries (1A4c) sector together with fishing activities.

For mobile sources, internal NERI databases for road transport, air traffic, sea transport and non road machinery have been set up in order to produce the emission inventories. The output results from the NERI databases are calculated in a SNAP format, as activity rates (fuel consumption) and emission factors, which are then exported directly to the central Danish CollectER database.

Apart from national inventories, the NERI databases are used also as a calculation tool in research projects, environmental impact assessment studies, and to produce basic emission information which requires various aggregation levels.

3.3.1 Source category description

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

Fuel consumption

Table 3.17 Fuel use (PJ) for domestic transport in 2007 in NFR sectors.

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

Table 3.17 shows the fuel use for domestic transport based on DEA statistics for 2007 in NFR sectors. The fuel use figures in time-series 1985-2007 are given in Annex 2.B.15 (NFR format) and are shown for 2007 in Annex 2.B.14 (CollectER format). Road transport has a major share of the fuel consumption for domestic transport. In 2007 this sector's fuel consumption share is 77 %, while the fuel consumption shares for Agriculture/forestry/fisheries and Industry-Other are 9 and 6 %, respectively. For the remaining sectors the total fuel consumption share is 7 %.

From 1985 to 2007, diesel and gasoline fuel use has increased by 57 % and 22 %, respectively, and in 2007 the fuel use shares for diesel and gasoline were 64 % and 35 %, respectively (Figures 3.15 and 3.16). Other fuels only have a 1 % share of the domestic transport total. Almost all gasoline is used in road transportation vehicles. Gardening machinery and recreational craft are merely small consumers. Regarding diesel, there is considerable fuel use in most of the domestic transport categories, whereas a more limited use of residual oil and jet fuel is being used in the navigation sector and by aviation (civil and military flights), respectively.

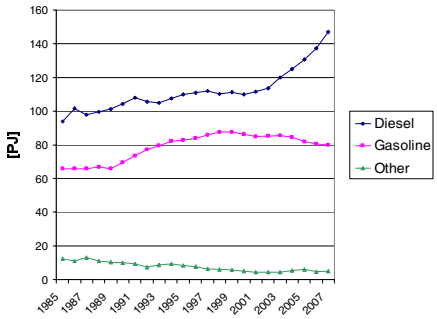

Figure 3.15 Fuel consumption pr fuel type for domestic transport 1985-2007.

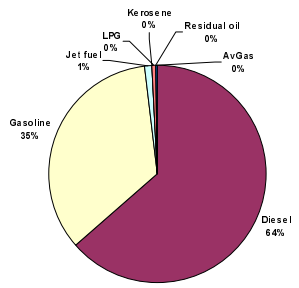

Figure 3.16 Fuel use share pr fuel type for domestic transport in 2007.

Road transport

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

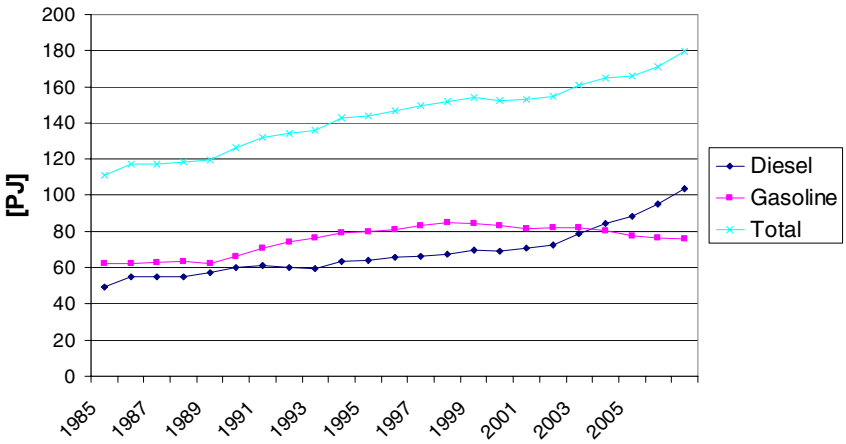

Figure 3.17 Fuel consumption pr fuel type and as totals for road transport 1990-2007.

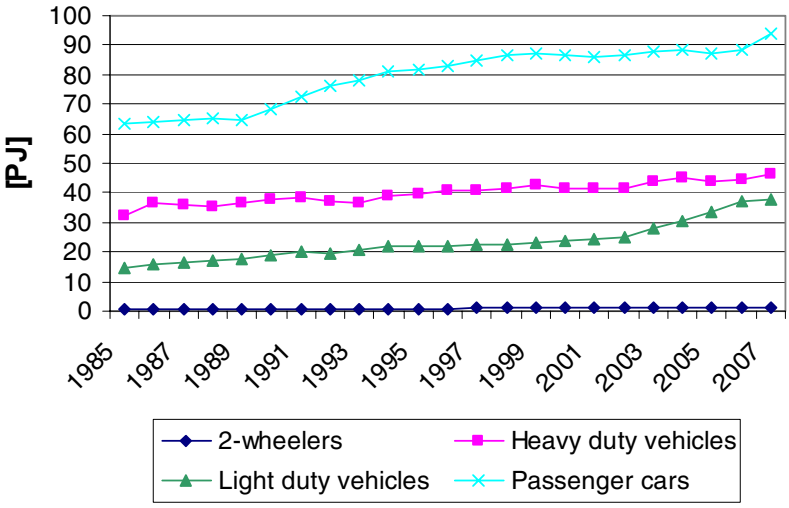

Figure 3.18 Total fuel consumption pr vehicle type for road transport 1990-2007.

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

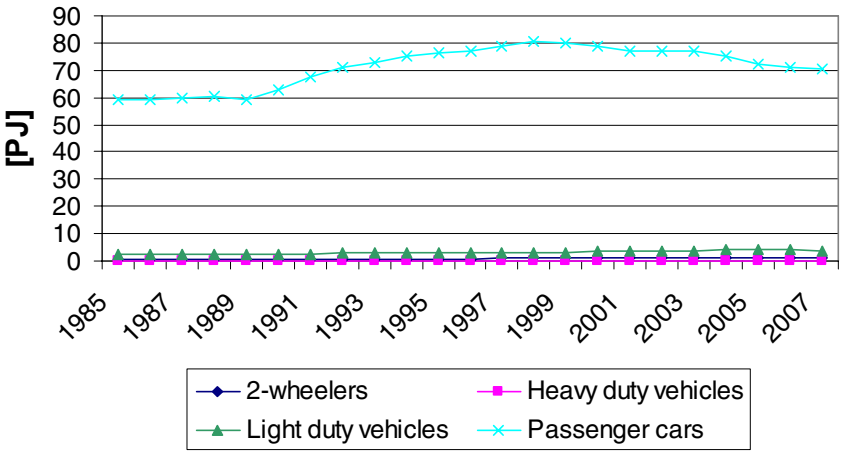

Figure 3.19 Gasoline fuel consumption pr vehicle type for road transport 1990-2007.

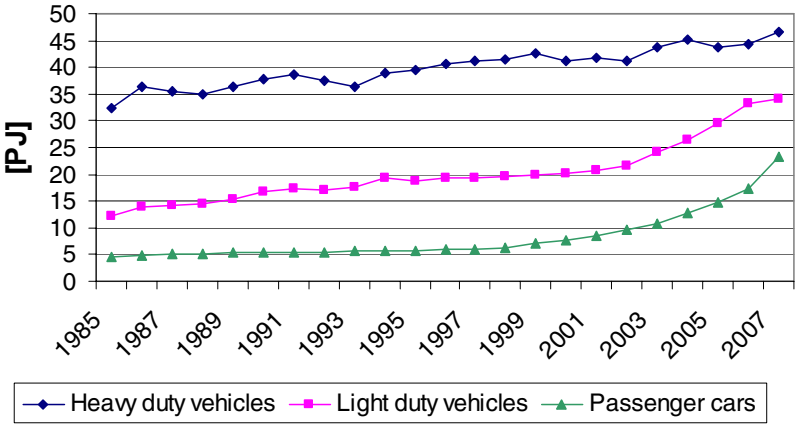

Figure 3.20 Diesel fuel consumption pr vehicle type for road transport 1990-2007.

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

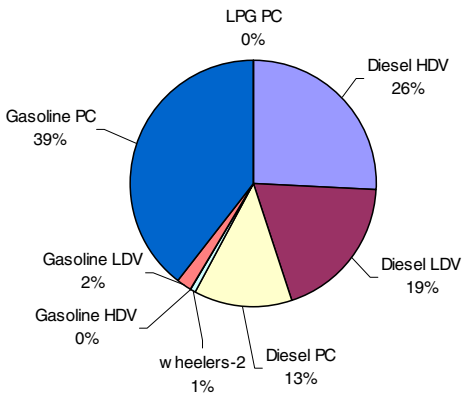

Figure 3.21 Fuel consumption share (PJ) pr vehicle type for road transport in 2007.

Other mobile sources

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

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

The 1985-2007 time-series are shown pr fuel type in Figures 3.23-3.26 for diesel, gasoline and jet fuel, respectively.

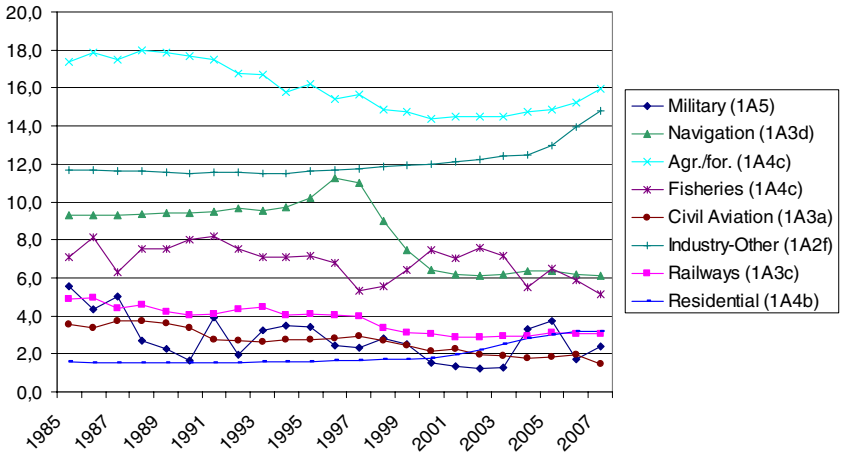

Figure 3.22 Total fuel consumption in CRF sectors for other mobile sources 1985-2007.

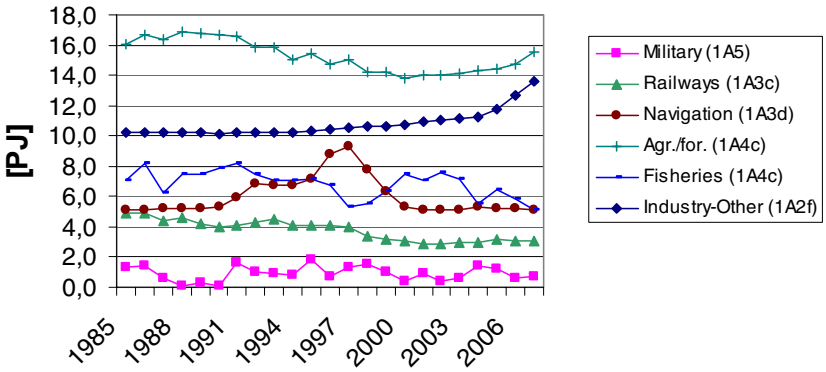

Figure 3.23 Diesel fuel consumption in CRF sectors for other mobile sources 1985-2007.

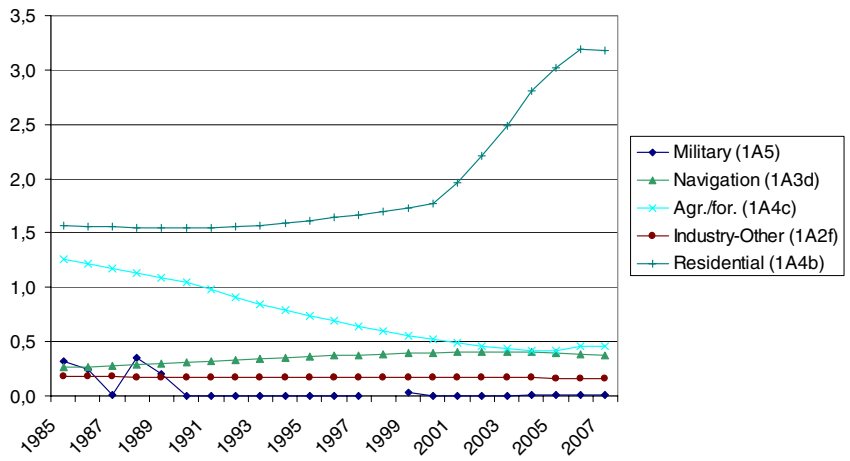

Figure 3.24 Gasoline fuel consumption in CRF sectors for other mobile source 1985-2007.

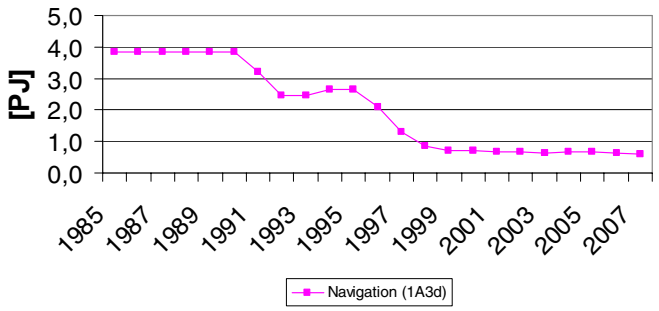

Figure 3.25 Residual oil fuel consumption in CRF sectors for other mobile sources 1985-2007.

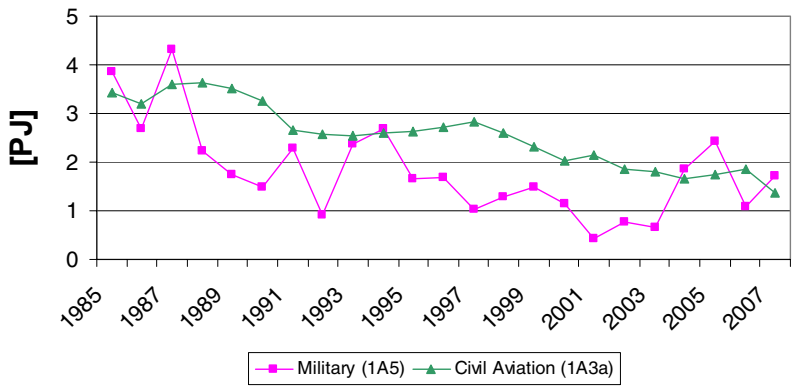

Figure 3.26 Jet fuel consumption in CRF sectors for other mobile sources 1985-2007.

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

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

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

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

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

Bunkers

The residual oil and diesel oil fuel use 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 use 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.

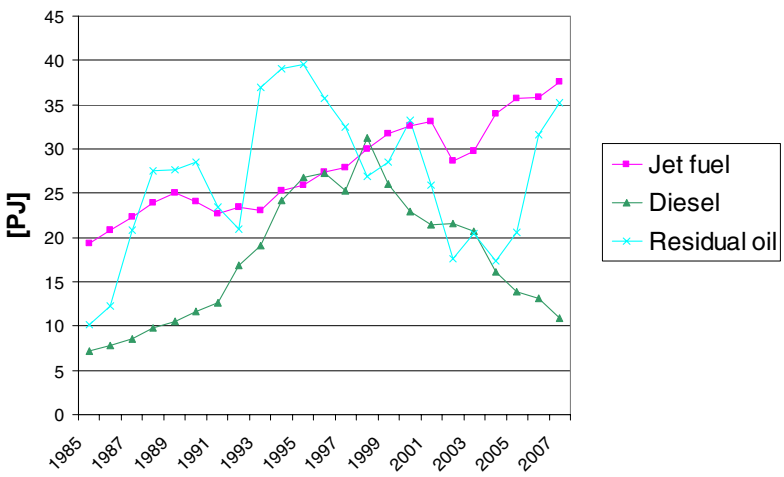

Figure 3.27 Bunker fuel use 1985-2007.

Emissions of SO_2, NO_X, NMVOC, CO, NH_3, TSP, PM_{10} and $PM_{2.5}$

In Table 3.18 the SO_2, NO_X, NMVOC, CO NH_3, TSP, PM_{10} and $PM_{2.5}$ emissions for road transport and other mobile sources are shown for 2007 in NFR sectors. For particulate matter (PM; TSP, PM_{10} and $PM_{2.5}$), only the exhaust emission contributions are included in Table 3.18. Non-exhaust TSP, PM_{10} and $PM_{2.5}$ emissions are treated in a separate section below. The emission figures in the time-series 1985-2007 are given in Annex 2.B.15 (NFR format) and are shown for 2007 in Annex 2.B.14 (CollectER format).

From 1985 to 2007, the road transport emissions of SO_2, NO_X, NMVOC, CO and PM (all size fractions) have decreased by 99, 30, 75, 72 and 33 %, respectively (Figures 3.28-3.32), whereas the NH_3 emissions have increased by 2805 % during the same time period (Figure 3.33).

For other mobile sources, the emission changes for SO_2, NO_X, NMVOC, CO and PM (all size fractions) are -90, -21, -14, -8 and -59 %, respectively (Figures 3.35-3.39). The NH_3 emissions have increased by 13 % during the same time period (Figure 3.40).

Table 3.18 Emissions of SO_2, NO_X, NMVOC, CO NH_3, TSP, PM_{10} and $PM_{2.5}$ in 2007 for road transport and other mobile sources.

NFR ID	SO_2 [tons]	NO_x [tons]	NMVOC [tons]	CO [tons]	NH_3 [tons]	TSP [tons]	PM_{10} [tons]	$PM_{2.5}$ [tons]
Industry-Other (1A2f)	32	10 654	1 497	7 378	3	937	937	937
Civil Aviation (1A3a)	34	498	153	870	0	3	3	3
Railways (1A3c)	1	3 555	231	629	1	120	120	120
Navigation (1A3d)	838	5 929	1 087	6 573	0	257	256	255
Residential (1A4b)	1	288	8 101	89 398	0	80	80	80
Agri./for./fish. (1A4c)	518	18 180	2 407	16 677	3	1 015	1 014	1 013
Military (1A5)	40	771	73	546	0	20	20	20
Total other mobile	1 465	39 875	13 548	122 071	8	2 432	2 429	2 428
Road (1A3b)	83	64 485	20 364	155 084	1 791	2 957	2 957	2 957
Total mobile	1 548	104 360	33 912	277 155	1 799	5 389	5 387	5 385

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 3.28). In 1999, the sulphur content was reduced from 500 ppm to 50 ppm (reaching gasoline levels), and for both gasoline and diesel the sulphur content was reduced to 10 ppm in 2005. Since Danish diesel and gasoline fuels have the same sulphur percentages, at present, the 2007 shares for SO_2 emissions and fuel use for passenger cars, heavy-duty vehicles, light-duty vehicles and 2-wheelers are the same in each case: 52, 26, 21 and 1 %, respectively (Figure 3.34).

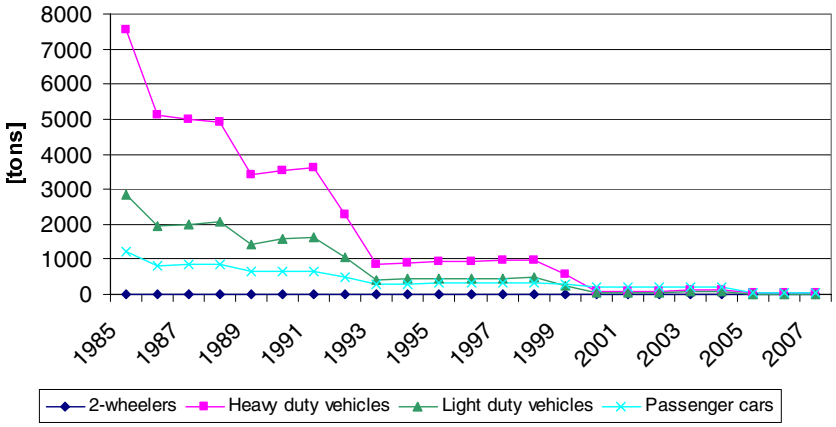

Figure 3.28 SO_2 emissions (tonnes) pr vehicle type for road transport 1985-2007.

Historically, the emission totals of NMVOC and CO have been very dominated by the contributions coming from private cars, as shown in Figures 3.30-3.31. However, the NMVOC and CO (and NO_x) emissions from this vehicle type have shown a steady decreasing tendency since the introduction of private catalyst cars in 1990 (EURO I) and the introduction of even more emission-efficient EURO II, III and IV private cars (introduced in 1997, 2001 and 2006, respectively).

In the case of NO_x, the real traffic emissions for heavy duty vehicles do not 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 (Figure 3.29).

Exhaust particulate emissions from road transportation vehicles are well below $PM_{2.5}$. The emissions from light- and heavy-duty vehicles have significantly decreased since the mid-1990s due to gradually stricter EURO emission standards. The environmental benefit of introducing diesel private cars with lower particulate emissions since 1990 is more than outbalanced by an increase in sales of new vehicles in recent years (Figure 3.32).

An undesirable environmental side effect of the introduction of catalyst cars is the increase in the emissions of NH_3 from the first two generations of catalyst cars (Euro I and II) compared to conventional cars. The emission factors for later catalytic converter technologies are considerably lower than the ones for Euro I and II, thus causing the emissions to decrease from 2001 onwards (Figure 3.30).

The 2007 emission shares for heavy-duty vehicles, passenger cars, light-duty vehicles and 2-wheelers for NO_x (53, 30, 17 and 0 %), NMVOC (7, 67, 9 and 17 %), CO (5, 76, 7, 12 %), PM (30, 41, 27 and 2 %) and NH_3 (1, 96, 3 and 0 %), are also shown in Figure 3.34.

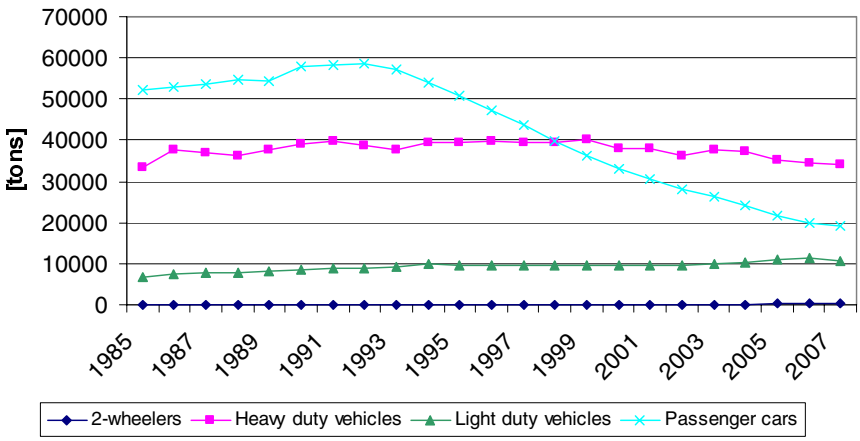

Figure 3.29 NO_x emissions (tonnes) pr vehicle type for road transport 1985-2007.

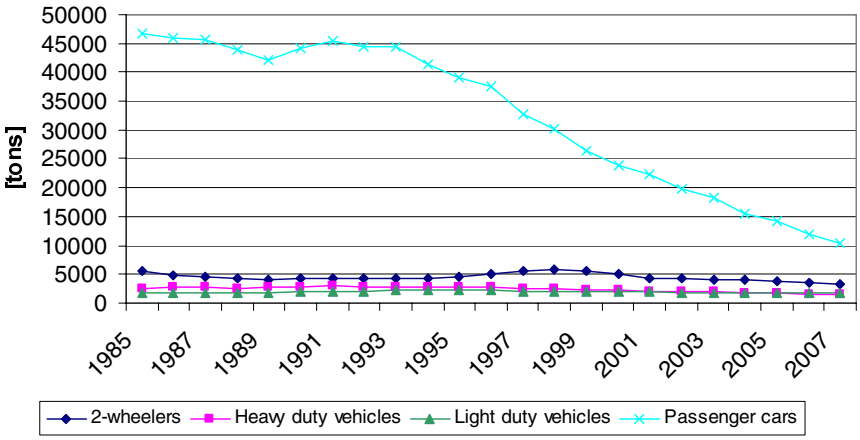

Figure 3.30 NMVOC emissions (tonnes) pr vehicle type for road transport 1985-2007.

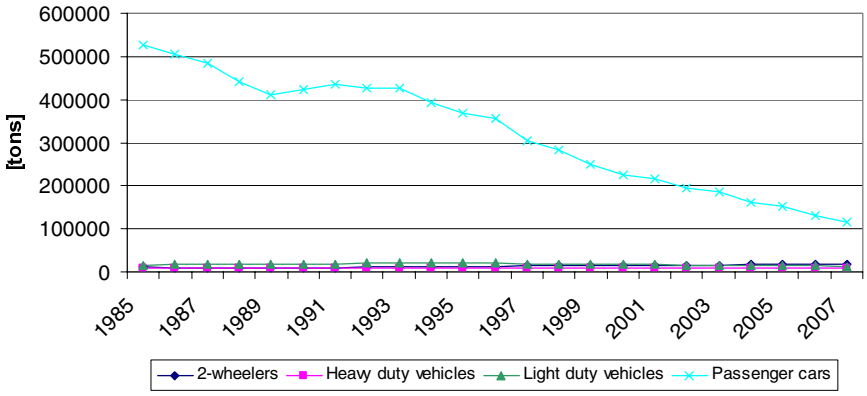

Figure 3.31 CO emissions (tonnes) pr vehicle type for road transport 1985-2007.

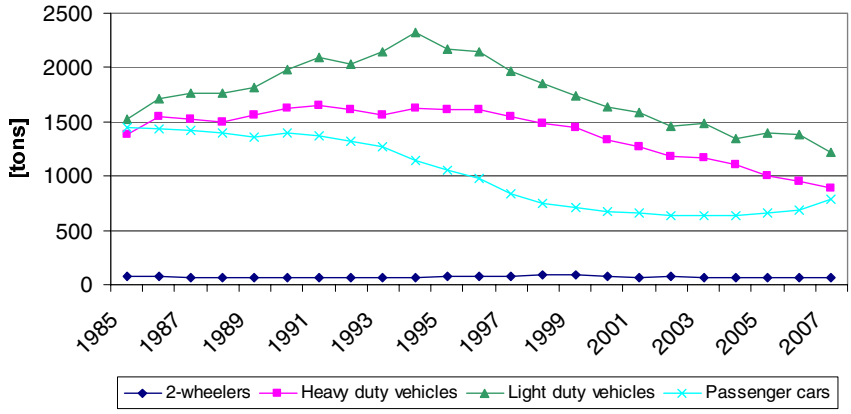

Figure 3.32 PM emissions (tonnes) pr vehicle type for road transport 1985-2007.

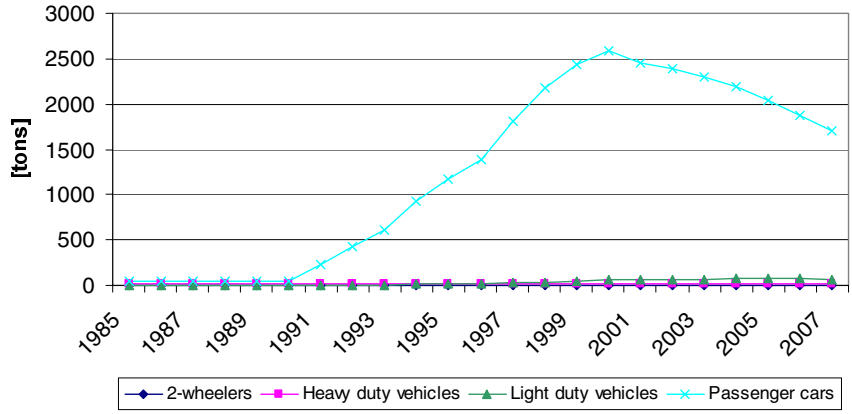

Figure 3.33 NH_3 emissions (tonnes) pr vehicle type for road transport 1985-2007.

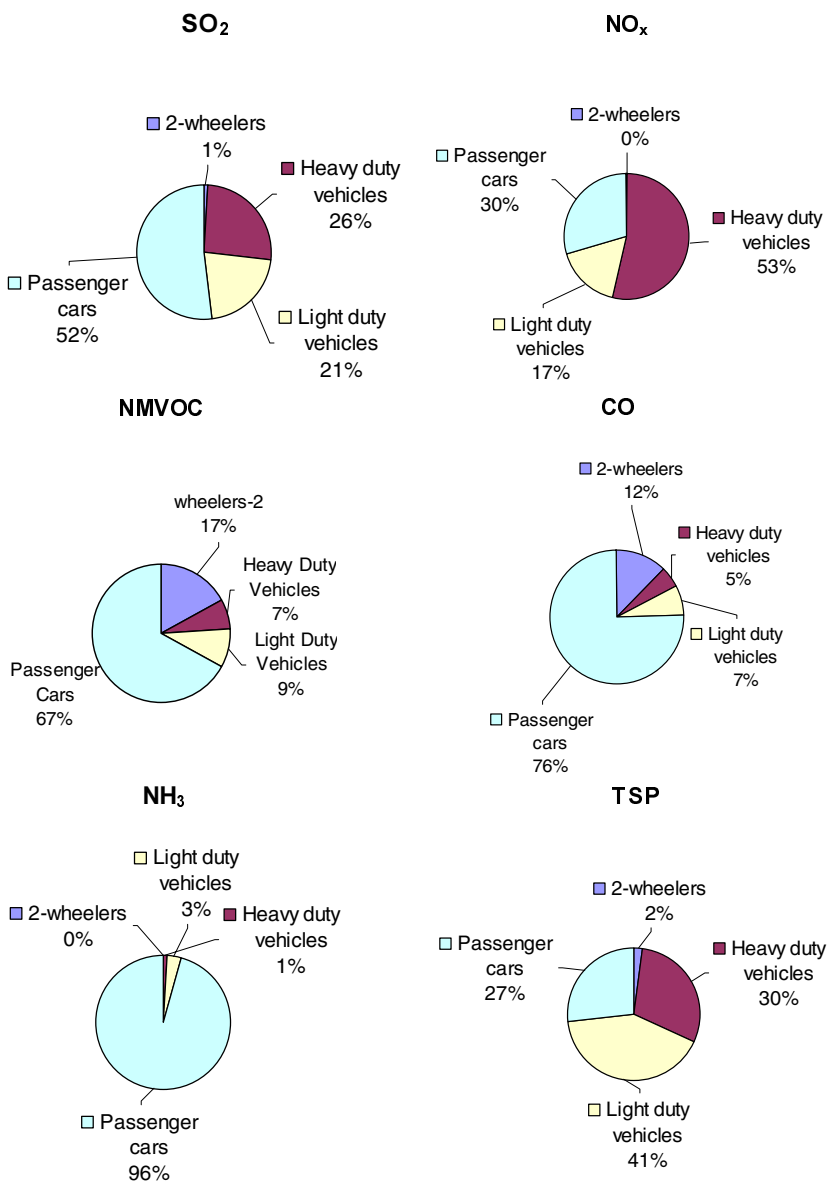

Figure 3.34 SO_2, NO_X, NMVOC, CO, NH_3 and PM emission shares pr vehicle type for road transport in 2007.

Other mobile sources

For SO_2 the trends in the Navigation (1A3d) emissions shown in Figure 3.35 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.

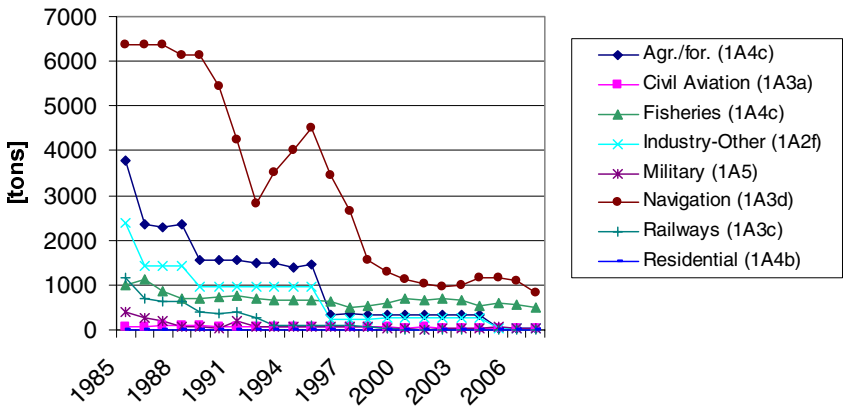

Figure 3.35 SO_2 emissions (k-tonnes) in NFR sectors for other mobile sources 1985-2007.

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

NO_X emissions mainly come from diesel machinery, and the most important sources are Agriculture/forestry/fisheries (1A4c), Industry (1A2f), Navigation (1A3d) and Railways (1A3c), as shown in Figure 3.34. The 2007 emission shares are 45, 27, 15 and 9 %, respectively (Figure 3.37). 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 use fluctuations for these sectors, and the development of emission factors. For ship engines the emission factors tend to increase for new engines until mid-1990s. After that, the emission factors gradually reduce until 2000, bringing them to a level comparable with the emission limits for new engines in this year. For agricultural machines, there have been somewhat higher NO_x emission factors for 1991-stage I machinery, and an improved emission performance for stage I and II machinery since the late 1990s.

The emission development for industry NO_x is the product of a slight fuel-use increase from 1985 to 2007 and a development in emission factors as explained for agricultural machinery. For railways, the gradual shift towards electrification explains the declining trend in diesel fuel use and NO_X emissions for this transport sector until 2001.

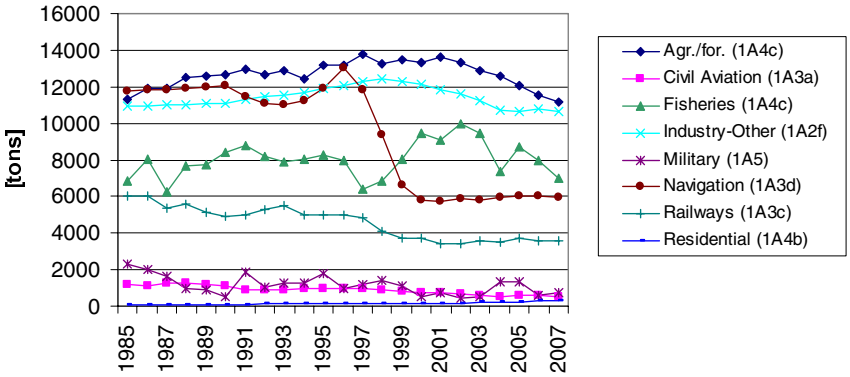

Figure 3.36 NO_X emissions (tonnes) in NFR sectors for other mobile sources 1985-2007.

The 1985-2007 time-series of NMVOC and CO emissions are shown in Figures 3.35 and 3.36 for other mobile sources. The 2007 sector emission shares are shown in Figure 3.41. For NMVOC, the most important sectors are Residential (1A4b), Agriculture/forestry/fisheries (1A4c), Industry (1A2f) and Navigation (1A3d), with 2007 emission shares of 59, 18, 11 and 8 %, respectively. The same four sectors also contribute with most of the CO emissions in the same consecutive order; the emission shares are 73, 14, 6 and 5 %, respectively. Minor NMVOC and CO emissions come from Railways (1A3c), Civil Aviation (1A3a) and Military (1A5).

For NMVOC and CO, the significant emission increases for the residential sector after 2000 are due to the increased number of gasoline working machines. Improved NMVOC emission factors for diesel machinery in agriculture and gasoline equipment in forestry (chain saws) are the most important explanations for the NMVOC emission decline in the Agriculture/forestry/fisheries sector. This explanation also applies for the industrial sector, which is dominated by diesel-fuelled machinery. From 1997 onwards, the NMVOC emissions from Navigation decrease due to the gradually phase-out of the 2-stroke engine technology for recreational craft. The main reason for the significant 1985-2006 CO emission decrease for Agriculture/forestry/fisheries is the phasing out of gasoline tractors.

As shown in Figure 3.41, for other mobile sources the largest TSP contributors in 2007 are Agriculture/forestry/fisheries (1A4c), Industry (1A2f) and Navigation (1A3d), with emission shares of 42, 38 and 11 %, respectively. The remaining sectors: Railways (1A3c), Civil aviation (1A3a), Military (1A5) and Residential (1A4b) represent only minor emission sources.

The 1985-2007 TSP emissions for navigation and fisheries are determined by the fuel use fluctuations in these years, and the development of the emission factors, which to a major extent is a function of the fuel sulphur content. The emission development for Agriculture/forestry is determined by the generally decreasing total diesel fuel use and gradually reducing emission factors over the time period.

The TSP emission development for industrial non-road machinery is the product of a slight fuel use increase from 1985 to 2007 and a development in emission factors, as explained for agricultural machinery.

The TSP emission explanations for railways are the same as for NO_x (Figure 3.36).

The amounts of NH_3 emissions calculated for other mobile sources are very small. The largest emission sources are Agriculture/forestry-/fisheries (1A4c), Industry (1A2f) and Railways (1A3c), with emission shares of 43, 35 and 8 %, respectively.

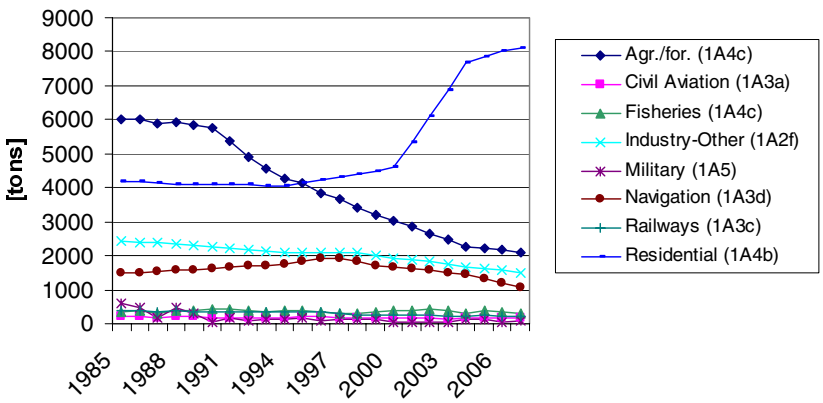

Figure 3.37 NMVOC emissions (tonnes) in NFR sectors for other mobile sources 1985-2007.

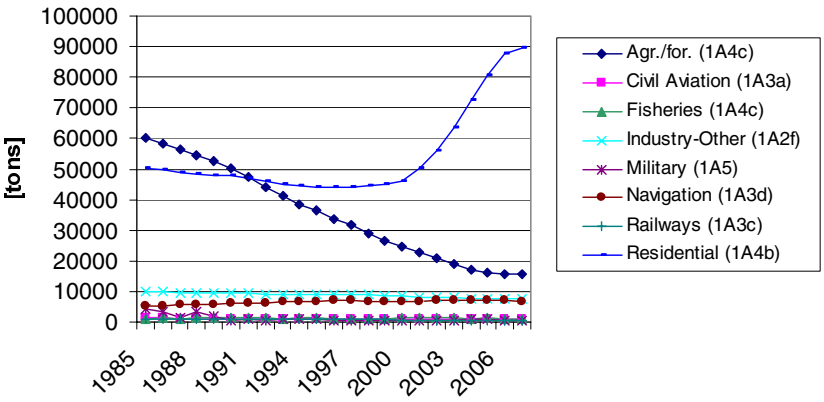

Figure 3.38 CO emissions (tonnes) in NFR sectors for other mobile sources 1985-2007.

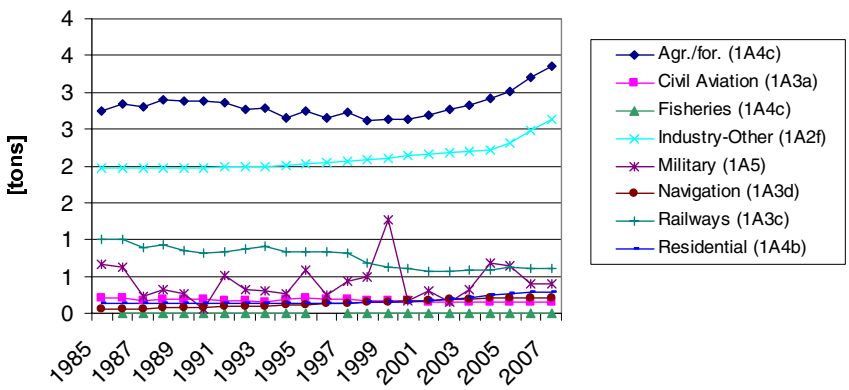

Figure 3.39 NH_3 emissions (tonnes) in NFR sectors for other mobile sources 1985-2007.

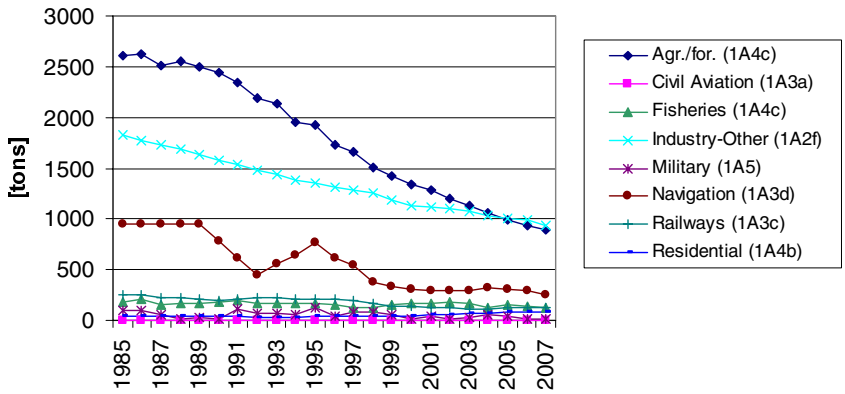

Figure 3.40 TSP emissions (tonnes) in NFR sectors for other mobile sources 1985-2007.

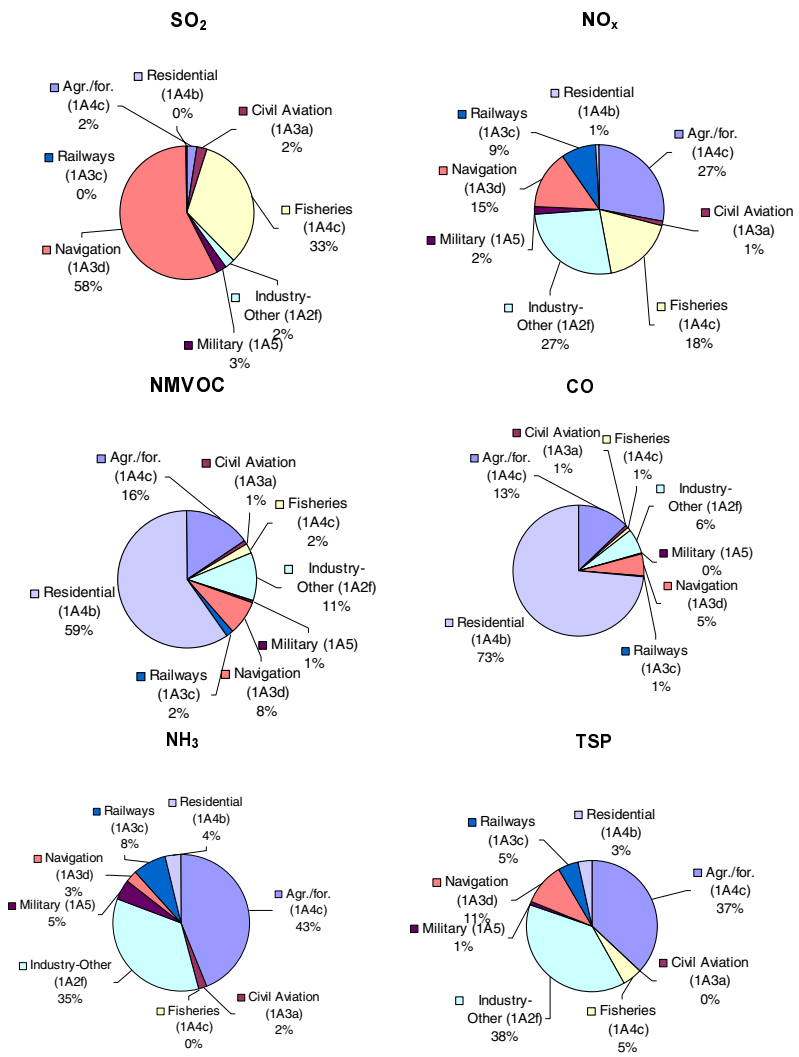

Figure 3.41 SO_2, NO_X, NMVOC, CO, NH_3 and PM emission shares pr vehicle type for other mobile sources in 2007.

Non-exhaust emissions of TSP, PM_{10} and $PM_{2.5}$

Apart from the exhaust emission estimates of particulate matter (PM), the Danish emission inventories also comprise the non-exhaust PM emissions coming from road transport brake and tyre wear, and road abrasion.

In Table 3.19, the non-exhaust TSP, PM_{10} and $PM_{2.5}$ emissions for road transport are shown for 2007 in NFR sectors. The activity data, emission factors are also shown in Annex 2.B.14.

Table 3.19 Emissions of TSP, PM_{10} and $PM_{2.5}$ in 2007 from road transport and other mobile sources.

NFR Sector	TSP [tonnes]	PM_{10} [tonnes]	$PM_{2.5}$ [tonnes]
Road brake wear	654	641	255
Road tyre wear	1007	604	423
Road abrasion	1144	572	309
Total Road non-exhaust	2805	1817	987

The respective source category distributions for TSP, PM_{10} and $PM_{2.5}$ emissions are identical for each of the non-exhaust emission type's brake wear, tyre wear and road abrasion, and, hence, only the PM_{10} distributions are shown in Figure 3.42. For brake and tyre wear, passenger cars caused the highest emissions in 2007, followed by light-duty vehicles, trucks, buses and 2-wheelers. Trucks cause higher road abrasion emissions than light-duty vehicles, but apart from this, the size order of emission sources is the same as for brake and tyre wear.

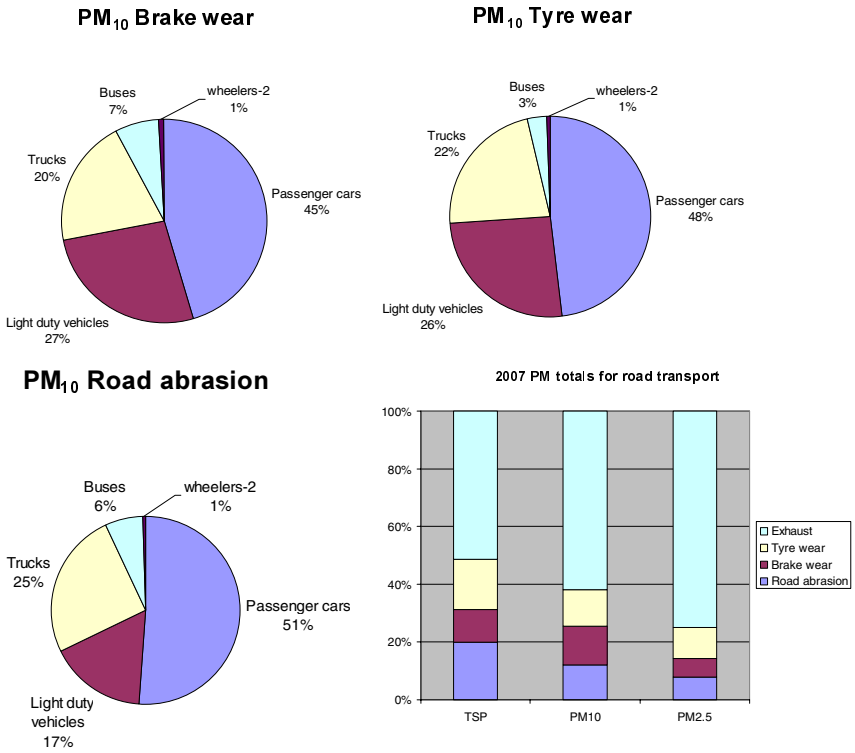

Figure 3.42 Brake and tyre wear and road abrasion PM_{10} emission shares and PM exhaust/non-exhaust distributions for road traffic in 2007.

Figure 3.42 also shows the exhaust/non-exhaust distribution of the total particulate emissions from road transport, for each of the size classes TSP, PM_{10} and $PM_{2.5}$. The exhaust emission shares of total road transport TSP, PM_{10} and $PM_{2.5}$ are 51, 62 and 75 %, respectively, in 2007. For brake and tyre wear and road abrasion the TSP shares are 11, 17 and 20 %, respectively. The same three sources have PM_{10} shares of 13, 13 and 12 %, respectively, and $PM_{2.5}$ shares of 6, 11 and 8 %, respectively. In

general, the non-exhaust shares of total particulate emissions are expected to increase in the future as total exhaust emissions decline. The latter emission trend is due to the stepwise strengthening of exhaust emission standards for all vehicle types.

Heavy metals

In Table 3.20, the heavy metal emissions for road transport and other mobile sources are shown for 2006 in NFR sectors. The emission figures in the time-series 1990-2006 are given in Annex 2.B.15 (NFR format) and are shown for 1990 and 2006 in Annex 2.B.14 (CollectER format).

Table 3.20 Heavy metal emissions in 2005 for road transport and other mobile sources.

NFR Sector	As [kg]	Cd [kg]	Cr [kg]	Cu [kg]	Hg [kg]	Ni [kg]	Pb [kg]	Se [kg]	Zn [kg]
Industry-Other (1A2f)		3	16	549		23	0	3	323
Civil Aviation (1A3a)	0	0	2	57	0	2	1329	0	34
Railways (1A3c)		1	4	122		5		1	72
Navigation (1A3d)	12	2	8	67	5	456	13	26	94
Residential (1A4b)		1	4	123		5	2	1	73
Agri./for./fish. (1A4c)	6	5	24	642	6	35	12	28	435
Military (1A5)	0	1	3	94	0	4	81	1	55
Total other mobile	18	12	60	1655	11	530	1437	59	1085
Road (1A3b)		42	208	7075		291	52	42	4162
Total mobile	18	54	268	8730	11	821	1489	100	5247

The road transport emissions of Cd, Cr, Cu and Zn account for around two thirds of the total for all mobile sources in 2007. No road transport emissions occur for As and Hg. Instead, the emissions of these species come from the use of marine diesel oil and residual oil in fisheries and navigation. The latter sector also contributes with a high emission of Ni (from residual oil), whereas the Se emission comes from agriculture/forestry/fisheries, road transport and navigation, in almost equal shares. The Figures 3.43 and 3.44 show the heavy metal emission distributions into vehicle categories and other mobile sectors, respectively.

The heavy metal emission factors are fuel related, and are taken from the EMEP/CORINAIR guidebook. The emission factors are constant throughout the 1990-2007 periods, except for Pb where national data exists. For road transport, the emission factors for Cd, Cu, Ni, Se and Zn are the same for gasoline and diesel, and hence the emission distributions between vehicle categories are the same as for total fuel consumption contribution. The emission distributions for Cr and Pb are caused by higher emission factors for gasoline than for diesel (Cr), and no diesel related emissions (for Pb).

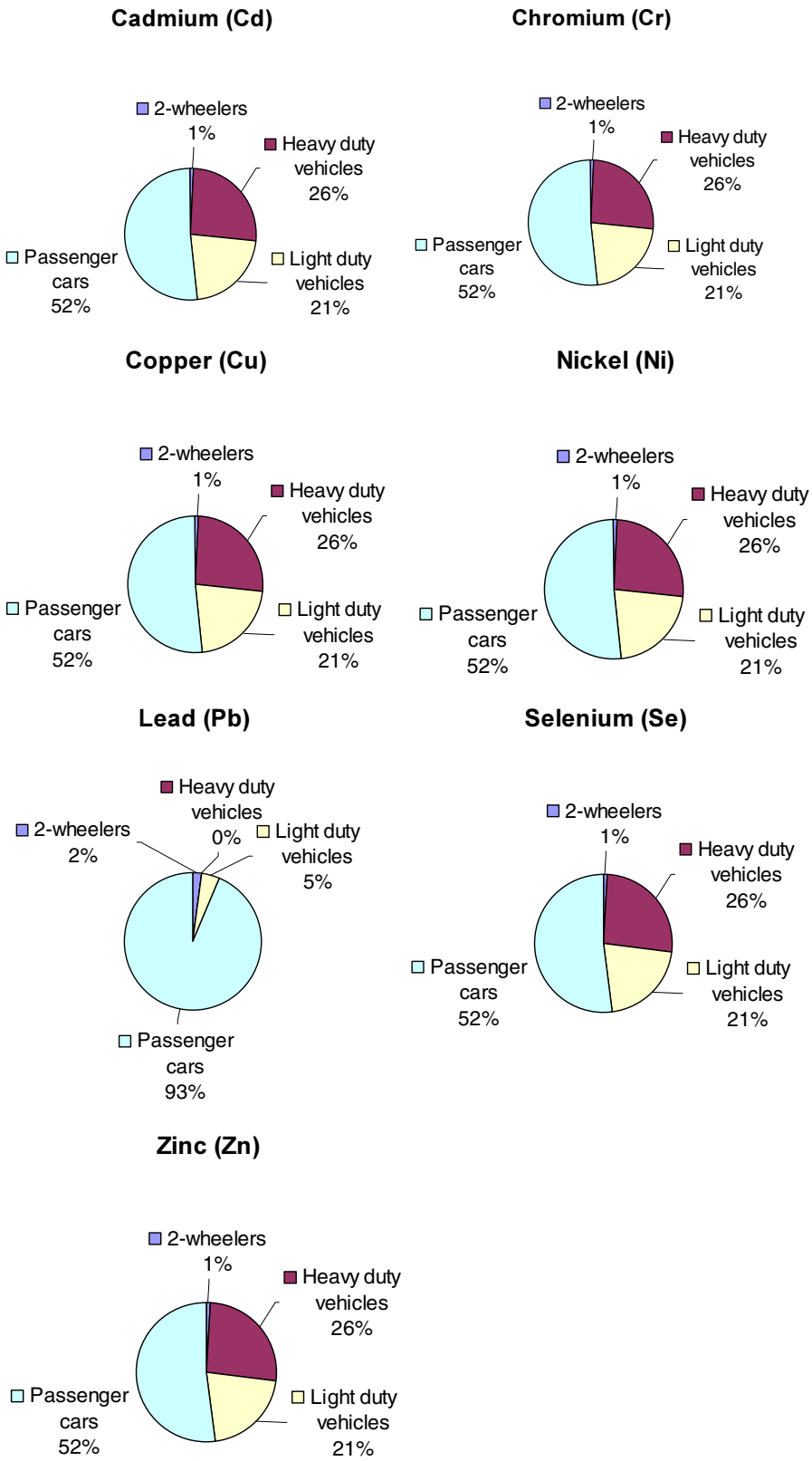

Figure 3.43 Heavy metal emission shares for road transport in 2007.

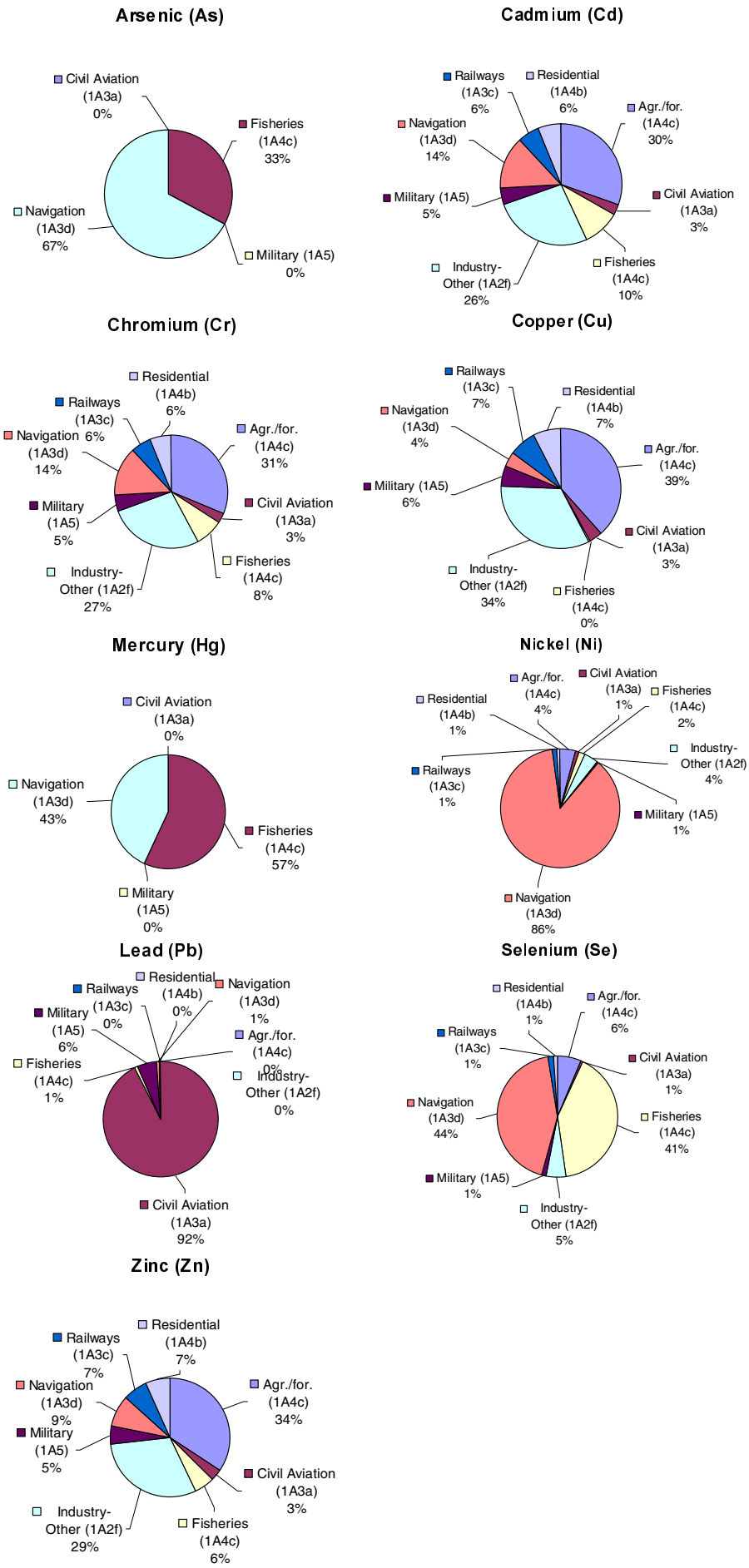

Figure 3.44 Heavy metal emission shares for other mobile sources in 2007

Since the heavy metal emission factors (except Pb) are constant throughout the 1990-2007 periods, as a consequence, the emission development follows the trends in fuel use. The road transport emissions have increased by 42 % from 1990 to 2007. For Pb, however, there has been an almost 100 % emission decline, due to the phasing out of leaded gasoline fuels in 1994 (Figure 3.45).

For other mobile sources, heavy metal emissions generally decrease throughout the time period. The fuel quality of the gasoline used by road transportation vehicles and non road engines is the same, and hence a large decrease in Pb emissions (77 %) is calculated for other mobile sources also. In absolute figures, the largest emission declines are noted for the main gasoline fuel consumers, household and gardening equipment and recreational craft. In addition, from 1990 to 2007, gasoline fuel use reached zero for agricultural tractors. Lead is added to aviation gasoline used by piston engine aircraft, causing Civil aviation (1A3a) to be the largest mobile source of Pb emissions (Figure 3.46). The 82 % decline in Ni emissions is due to lower residual fuel use in navigation.

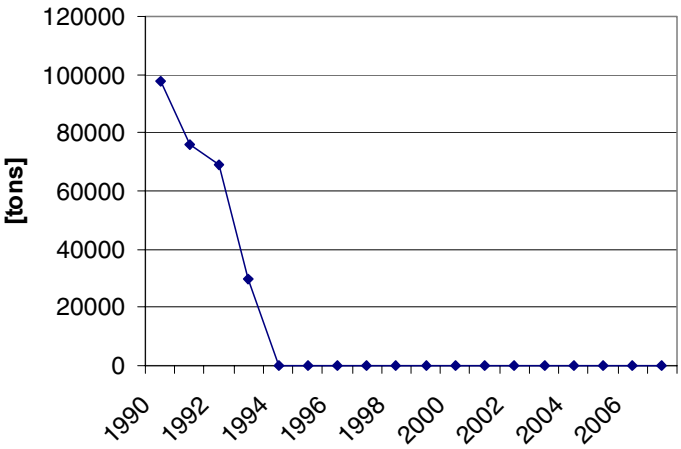

Figure 3.45 Pb emissions (kg) in NFR sectors for road transport 1990-2007.

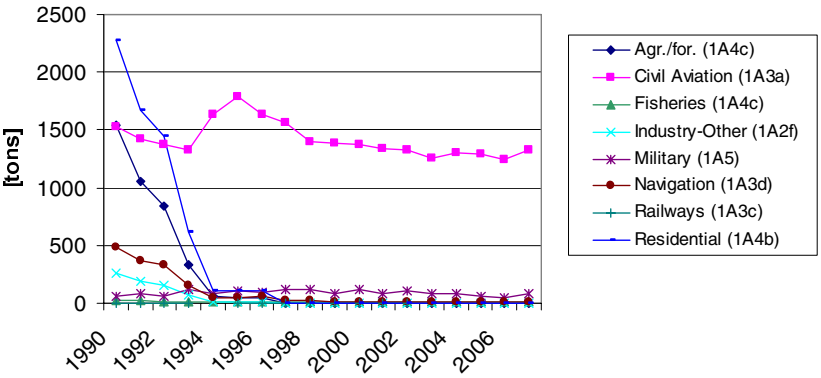

Figure 3.46 Pb emissions (kg) in NFR sectors for other mobile sources 1990-2007.

Dioxin and PAH

In Table 3.21, the dioxin and PAH emissions for road transport and other mobile sources are shown for 2007 in NFR sectors. The emission figures in the time-series 1990-2007 are given in Annex 2.B.15 (NFR format) and are shown for 1990 and 2007 in Annex 2.B.14 (CollectER format).

Table 3.21 Dioxin and PAH emissions in 2007 for road transport and other mobile sources.

NFR ID	Dioxins/ Furans	Flouran-thene	Benzo(b) flouranthene	Benzo(k) flouranthene	Benzo(a) pyrene	Benzo(g,h,i) perylene	Indeno (1,2,3-c,d) pyrene
	[g]	[kg]	[kg]	[kg]	[kg]	[kg]	[kg]
Industry-Other (1A2f)	0,01	60	7	7	4	6	4
Civil Aviation (1A3a)	0,00	0	0	0	0	0	0
Railways (1A3c)	0,00	4	1	1	0	0	0
Navigation (1A3d)	0,06	40	3	2	1	7	5
Residential (1A4b)	0,02	14	1	0	0	2	1
Agri./for./fish. (1A4c)	0,08	108	11	9	5	15	10
Military (1A5)	0,00	3	0	0	0	0	0
Total other mobile	0,17	229	24	20	10	31	20
Road (1A3b)	0,18	792	74	84	58	111	63
Total mobile	0,34	1021	98	103	68	142	84

For mobile sources, road transport displays the largest emission of dioxins and PAH. The dioxin emission share for road transport is 52 % of all mobile emissions in 2007, whereas Agriculture/forestry/fisheries and Navigation have smaller shares of 22 and 17 %. For the different PAH components, road transport shares are around 80 % of total emissions for mobile sources. The remaining emissions almost solely come from Agriculture/forestry-/fisheries, Navigation and Industry with Agriculture/forestry/fisheries as the largest source.

Figures 3.47 and 3.48 show the dioxin and PAH emission distributions into vehicle categories and other mobile sectors, respectively.

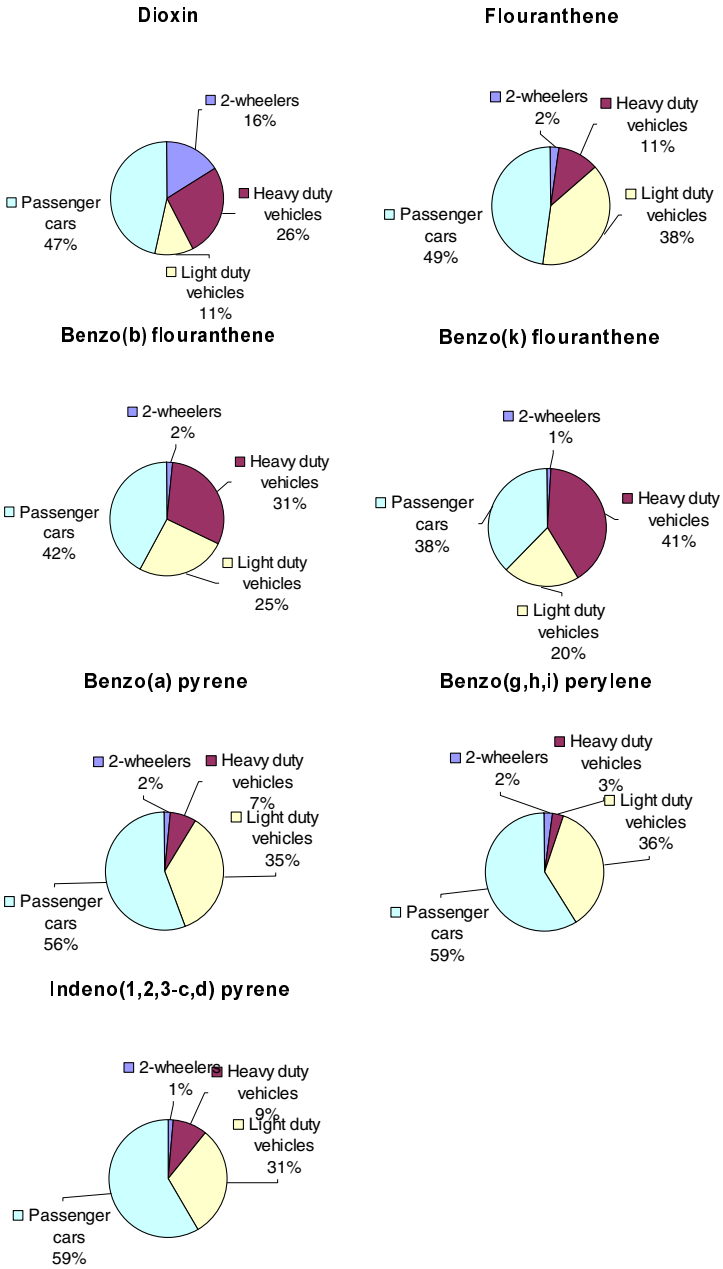

Figure 3.47 Dioxin and PAH emission shares for road transport in 2007.

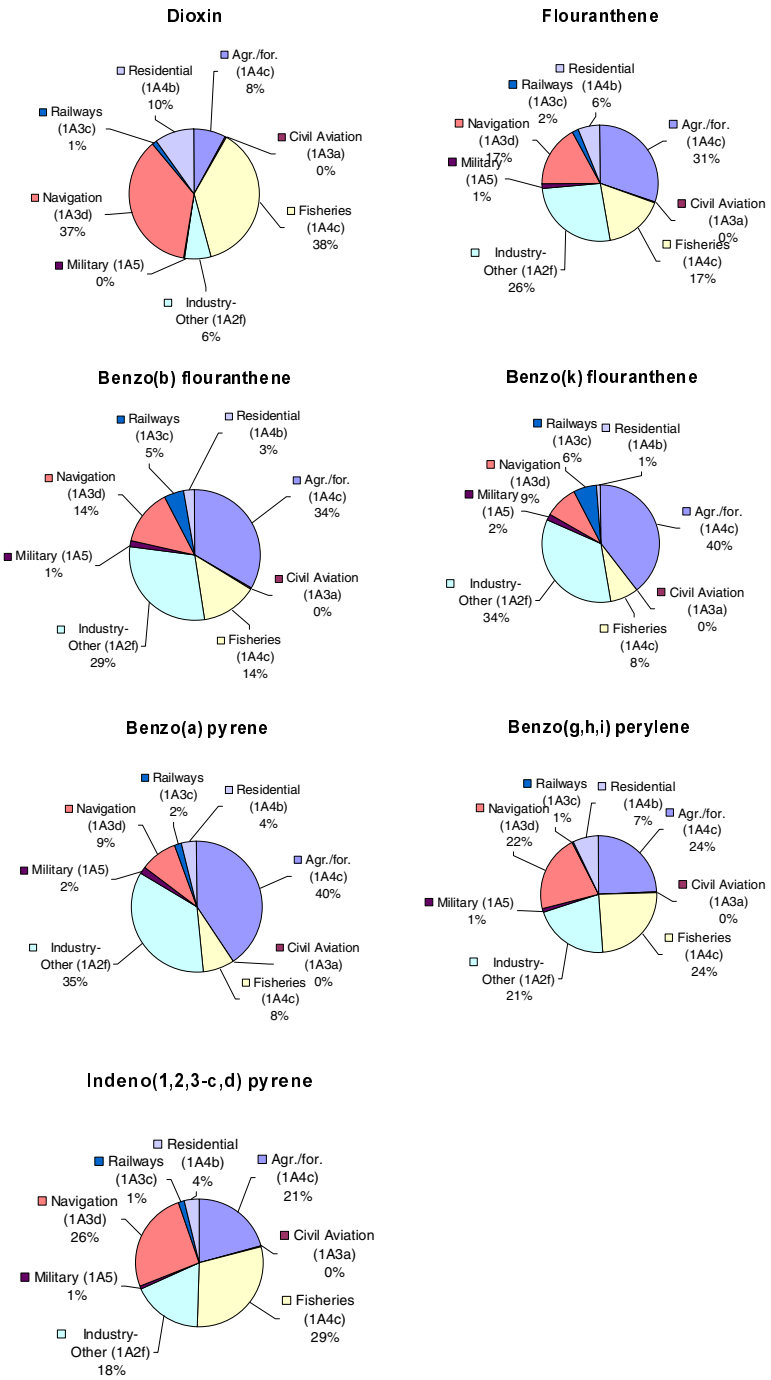

Figure 3.48 Dioxin and PAH emission shares for other mobile sources in 2007.

Bunkers

The most important emissions from bunker fuel use (fuel use 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 Table 3.22 for 2007, split into sea transport and civil aviation. All emission figures in the 1985-2007 time-series are given in Annex 2.B.16 (NFR format). In Annex 2.B.14, the emissions are also given in CollectER format for 2007.

Table 3.22 Emissions in 2007 for international transport and national totals.

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

The differences in emissions between navigation and civil aviation are much larger than the differences in fuel consumption (and derived CO_2 emissions), and display a poor emission performance for international sea transport. In broad terms, the emission trends shown in Figure 3.49 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).

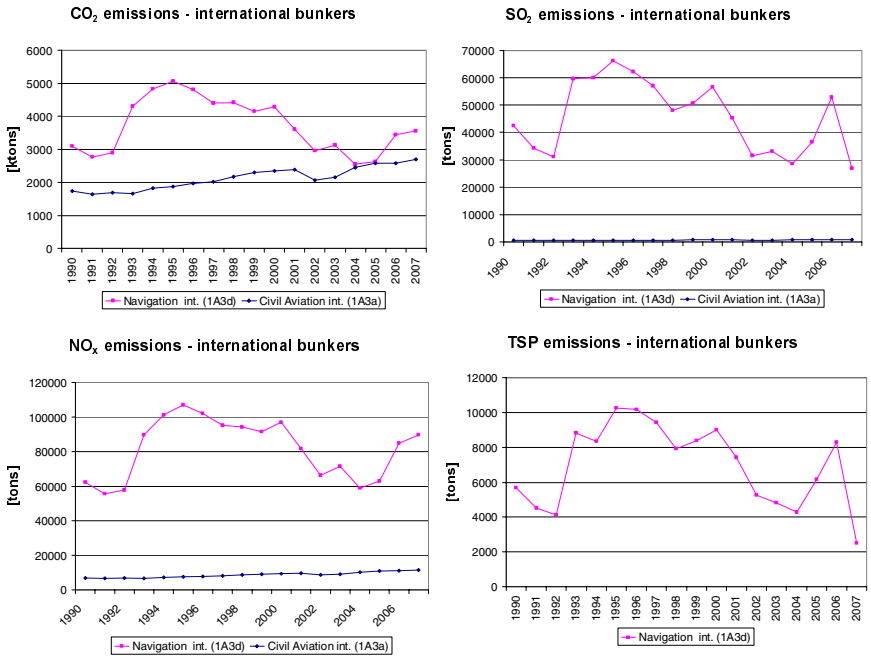

Figure 3.49 CO_2, SO_2, NO_X and TSP emissions for international transport 1990-2007.

3.3.2 Methodological issues

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

Methodology and references for Road Transport

For road transport, the detailed methodology is used to make annual estimates of the Danish emissions, as described in the EMEP/CORINAIR Emission Inventory Guidebook (EMEP/CORINAIR, 2007). The actual calculations are made with a model developed by NERI, using the European COPERT III model methodology, and updated fuel use and emission factors from the latest version of COPERT - COPERT IV. The

latter model approach is explained in (EMEP/CORINAIR, 2007). In COPERT, fuel use and emission simulations can be made for operationally hot engines, taking into account gradually stricter emission standards and emission degradation due to catalyst wear. Furthermore, the emission effects of cold-start and evaporation are simulated.

Vehicle fleet and mileage data

Corresponding to the COPERT III fleet classification, all present and future vehicles in the Danish fleet are grouped into vehicle classes, sub-classes and layers. The layer classification is a further division of vehicle sub-classes into groups of vehicles with the same average fuel use and emission behaviour, according to EU emission legislation levels. Table 3.23 gives an overview of the different model classes and sub-classes, and the layer level with implementation years are shown in Annex 2.B.1.

Table 3.23 Model vehicle classes and sub-classes, trip speeds and mileage split.

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

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

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

Denmark (2008), and data are split into vehicle categories-first registration years, by using the 2004 distribution matrix.

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

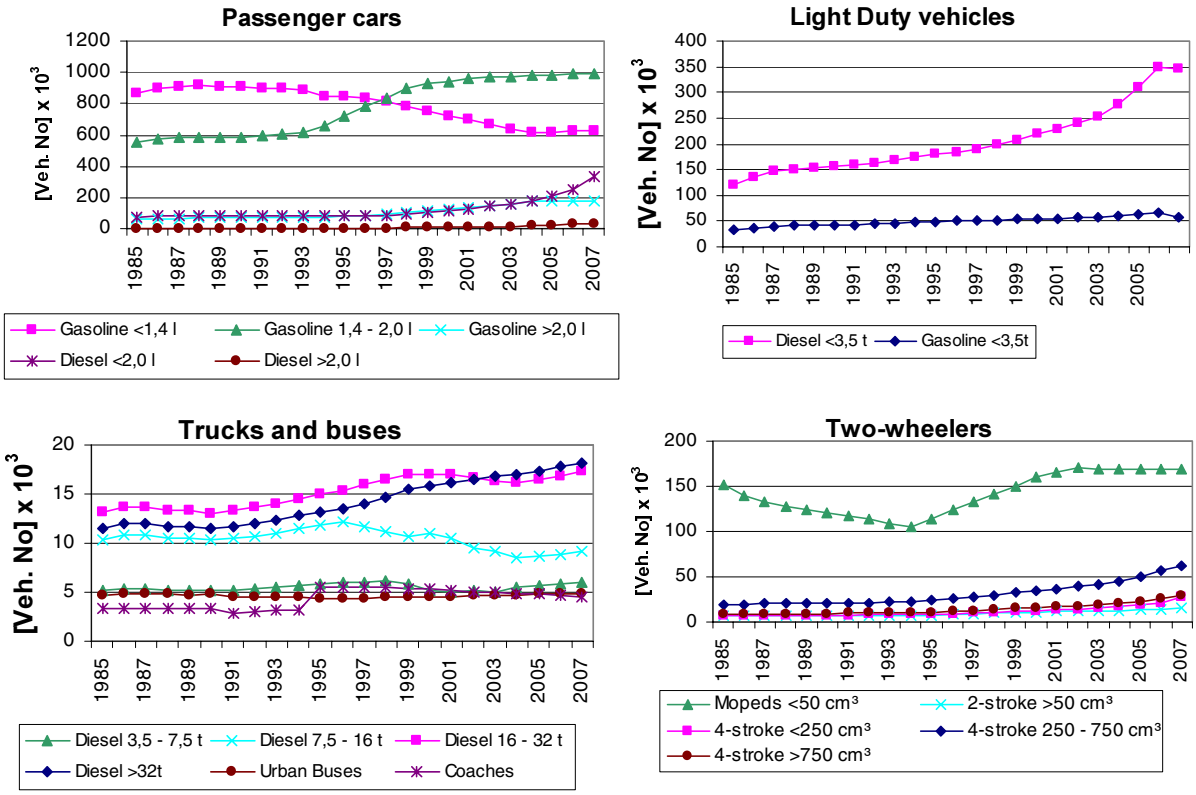

Figure 3.50 Number of vehicles in sub-classes in 1985-2007.

The vehicle numbers pr sub-class are shown in Figure 3.50. It must be noted that for 2005-2007, the 2004 stock shares are used to distribute the fleet into the different vehicle sub-categories for passenger cars and heavy duty trucks. Consequently, it gives less meaning to explain the fleet curves beyond 2004 for these vehicle types.

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

There has been a considerable growth in the number of diesel light-duty vehicles from 1985 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 1985 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 1985-2007 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 3.51) by using the correspondence between layers and first year of registration:

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

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

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

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

For heavy duty trucks, there is a slight deviation from the strict correspondence between EU emission layers and first registration year. In this case, specific information from the Danish Car Importers Association (Danske Bilimportører, DBI) of the Euro level for the trucks sold in Denmark between 2001 and 2007, is used to estimate a percentage new sales/Euro level matrix for truck engines for these inventory years. A full new sales matrix covering all relevant inventory years is subsequently made, based on a broader view of the 2001-2007 DBI data, and taking into account the actual starting dates for Euro 0-6 engines, see Annex 2.B.16.

Vehicle numbers and weighted annual mileages pr layer are shown in Annex 2.B.1 and 3.B.2 for 1985-2006. The trends in vehicle numbers pr layer are also shown in Figure 3.51. The latter figure shows how vehicles complying with the gradually stricter EU emission levels (EURO I, II, III, IV etc.) have been introduced into the Danish motor fleet.

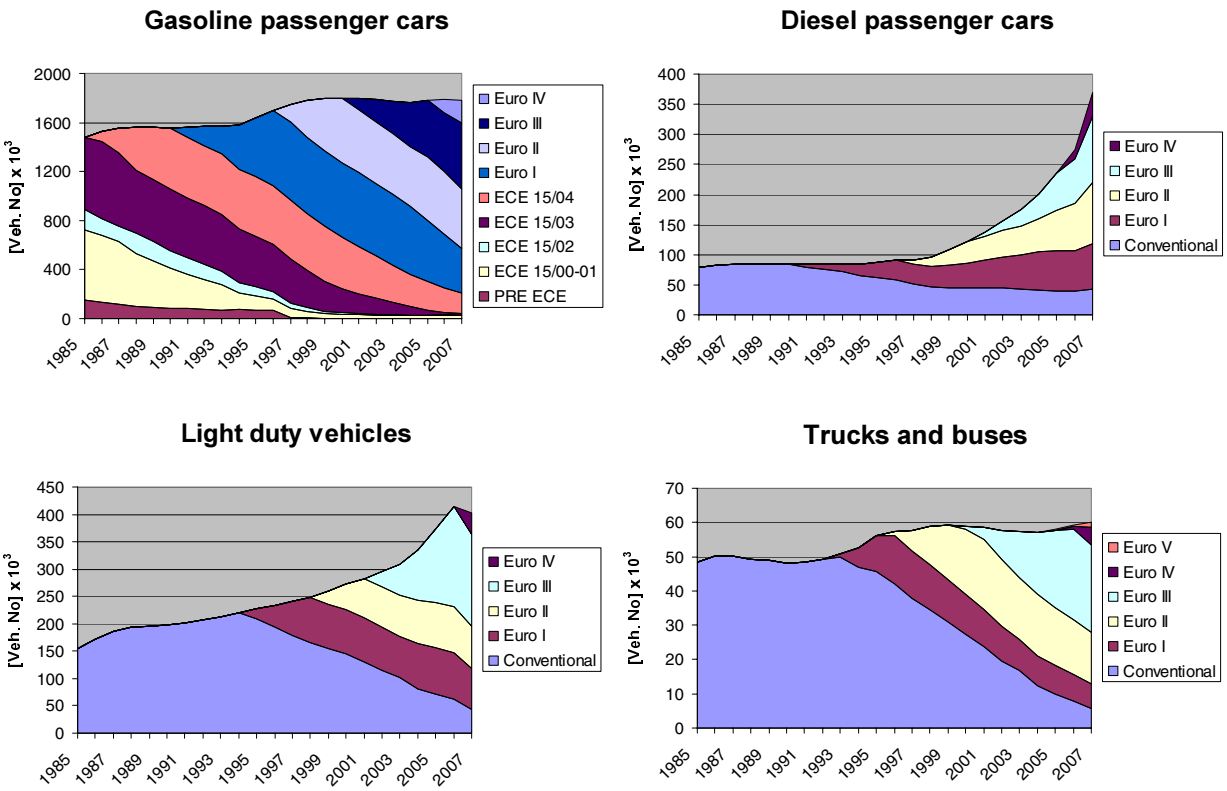

Figure 3.51 Layer distribution of vehicle numbers pr vehicle type in 1985-2007.

Emission legislation

For Euro 1-4 passenger cars and light duty trucks, the chassis dynamometer test cycle used in the EU for emission approval is the NEDC (New European Driving Cycle), see Nørgaard and Hansen (2004). The test cycle is also used also for fuel use measurements. 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[6] (average speed: 19 km pr h). The second part of the test is the run-through of the EUDC (Extra Urban Driving Cycle) test driving segment, simulating the fuel use under rural and highway driving conditions. The driving length of EUDC is 7 km at an average speed of 63 km pr h. More information regarding the fuel measurement procedure can be found in the EU-directive 80/1268/EØF.

For NOx, VOC (NMVOC + CH4), CO and PM, the emissions from road transport vehicles have to comply with the different EU directives listed in Table 3.24. The emission directives distinguish between three vehicle classes according to vehicle reference mass[7]: 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 2.B.3.

[6] 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.

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

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 use and emission data for cold-start emission calculations and gasoline evaporation (hydrocarbons).

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

In terms of the sulphur content in the fuels used by road transportation vehicles, the EU directive 2003/17/EF describes the fuel quality standards agreed by the EU. In Denmark, the sulphur content in gasoline and diesel was reduced to 10 ppm in 2005, by means of a fuel tax reduction for fuels with 10 ppm sulphur contents.

Table 3.24 Overview of the existing EU emission directives for road transport vehicles.

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

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

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

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 3.23. The factors are listed in Annex 2.B.4. For EU emission levels not represented by actual data, the emission factors are scaled according to the reduction factors given in Annex 2.B.5.

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

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

The experimental basis for heavy-duty trucks and buses is updated computer simulated emission factors for Euro 0-V engines. In COPERT IV the number of heavy duty vehicle categories has increased substantially, and from the traffic data side it is not possible to support all these new vehicle categories with consistent fleet and mileage data. Thus, the COPERT III vehicle size classification still remains as the Danish inventory basis for heavy duty vehicles.

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

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

Deterioration factors

For three-way catalyst cars the emissions of NO_X, NMVOC and CO gradually increase due to catalyst wear and are, therefore, modified as a function of total mileage by the so-called deterioration factors. Even though the emission curves may be serrated for the individual vehicles, on average, the emissions from catalyst cars stabilise after a given cut-

off mileage is reached due to OBD (On Board Diagnostics) and the Danish inspection and maintenance programme.

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

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

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

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

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

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

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

where DF is the deterioration factor.

For N_2O and NH_3, COPERT IV takes into account deterioration as a linear function of mileage for gasoline fuelled EURO 1-4 passenger cars and light duty vehicles. The level of emission deterioration also relies on the content of sulphur in the fuel. The deterioration coefficients are given in EMEP/CORINAIR (2007), for the corresponding layer. A cut-off mileage of 120.000 km (pers. comm. Ntziachristos, 2007) is behind the calculation of the modified emission factors, and for the Danish situation the low sulphur level interval is assumed to be most representative.

Emissions and fuel consumption for hot engines

Emissions and fuel-use results for operationally hot engines are calculated for each year and for layer and road type. The procedure is to combine fuel consumption and emission factors (and deterioration factors for catalyst vehicles), number of vehicles, annual mileage levels

and the relevant road-type shares given in Table 3.23. For non-catalyst vehicles this yields:

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

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

For catalyst vehicles the calculation becomes:

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

Extra emissions and fuel consumption for cold engines

Extra emissions of NO_X, VOC, CH_4, CO, PM, NH_3 and fuel consumption from cold start are simulated separately. For SO_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 NH_3, specific cold start emission factors are also proposed by COPERT IV. For catalyst vehicles, however, just like in the case of hot emission factors, the emission factors for cold start are functions of cumulated mileage (emission deterioration). The level of emission deterioration also relies on the content of sulphur in the fuel. The deterioration coefficients are given in EMEP/CORINAIR (2007), for the corresponding layer. For cold start, the cut-off mileage and sulphur level interval for hot engines are used, as described in the deterioration factors paragraph.

Evaporative emissions from gasoline vehicles

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

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

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

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

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

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

where S^C is the soak emission, l_{trip} = the average trip length, and HS and WS are the hot and warm soak emission factors, respectively. Since all catalyst vehicles are assumed to be carbon canister controlled, no soak emissions are estimated for this vehicle type. Average maximum

and minimum temperatures pr month are used in combination with diurnal emission factors to estimate the diurnal emissions from uncontrolled vehicles $E^d(U)$:

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

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

Fuel use balance

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

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

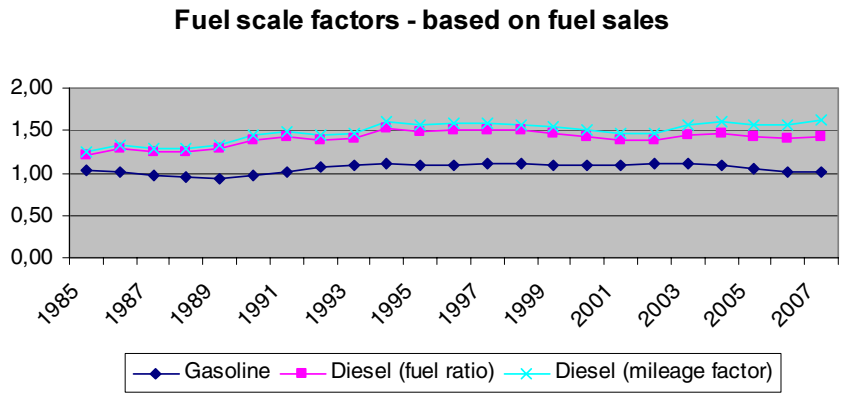

Figure 3.52 DEA:NERI Fuel ratios and diesel mileage adjustment factor based on DEA fuel sales data and NERI fuel consumption estimates.

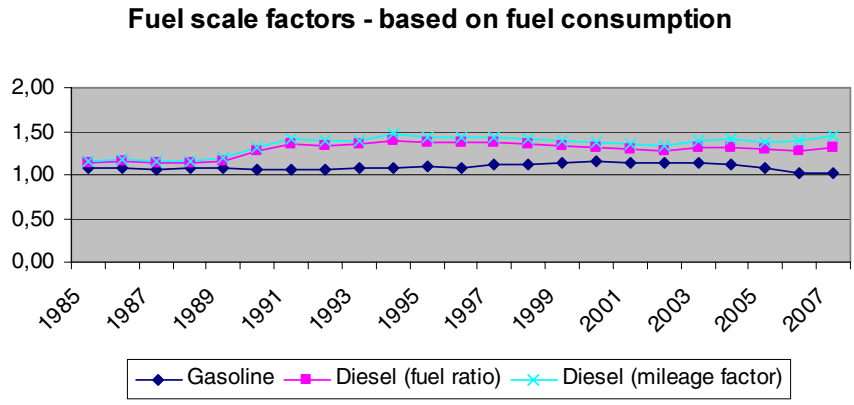

Figure 3.53 DEA:NERI Fuel ratios and diesel mileage adjustment factor based on DEA fuel consumption data and NERI fuel consumption estimates.

In the figures 3.52 and 3.53 the COPERT IV:DEA gasoline and diesel fuel use ratios are shown for fuel sales and fuel consumption from 1985-2006. 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 use 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 use ratio.

From the Figures 3.52 and 3.53 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 use 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 use and emission factors are shown in Annex 2.B.6 for 1990-2007. The total fuel use and emissions are shown in Annex 2.B.7, pr vehicle category and as grand totals, for 1990-2007 (and NFR format in Annex 2.B.15). In Annex 2.B.14, fuel-use and emission factors as well as total emissions are given in CollectER format for 2007.

In Table 3.25, the aggregated emission factors for SO_2, NO_X, NMVOC and TSP are shown in CollectER format for Danish road transport.

Table 3.25 Fuel-based emission factors for SO_2, NO_X, NMVOC, CO, NH_3 and TSP for road transport in Denmark (2007).

SNAP ID	Category	Fuel type	Mode	Emission factors[1] [g pr GJ]					
				SO_2	NO_X	NMVOC	CO	NH_3	TSP
70101	Passenger cars	Diesel	Highway driving	0.47	320.46	7.84	36.63	0.48	29.60
70101	Passenger cars	Gasoline 2-stroke	Highway driving	2.28	288.90	2357.34	3490.86	0.80	48.15
70101	Passenger cars	Gasoline conventional	Highway driving	0.46	1332.24	331.15	2773.37	0.89	10.46
70101	Passenger cars	Gasoline catalyst	Highway driving	0.46	114.52	24.84	691.33	32.04	0.67
70101	Passenger cars	LPG	Highway driving	0.00	1151.70	187.09	3914.25	0.00	10.06
70102	Passenger cars	Diesel	Rural driving	0.47	295.69	11.03	61.01	0.52	22.91
70102	Passenger cars	Gasoline 2-stroke	Rural driving	2.28	352.84	2476.82	2594.44	0.69	41.51
70102	Passenger cars	Gasoline conventional	Rural driving	0.46	1156.70	453.39	3162.05	0.98	11.73
70102	Passenger cars	Gasoline catalyst	Rural driving	0.46	91.66	26.18	515.08	37.49	0.60
70102	Passenger cars	LPG	Rural driving	0.00	1248.46	305.18	1146.38	0.00	14.49
70103	Passenger cars	Diesel	Urban driving	0.47	277.45	27.32	136.83	0.39	35.33
70103	Passenger cars	Gasoline 2-stroke	Urban driving	2.28	51.89	4470.04	7400.54	0.33	19.72
70103	Passenger cars	Gasoline conventional	Urban driving	0.46	634.50	858.71	7875.97	0.64	11.30
70103	Passenger cars	Gasoline catalyst	Urban driving	0.46	123.99	198.46	2274.41	13.46	0.68
70103	Passenger cars	LPG	Urban driving	0.00	616.11	440.44	1327.53	0.00	11.75
70201	Light duty vehicles	Diesel	Highway driving	0.47	283.52	27.45	161.76	0.36	35.30
70201	Light duty vehicles	Gasoline conventional	Highway driving	0.46	1369.26	170.29	2987.40	0.81	16.17
70201	Light duty vehicles	Gasoline catalyst	Highway driving	0.46	95.07	10.67	425.55	24.36	0.51
70202	Light duty vehicles	Diesel	Rural driving	0.47	297.95	30.72	145.27	0.40	31.07
70202	Light duty vehicles	Gasoline conventional	Rural driving	0.46	1188.86	262.59	2316.18	0.76	15.25
70202	Light duty vehicles	Gasoline catalyst	Rural driving	0.46	83.64	15.05	318.58	24.89	0.41
70203	Light duty vehicles	Diesel	Urban driving	0.47	304.39	50.61	173.30	0.29	40.43
70203	Light duty vehicles	Gasoline conventional	Urban driving	0.46	624.19	717.35	7390.65	0.44	8.85
70203	Light duty vehicles	Gasoline catalyst	Urban driving	0.46	97.04	113.84	2657.70	7.00	0.40
70301	Heavy duty vehicles	Diesel	Highway driving	0.47	715.05	22.66	139.68	0.32	17.42
70301	Heavy duty vehicles	Gasoline	Highway driving	0.46	1037.78	474.61	7610.35	0.28	55.35
70302	Heavy duty vehicles	Diesel	Rural driving	0.47	740.33	30.25	146.23	0.33	17.95
70302	Heavy duty vehicles	Gasoline	Rural driving	0.46	1141.55	820.40	8371.39	0.30	60.88
70303	Heavy duty vehicles	Diesel	Urban driving	0.47	745.30	41.47	173.67	0.27	21.89
70303	Heavy duty vehicles	Gasoline	Urban driving	0.46	456.62	696.09	7102.99	0.20	40.59
704	Mopeds	Gasoline		0.46	112.42	8440.75	9577.73	1.26	137.39
70501	Motorcycles	Gasoline	Highway driving	0.46	249.42	1006.99	14684.49	1.20	23.58
70502	Motorcycles	Gasoline	Rural driving	0.46	195.74	1257.04	14427.72	1.51	29.57
70503	Motorcycles	Gasoline	Urban driving	0.46	110.37	1701.44	13209.28	1.53	29.89

[1] References. SO_2: Country specific; NO_X and NMVOC: COPERT III (conventional passenger cars, light duty trucks, LPG passenger cars); PM: COPERT III (conventional diesel passenger cars, light duty diesel trucks) and COPERT IV (remaining vehicle layers).

Non-exhaust particulate emissions from road transport

The TSP, PM_{10} and $PM_{2.5}$ emissions arising from tyre and brake wear (SNAP 0707) and road abrasion (SNAP 0708) are estimated for the years 2000-2007 as prescribed by the UNECE convention reporting format. The emissions are calculated by multiplying the total annual mileage pr vehicle category with the correspondent average emission factors for each source type. The calculation procedure is consistent with the COPERT III model approach used to estimate the Danish national emissions coming from exhaust. A more thorough explanation of the calculations is given by Winther (2004), and emission factors are taken from EMEP/CORINAIR (2007). The emission factors and total emissions for 2007 are shown in Annex 2.B.14.

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 materiel in the industry, forestry, agriculture and household and gardening sectors. The emission calculations are made using the detailed method as described in the EMEP/CORINAIR Emission Inventory Guidebook (EMEP/CORINAIR, 2007) for air traffic, off-road working machinery and equipment, and ferries, while for the remaining sectors the simple method is used.

3.3.3 Activity data

Air traffic

The activity data for air traffic consists of air traffic statistics provided by the Danish Civil Aviation Agency (CAA-DK) and Copenhagen Airport. Fuel statistics for jet fuel use and aviation gasoline are obtained from the Danish energy statistics (DEA, 2008).

For 2001 onwards, pr flight records are provided by CAA-DK as data codes for aircraft type, and origin and destination airports (city-pairs).

Subsequently the aircraft types are separated by NERI into larger aircraft using jet fuel (jet engines, turbo props, helicopters) and small aircraft types with piston engines using aviation gasoline. This is done by using different aircraft dictionaries, internet look-ups and by communication with the CAA-DK. Each of the larger aircraft type is then matched with a representative type for which fuel consumption and emission data are available from the EMEP/CORINAIR databank. Relevant for this selection is aircraft maximum take off mass, engine types, and number of engines. A more thorough explanation is given in Winther (2001a, b).

The ideal flying distance (great circle distance) between the city-pairs is calculated by NERI in a separate database. The calculation algorithm uses a global latitude/altitude coordinate table for airports. In cases when airport coordinates are not present in the NERI database, these are looked up on the internet and entered into the database accordingly.

For inventory years prior to 2001, detailed LTO/aircraft type statistics are obtained from Copenhagen Airport (for this airport only), while information of total take-off numbers for other Danish airports is provided by CAA-DK. The assignment of representative aircraft types for Copenhagen Airport is done as described above. For the remaining Danish airports representative aircraft types are not directly assigned. Instead appropriate average assumptions are made relating to the fuel consumption and emission data part.

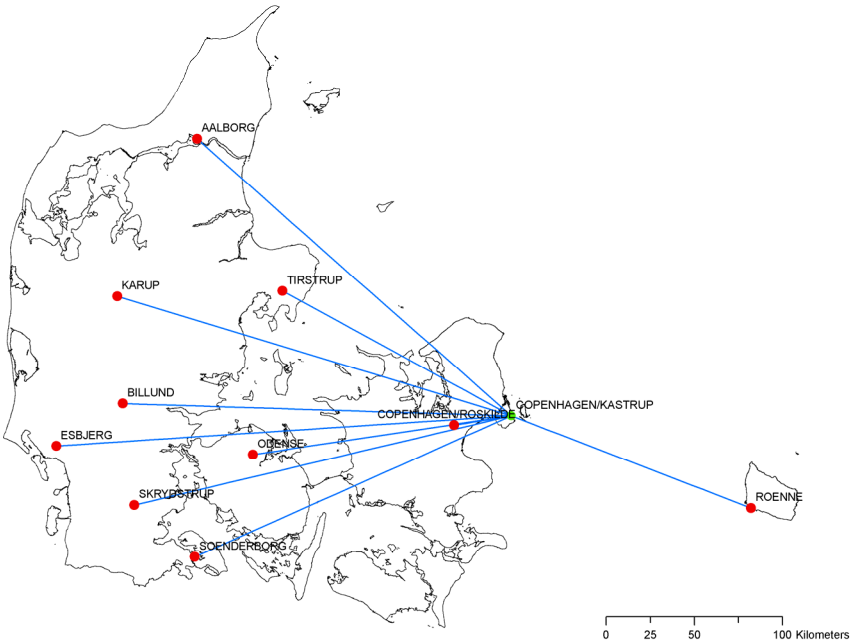

Figure 3.54 Most frequent domestic flying routes for large aircraft in Denmark.

Copenhagen Airport is the starting or end point for most of the domestic aviation made by large aircraft in Denmark (Figure 3.54). Even though many domestic flights not touching Copenhagen Airport are also reported in the flight statistics kept by CAA-DK, these flights, however, are predominantly made with small piston engine aircraft using aviation gasoline. Hence, the consumption of jet fuel by flights not using Copenhagen is merely marginal.

Non-road working machinery and equipment

Non-road working machinery and equipment are used in agriculture, forestry and industry, for household/gardening purposes and in inland waterways (recreational craft). Information on the number of different types of machines, their respective load factors, engine sizes and annual working hours has been provided by Winther et al. (2006). The stock development from 1985-2007 for the most important types of machinery are shown in Figures 3.55a-3.61 below. The stock data are also listed in Annex 2.B.10, together with figures for load factors, engine sizes and annual working hours. As regards stock data for the remaining machinery types, please refer to (Winther et al., 2006).

For agriculture, the total number of agricultural tractors and harvesters pr year are shown in the Figures 3.55a -3.55b, respectively. The Figures clearly show a decrease in the number of small machines, these being replaced by machines in the large engine-size ranges.

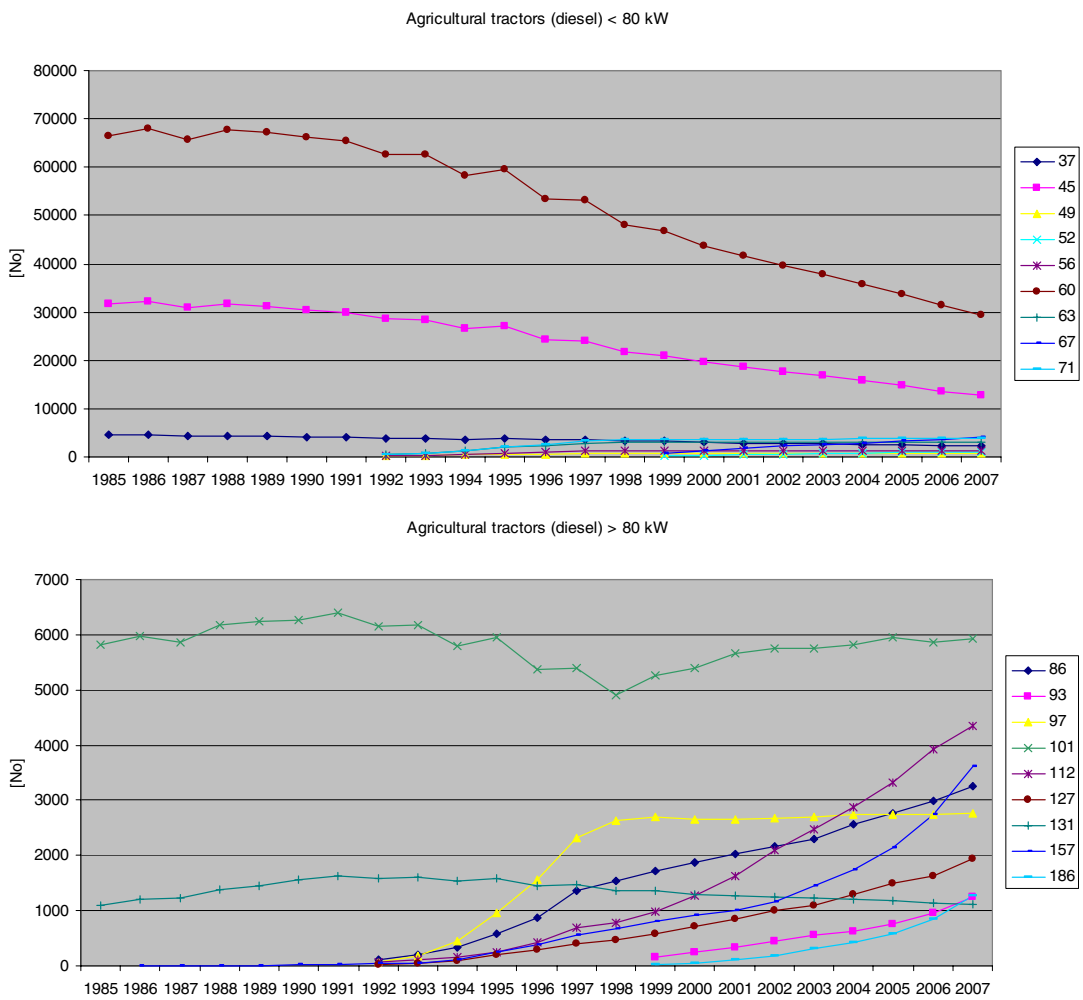

Figure 3.55a Total numbers in kW classes for tractors from 1985 to 2007.

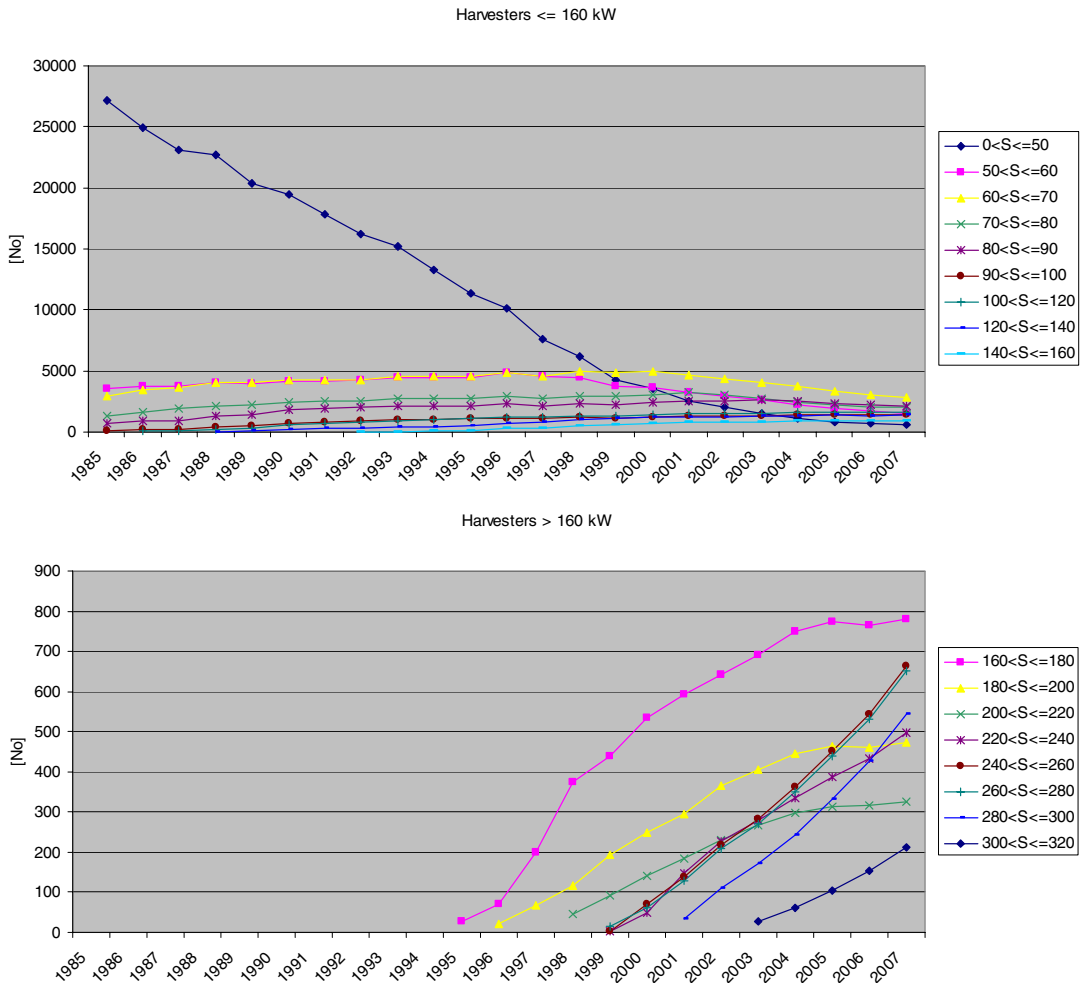

Figure 3.55b Total numbers in kW classes for harvesters from 1985 to 2007.

The tractor and harvester developments towards fewer vehicles and larger engines, shown in Figure 3.56, are very clear. From 1985 to 2007, tractor and harvester numbers decrease by around 20 % and 48 %, respectively, whereas the average increase in engine size for tractors is 24 %, and 135 % for harvesters, in the same time period.

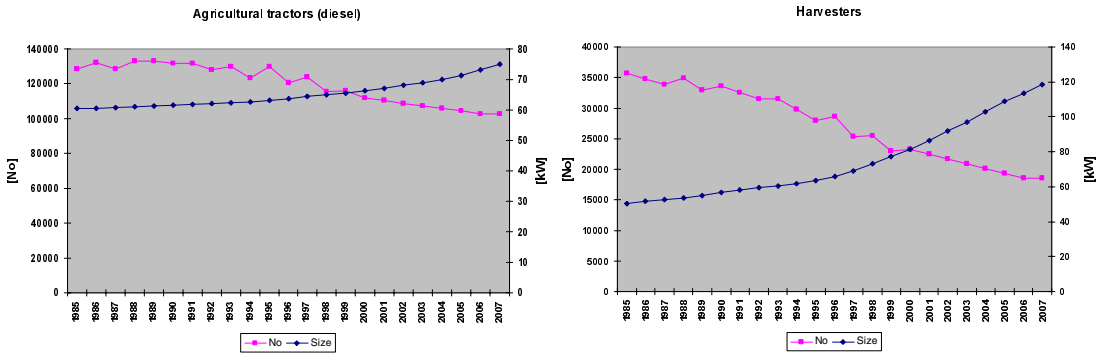

Figure 3.56 Total numbers and average engine size for tractors and harvesters (1985 to 2007).

The most important machinery types for industrial use are different types of construction machinery and fork lifts. The Figures 3.57 and 3.58 show the 1985-2007 stock development for specific types of construction machinery and diesel fork lifts. Due to lack of data, the construction machinery stock for 1990 is used also for 1985-1989. 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.

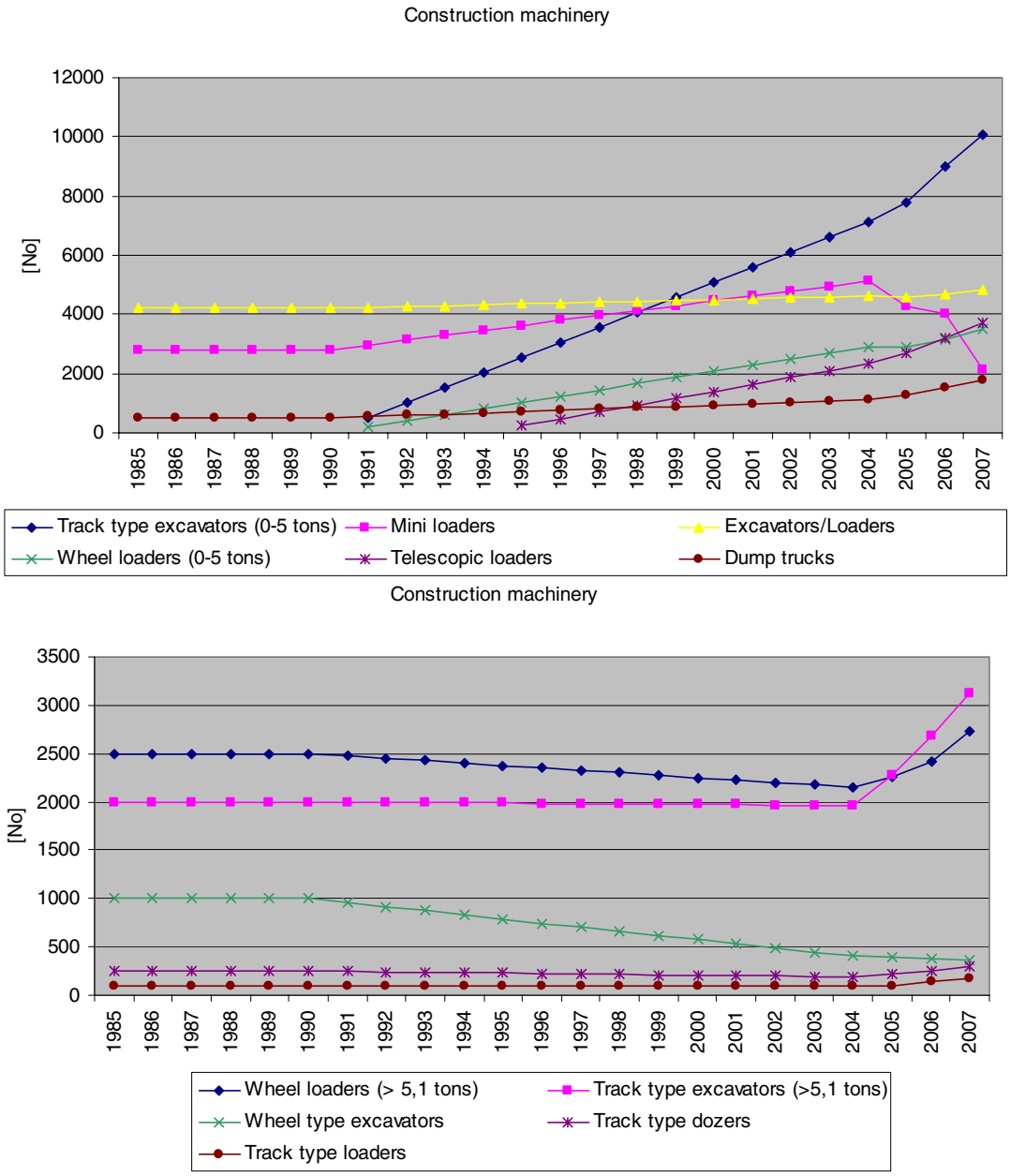

Figure 3.57 1985-2007 stock development for specific types of construction machinery.

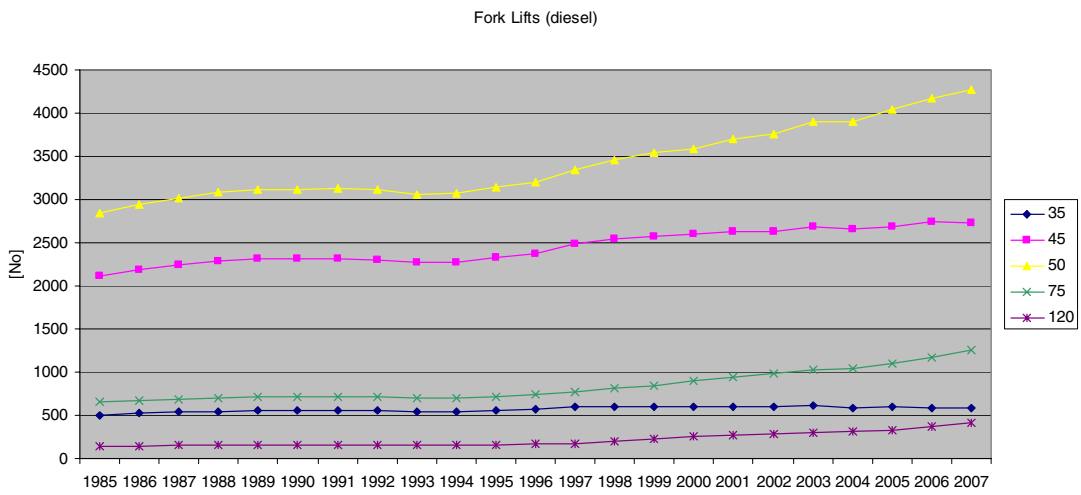

Figure 3.58 Total numbers of diesel fork lifts in kW classes from 1985 to 2007.

The emission level shares for tractors, harvesters, construction machinery and diesel fork lifts are shown in Figure 3.59, 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 3.59. 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 3.59.

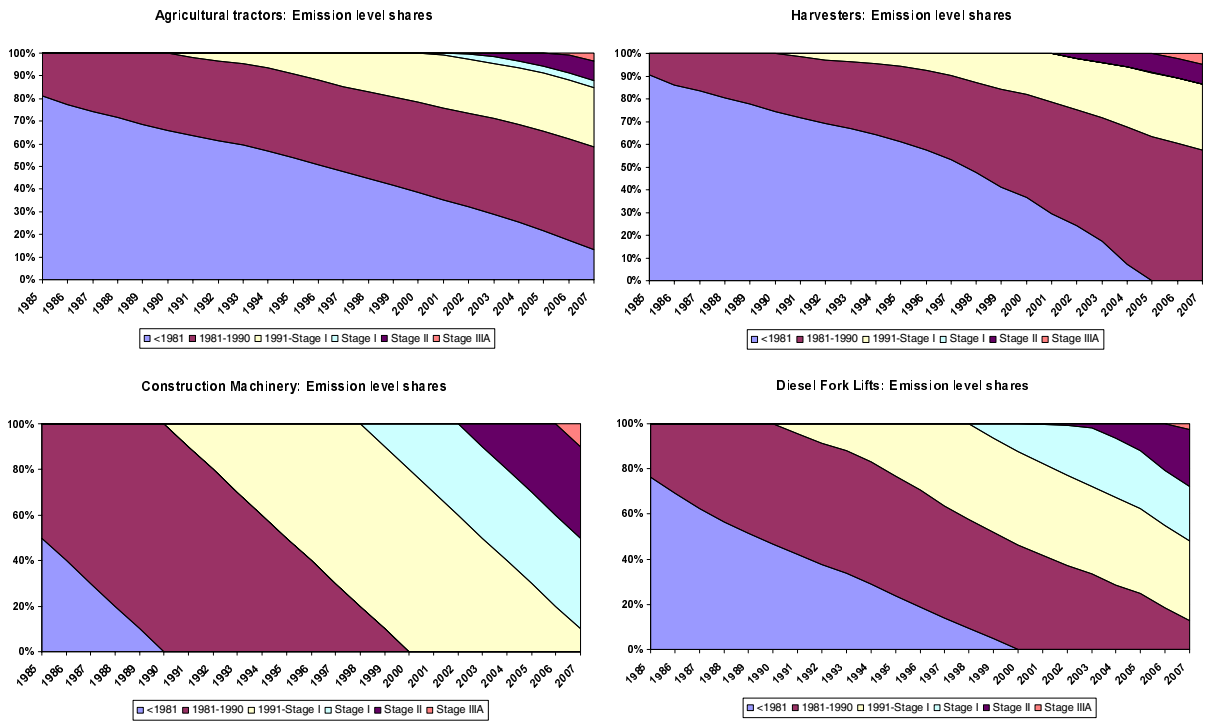

Figure 3.59 Emission level shares for tractors, harvesters, construction machinery and diesel fork lifts (1985 to 2007).

The 1985-2007 stock development for the most important household and gardening machinery types is shown in Figure 3.60. The 2006 stock data for these machinery types are repeated for 2007, since no new stock information has been obtained.

For lawn movers and cultivators, the machinery stock remains the same for all years, whereas the stock figures for riders, chain saws, shrub clearers, trimmers and hedge cutters increase from 1990 onwards. 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.

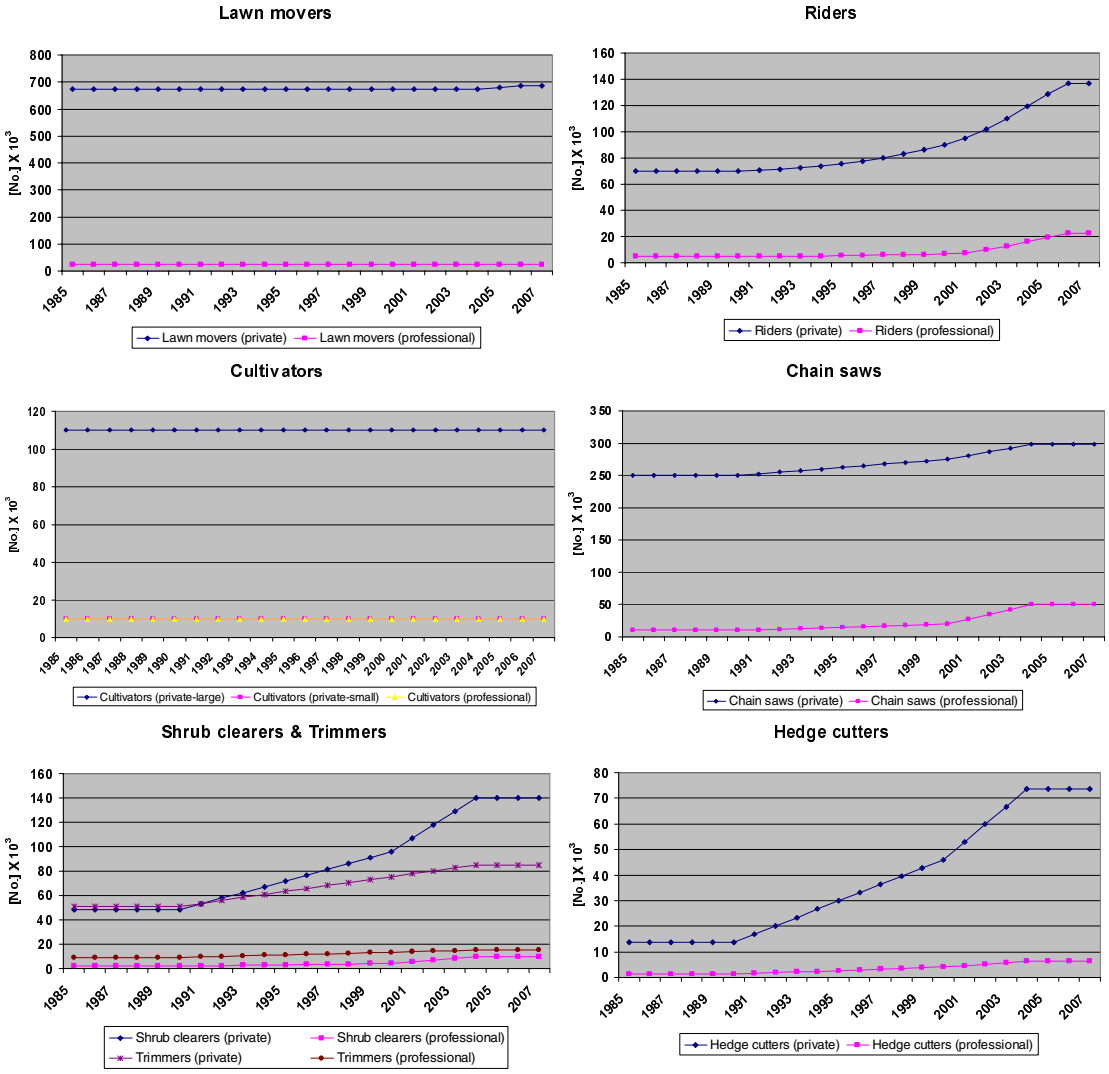

Figure 3.60 Stock development 1985-2007 for the most important household and gardening machinery types.

Figure 3.61 shows the development in numbers of different recreational craft from 1985-2007. The 2004 stock data for recreational craft are repeated for 2005-2007, since no new fleet information has been obtained.

For diesel boats, increases in stock and engine size are expected during the whole period, except for the number of motor boats (< 27 ft.) and the engine sizes for sailing boats (<26 ft.), where the figures remain unchanged. A decrease in the total stock of sailing boats (<26 ft.) by 21 %

and increases in the total stock of yawls/cabin boats and other boats (<20 ft.) by around 25 % are expected. Due to a lack of information specific to Denmark, the shifting rate from 2-stroke to 4-stroke gasoline engines is based on a German non-road study (IFEU, 2004).

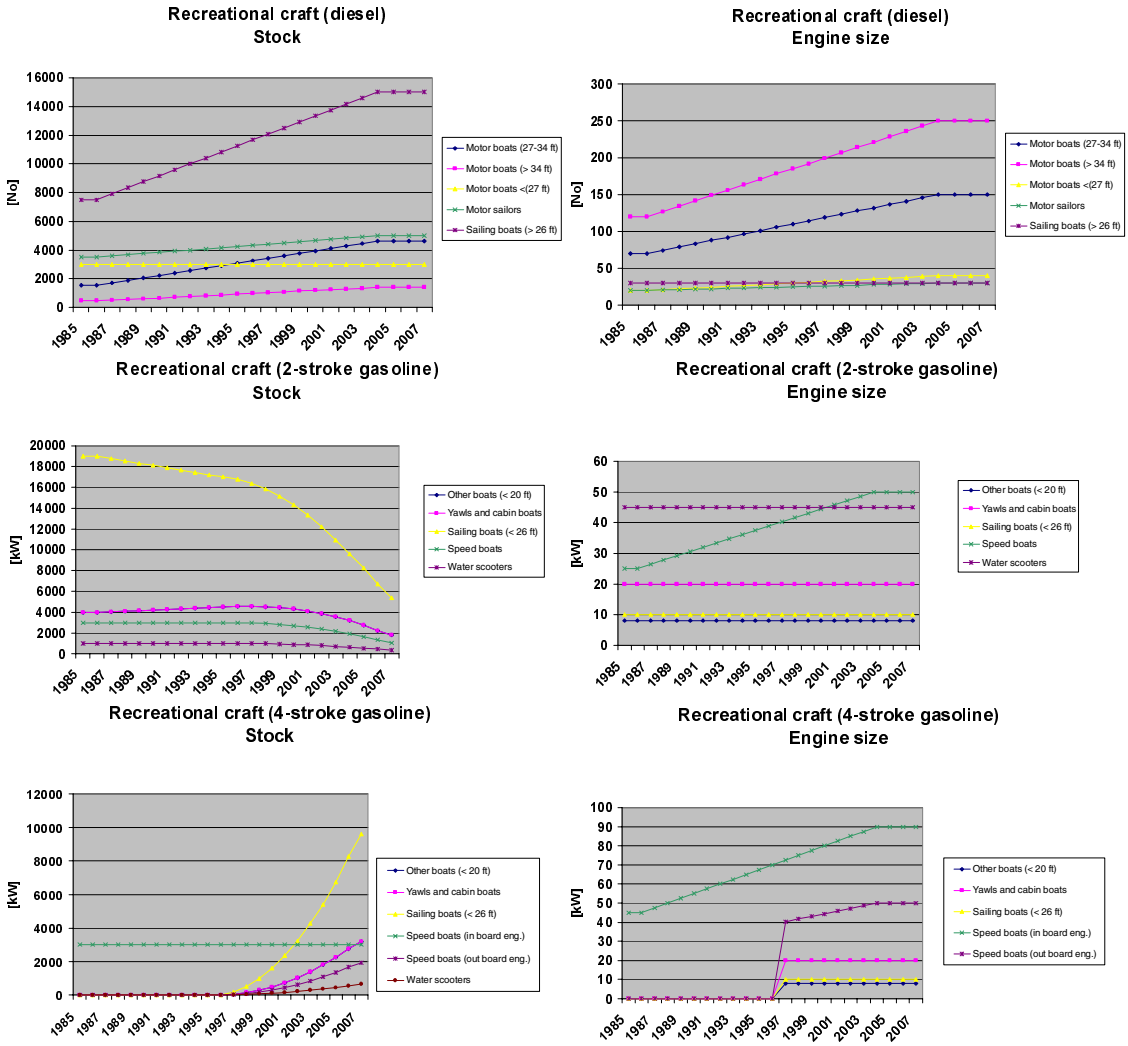

Figure 3.61 1985-2006 Stock and engine size development for recreational craft.

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, 2008a).

Table 3.26 lists the most important domestic ferry routes in Denmark in the period 1990-2007. For these ferry routes and the years 1990-2005, the following detailed traffic and technical data have been gathered by Winther (2008a): Ferry name, year of service, engine size (MCR), engine type, fuel type, average load factor, auxiliary engine size and sailing time (single trip).

For 2006 and 2007, traffic data for specific ferries have been provided by Kristensen (2008) in the case of Mols-Linien (Sjællands Odde-Ebeltoft, Sjællands Odde-Århus, Kalundborg-Århus) and by Hjortberg (2008) for Bornholmstrafikken (Køge-Rønne).

Table 3.26 Ferry routes comprised in the Danish inventory.

Ferry service	Service period
Halsskov-Knudshoved	1990-1999
Hundested-Grenaa	1990-1996
Kalundborg-Juelsminde	1990-1996
Kalundborg-Samsø	1990-
Kalundborg-Århus	1990-
Korsør-Nyborg, DSB	1990-1997
Korsør-Nyborg, Vognmandsruten	1990-1999
København-Rønne	1990-2004
Køge-Rønne	2004-
Sjællands Odde-Ebeltoft	1990-
Sjællands Odde-Århus	1999-
Tårs-Spodsbjerg	1990-

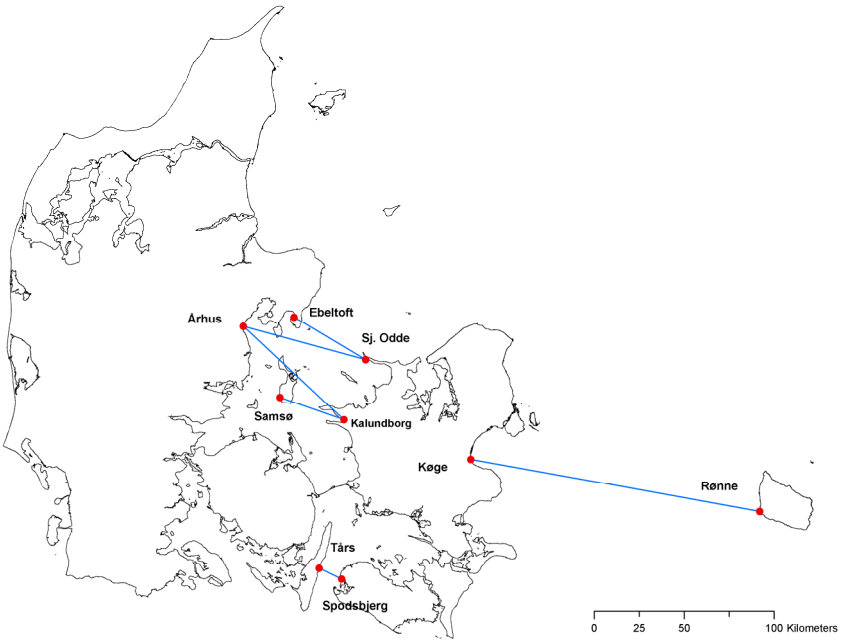

Figure 3.62 Domestic regional ferry routes in Denmark (2007).

The number of round trips pr ferry route is shown in Figure 3.62. 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). There is a lack of historical traffic data for 1985-1989, and hence, data for 1990 is used for these years, to support the fuel use and emission calculations.

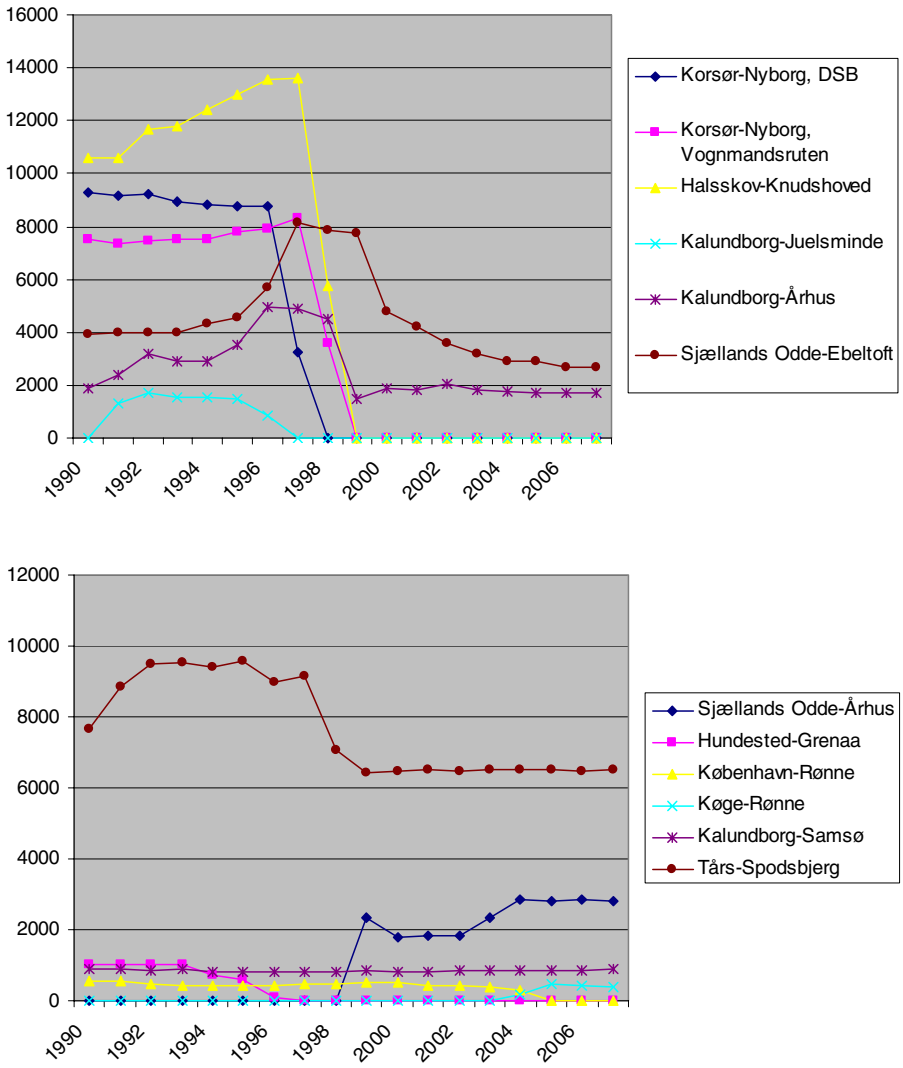

Figure 3.63 No. of round trips for the most important ferry routes in Denmark 1990-2006.

It is seen from Table 3.26 (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 (2008a).

The fleet activity data for regional ferries, and the fleet activity based fuel consumption estimates for local ferries and other national sea transport provided by Winther (2008a) replace the previous fuel based activity data which originated directly from the DEA statistics.

Other sectors

The activity data for military, railways, international sea transport and fishery consists of fuel consumption information from DEA (2007). For international sea transport, the basis is fuel sold in Danish ports for vessels with a foreign destination, as prescribed by the IPCC guidelines.

For fisheries, the calculation methodology described by Winther (2008a) remains fuel based. However, the input fuel data differ from the fuel sales figures previously used. The changes are the result of further data processing of the DEA reported gas oil sales for national sea transport and fisheries, prior to inventory input. For years when the fleet activity estimates of fuel consumption for national sea transport are smaller than reported fuel sold, fuel is added to fisheries in the inventory. Conversely, lower fuel sales in relation to bottom-up estimates for national sea transport means that fuel is being subtracted from the original fisheries fuel sales figure in order to make up the final fuel consumption input for fisheries.

The updated fuel consumption time series for national sea transport lead, in turn, to changes in the energy statistics for fisheries (gas oil) and industry (heavy fuel oil), so the national energy balance can remain unchanged.

For all sectors, fuel-use figures are given in Annex 2.B.14 for 2006 in CollectER format.

Emission legislation

For non-road working machinery and equipment, and recreational craft and railway locomotives/motor cars, the emission directives list specific emission limit values (g pr kWh) for CO, VOC, NO_x (or VOC + NO_x) and TSP, depending on engine size (kW for diesel, ccm for gasoline) and date of implementation (referring to engine market date).

For diesel, the directives 97/68 and 2004/26 relate to non-road machinery other than agricultural and forestry tractors, and the directives have different implementation dates for machinery operating under transient and constant loads. The latter directive also comprises emission limits for railway machinery. For tractors the relevant directives are

2000/25 and 2005/13. For gasoline, the directive 2002/88 distinguishes between hand-held (SH) and not hand-held (NS) types of machinery.

For engine type approval, the emissions (and fuel use) 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 3.27 Overview of EU emission directives relevant for diesel fuelled non-road machinery.

Stage/Engine size [kW]	CO	VOC	NO_x	$VOC+NO_x$	PM	Diesel machinery			Tractors	
							Implement. date		EU	Implement.
			[g pr kWh]			EU Directive	Transient	Constant	directive	date
Stage I										
37<=P<75	6.5	1.3	9.2	-	0.85	97/68	1/4 1999	-	2000/25	1/7 2001
Stage II										
130<=P<560	3.5	1	6	-	0.2	97/68	1/1 2002	1/1 2007	2000/25	1/7 2002
75<=P<130	5	1	6	-	0.3		1/1 2003	1/1 2007		1/7 2003
37<=P<75	5	1.3	7	-	0.4		1/1 2004	1/1 2007		1/1 2004
18<=P<37	5.5	1.5	8	-	0.8		1/1 2001	1/1 2007		1/1 2002
Stage IIIA										
130<=P<560	3.5	-	-	4	0.2	2004/26	1/1 2006	1/1 2011	2005/13	1/1 2006
75<=P<130	5	-	-	4	0.3		1/1 2007	1/1 2011		1/1 2007
37<=P<75	5	-	-	4.7	0.4		1/1 2008	1/1 2012		1/1 2008
19<=P<37	5.5	-	-	7.5	0.6		1/1 2007	1/1 2011		1/1 2007
Stage IIIB										
130<=P<560	3.5	0.19	2	-	0.025	2004/26	1/1 2011	-	2005/13	1/1 2011
75<=P<130	5	0.19	3.3	-	0.025		1/1 2012	-		1/1 2012
56<=P<75	5	0.19	3.3	-	0.025		1/1 2012	-		1/1 2012
37<=P<56	5	-	-	4.7	0.025		1/1 2013	-		1/1 2013
Stage IV										
130<=P<560	3.5	0.19	0.4	-	0.025	2004/26	1/1 2014		2005/13	1/1 2014
56<=P<130	5	0.19	0.4	-	0.025		1/10 2014			1/10 2014

Table 3.28 Overview of the EU Emission Directive 2002/88 for gasoline fuelled non-road machinery.

	Category	Engine size [ccm]	CO [g pr kWh]	HC [g pr kWh]	NO_x [g pr kWh]	$HC+NO_x$ [g pr kWh]	Implementation date
	Stage I						
Hand held	SH1	S<20	805	295	5.36	-	1/2 2005
	SH2	20=<S<50	805	241	5.36	-	1/2 2005
	SH3	50=<S	603	161	5.36	-	1/2 2005
Not hand held	SN3	100=<S<225	519	-	-	16.1	1/2 2005
	SN4	225=<S	519	-	-	13.4	1/2 2005
	Stage II						
Hand held	SH1	S<20	805	-	-	50	1/2 2008
	SH2	20=<S<50	805	-	-	50	1/2 2008
	SH3	50=<S	603	-	-	72	1/2 2009
Not hand held	SN1	S<66	610	-	-	50	1/2 2005
	SN2	66=<S<100	610	-	-	40	1/2 2005
	SN3	100=<S<225	610	-	-	16.1	1/2 2008
	SN4	225=<S	610	-	-	12.1	1/2 2007

For recreational craft, Directive 2003/44 comprises the emission legislation limits for diesel engines, and for 2-stroke and 4-stroke gasoline engines, respectively. The CO and VOC emission limits depend on engine size (kW) and the inserted parameters presented in the calculation formulas in Table 3.29. 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 3.29 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

Tabel 3.30 Overview of the EU Emission Directive 2004/26 for railway locomotives and motorcars.

	Engine size [kW]		CO [g pr kWh]	HC [g pr kWh]	NOx [g pr kWh]	$HC+NO_X$ [g pr kWh]	PM [g pr kWh]	Implementation date
Locomotives	Stage IIIA							
	130<=P<560	RL A	3.5	-	-	4	0.2	1/1 2007
	560<P	RH A	3.5	0.5	6	-	0.2	1/1 2009
	2000<=P and piston displacement >= 5 l/cyl.	RH A	3.5	0.4	7.4	-	0.2	1/1 2009
	Stage IIIB	RB	3.5	-	-	4	0.025	1/1 2012
Motor cars	Stage IIIA							
	130<P	RC A	3.5	-	-	4	0.2	1/1 2006
	Stage IIIB							
	130<P	RC B	3.5	0.19	2	-	0.025	1/1 2012

Aircraft engine emissions of NO_x, CO, VOC and smoke are regulated by ICAO (International Civil Aviation Organization). The engine emission certification standards are contained in Annex 16 — Environmental Protection, Volume II — Aircraft Engine Emissions to the Convention on International Civil Aviation (ICAO Annex 16, 1993). The emission standards relate to the total emissions (in grams) from the so-called LTO (Landing and Take Off) cycle divided by the rated engine thrust (kN). The ICAO LTO cycle contains the idealised aircraft movements below 3000 ft (915 m) during approach, landing, airport taxiing, take off and climb out.

For smoke all aircraft engines manufactured from 1 January 1983 have to meet the emission limits agreed by ICAO. For NO_x, CO, VOC The emission legislation is relevant for aircraft engines with a rated engine thrust larger than 26.7 kN. In the case of CO and VOC, the ICAO regulations apply for engines manufactured from from 1 January 1983.

For NO_x, the emission regulations fall in four categories

a) For engines of a type or model for which the date of manufacture of the first individual production model is on or before 31 December 1995, and for which the production date of the individual engine is on or before 31 December 1999.

b) For engines of a type or model for which the date of manufacture of the first individual production model is after 31 December 1995, or for individual engines with a production date after 31 December 1999.
c) For engines of a type or model for which the date of manufacture of the first individual production model is after 31 December 2003.
d) For engines of a type or model for which the date of manufacture of the first individual production model is after 31 December 2007.

The regulations published by ICAO are given in the form of the total quantity of pollutants (D_p) emitted in the LTO cycle divided by the maximum sea level thrust (F_{oo}) and plotted against engine pressure ratio at maximum sea level thrust.

The limit values for NO_x are given by the formulae in Table 3.31.

Table 3.31 Current certification limits for NO_x for turbo jet and turbo fan engines.

	Engines first produced before 31.12.1995 & for engines manufactured up to 31.12.1999	Engines first produced after 31.12.1995 & for engines manufactured after 31.12.1999	Engines for which the date of manufacture of the first individual production model was after 31 December 2003	Engines for which the date of manufacture of the first individual production model was after 31 December 2007
Applies to engines >26.7 kN	$Dp/F_{oo} = 40 + 2\pi_{oo}$	$Dp/F_{oo} = 32 + 1.6\pi_{oo}$		
Engines of pressure ratio less than 30				
Thrust more than 89 kN			$Dp/F_{oo} = 19 + 1.6\pi_{oo}$	$Dp/F_{oo} = 16.72 + 1.4080\pi_{oo}$
Thrust between 26.7 kN and not more than 89 kN			$Dp/F_{oo} = 37.572 + 1.6\pi_{oo} - 0.208F_{oo}$	$Dp/F_{oo} = 38.54862 + (1.6823\pi_{oo}) – (0.2453F_{oo}) – (0.00308\pi_{oo}F_{oo})$
Engines of pressure ratio more than 30 and less than 62.5				
Thrust more than 89 kN			$Dp/F_{oo} = 7+2.0\pi_{oo}$	$Dp/F_{oo} = -1.04+ (2.0*\pi_{oo})$
Thrust between 26.7 kN and not more than 89 kN			$Dp/F_{oo} = 42.71 +1.4286\pi_{oo} -0.4013F_{oo} +0.00642\pi_{oo}F_{oo}$	$Dp/F_{oo} = 46.1600 + (1.4286\pi_{oo}) – (0.5303F_{oo}) – (0.00642\pi_{oo}F_{oo})$
Engines with pressure ratio 82.6 or more			$Dp/F_{oo} = 32+1.6\pi_{oo}$	$Dp/F_{oo} = 32+1.6\pi_{oo}$

Source: International Standards and Recommended Practices, Environmental Protection, ICAO Annex 16 Volume II Part III Paragraph 2.3.2, 2nd edition July 1993, plus amendments: Amendment 3 (20 March 1997),Amendment 4 (4 November 1999),Amendment 5 (24 November 2005).

where:

D_p = the sum of emissions in the LTO cycle in g.

F_{oo} = thrust at sea level take-off (100 %).

π_{oo} = pressure ratio at sea level take-off thrust point (100 %).

The equivalent limits for HC and CO are D_p/F_{oo} = 19.6 for HC and D_p/F_{oo} = 118 for CO (ICAO Annex 16 Vol. II paragraph 2.2.2). Smoke is limited to a regulatory smoke number = 83 $(F_{oo})^{-0.274}$ or a value of 50, whichever is the lower.

A further description of the technical definitions in relation to engine certification as well as actual engine exhaust emission measurement data can be found in the ICAO Engine Exhaust Emission Database. The

latter database is accessible from http://www.caa.co.uk, hosted by the UK Civil Aviation Authority.

For seagoing vessels, NO_x emissions are regulated as explained in Marpol 73/78 Annex VI, formulated by IMO (International Maritime Organisation). The legislation is relevant for diesel engines with a power output higher than 130 kW, which are installed on a ship constructed on or after 1 January 2000 and diesel engines with a power output higher than 130 kW which undergo major conversion on or after 1 January 2000.

The NO_x emission limits for ship engines in relation to their rated engine speed (n) given in RPM (Revolutions Pr Minute) are the following:

- 17 g pr kWh, n < 130 RPM
- 45 x n-0.2 g pr kWh, 130 ≤ n < 2000 RPM
- 9.8 g pr kWh, n ≥ 2000 RPM

Further, the Marine Environment Protection Committee (MEPC) of IMO has approved proposed amendments to MARPOL Annex VI to be agreed by IMO in October 2008 in order to strengthen the emission standards for NO_x and the sulphur contents of heavy fuel oil used by ship engines.

For NO_x emission regulations, a three tiered approach is considered, which comprises the following:

- Tier I: Diesel engines (> 130 kW) installed on a ship constructed on or after 1 January 2000 and prior to 1 January 2011.
- Tier II: Diesel engines (> 130 kW) installed on a ship constructed on or after 1 January 2011.
- Tier III[8]: Diesel engines (> 130 kW) installed on a ship constructed on or after 1 January 2016.

As for the existing NO_x emission limits, the new Tier I-III NO_x legislation values rely on the rated engine speeds. The emission limit equations are shown in Table 3.32.

Table 3.32 Tier I-III NOx emission limits for ship engines (amendments to MARPOL Annex VI).

	NO_x limit	RPM (n)
Tier I	17 g pr kWh	n < 130
	45 · n-0.2 g pr kWh	130 ≤ n < 2000
	9,8 g pr kWh	n ≥ 2000
Tier II	14.4 g pr kWh	n < 130
	44 · n-0.23 g pr kWh	130 ≤ n < 2000
	7.7 g pr kWh	n ≥ 2000
Tier III	3.4 g pr kWh	n < 130
	9 · n-0.2 g pr kWh	130 ≤ n < 2000
	2 g pr kWh	n ≥ 2000

The Tier I emission limits are identical with the existing emission limits from MARPOL Annex VI.

[8] For ships operating in a designated Emission Control Area. Outside a designated Emission Control Area, Tier II limits apply.

Also to be agreed by IMO in October 2008, the NO_x Tier I limits are to be applied for existing engines with a power output higher than 5000 kW and a displacement pr cylinder at or above 90 litres, installed on a ship constructed on or after 1 January 1990 but prior to 1 January 2000.

In relation to the sulphur content in heavy fuel and marine gas oil used by ship engines, Table 3.33 shows the current legislation in force, and the amendment of MARPOL Annex VI to be agreed by IMO in October 2008.

Table 3.33 Current legislation in relation to marine fuel quality.

Legislation		Heavy fuel oil		Gas oil	
		S- %	Impl. date (day/month/year)	S- %	Impl. date
EU-directive 93/12		None		0.2[1]	1.10.1994
EU-directive 1999/32		None		0.2	1.1.2000
EU-directive 2005/33	SECA - Baltic sea	1.5	11.08.2006	0.1	1.1.2008
	SECA - North sea	1.5	11.08.2007	0.1	1.1.2008
	Outside SECA's	None		0.1	1.1.2008
MARPOL Annex VI	SECA – Baltic sea	1.5	19.05.2006		
	SECA – North sea	1.5	21.11.2007		
	Outside SECA	4.5	19.05.2006		
MARPOL Annex VI amendments	SECA's	1	01.03.2010		
	SECA's	0.1	01.01.2015		
	Outside SECA's	0.5	01.01.2020[2]		

[1] Sulphur content limit for fuel sold inside EU.

[2] Subject to a feasibility review to be completed no later than 2018. If the conclusion of such a review becomes negative the effective date would default 1 January 2025.

For non-road machinery, the EU directive 2003/17/EC gives a limit value of 50 ppm sulphur in diesel (from 2005).

Emission factors

The SO_2 emission factors are fuel related, and rely on the sulphur contents given in the relevant EU fuel directives or in the Danish legal announcements. However, for jet fuel the default factor from IPCC (1996) is used. Road transport diesel is assumed to be used by engines in military and railways, and road transport gasoline is assumed to be used by non road working machinery and recreational craft. Hence, these types of machinery have the same SO_2 emission factors, as for road transport.

For all mobile sources, the emission factor source for NH_3, heavy metals and PAH is the EMEP/CORINAIR guidebook (CORINAIR, 2007).

For military ground equipment, aggregated emission factors for gasoline and diesel are derived from road traffic emission simulations. For piston engine aircraft using aviation gasoline, aggregated emission factors for conventional cars are used.

For railways, specific Danish measurements from the Danish State Railways (DSB) (Næraa, 2007) are used to calculate the emission factors of NO_x, VOC, CO and TSP, and a NMVOC/CH_4 split is made based on own judgment.

For agriculture, forestry, industry, household gardening and inland waterways, the NO_x, VOC, CO and TSP emission factors are derived from various European measurement programmes; see IFEU (2004) and Winther et al. (2006). The NMVOC/CH_4 split is taken from USEPA (2004).

For national sea transport and fisheries, the NO_x emission factors predominantly come from the engine manufacturer MAN Diesel, as a function of engine production year. The CO, VOC and TSP emission factors come from the Danish TEMA2000 emission model (Trafikministeriet, 2000), whereas the PM_{10} and $PM_{2.5}$ size fractions are obtained from MAN Diesel.

Specifically for the ferries used by Mols Linjen new NO_x , VO and CO emission factors are provided by Kristensen (2008), originating from measurement results by Hansen et al. (2004), Wismann (1999) and PHP (1996).

For ship engines VOC/CH_4 splits are taken from EMEP/CORINAIR (2007), and all emission factors are shown in Annex 2.B.12.

The source for aviation (jet fuel) emission factors is the EMEP/CORINAIR guidebook (CORINAIR, 2007).

For all sectors, emission factors are given in CollectER format in Annex 2.B.14 for 2006. Table 3.34 shows the emission factors for SO_2, NO_X, NMVOC, CO, NH_3 and TSP in CollectER format 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 2.B.9. For more details regarding the use of these factors, please refer to paragraph 3.1.4 or Winther et al. (2006).

Table 3.34 Fuel based emission factors for SO_2, NO_X, NMVOC, CO, NH_3 and TSP for other mobile sources in Denmark (2007).

					Emission factors[1] [g pr GJ]					
SNAP ID	NFR ID	Category	Fuel type	Mode	SO_2	NO_X	NMVOC	CO	NH_3	TSP
801	1A5	Military	Diesel		0.47	492.21	30.61	140.33	0.35	26.76
801	1A5	Military	Jet fuel	< 3000 ft	22.99	250.57	24.94	229.89	0.00	1.16
801	1A5	Military	Jet fuel	> 3000 ft	22.99	250.57	24.94	229.89	0.00	1.16
801	1A5	Military	Gasoline		0.46	176.04	227.05	1856.59	23.18	2.33
801	1A5	Military	Av. gasoline		22.99	859.00	1242.60	6972.00	1.60	10.00
802	1A3c	Railways	Diesel		0.47	1155.92	74.96	204.41	0.20	39.02
803	1A3d	Inland waterways	Diesel		93.68	859.98	166.16	448.87	0.17	102.24
803	1A3d	Inland waterways	Gasoline		0.46	471.95	1805.80	15316.45	0.09	75.54
80402	1A3d	National sea traffic	Residual oil		586.80	1853.36	61.68	203.47		51.05
80402	1A3d	National sea traffic	Diesel		93.68	913.41	51.67	77.70	0.00	23.21
80402	1A3d	National sea traffic	Kerosene		1101.71	1393.60	56.90	180.90		139.40
80402	1A3d	National sea traffic	LPG		93.68	1361.84	56.69	187.03	0.00	23.21
80403	1A4c	Fishing	Residual oil		2.30	50.00	3.00	20.00		5.00
80403	1A4c	Fishing	Diesel		2.28	64.34	10809.60	18485.10	0.10	23.25
80403	1A4c	Fishing	Kerosene		0.00	1249.00	384.94	443.00	0.00	0.20
80403	1A4c	Fishing	Gasoline		733.50	2069.79	61.20	201.91		63.83
80403	1A4c	Fishing	LPG		93.68	1532.37	55.75	183.92		23.21
80404	Memo item	International sea traffic	Residual oil		22.99	293.55	23.12	141.74		1.16
80404	Memo item	International sea traffic	Diesel		22.83	859.00	1242.60	6972.00	1.60	10.00
80501	1A3a	Air traffic, other airports	Jet fuel	Dom. < 3000 ft	22.99	291.92	43.72	198.15		1.16
80501	1A3a	Air traffic, other airports	Av. gasoline		22.83	859.00	1242.60	6972.00	1.60	10.00
80502	Memo item	Air traffic, other airports	Jet fuel	Int. < 3000 ft	22.99	291.19	19.21	129.09		1.16
80502	Memo item	Air traffic, other airports	Av. gasoline		22.99	237.35	9.52	58.63		1.16
80503	1A3a	Air traffic, other airports	Jet fuel	Dom. > 3000 ft	2.34	716.23	74.95	391.81	0.18	56.80
80504	Memo item	Air traffic, other airports	Jet fuel	Int. > 3000 ft	0.46	107.62	1143.27	21924.54	1.41	29.26
806	1A4c	Agriculture	Diesel		2.34	566.80	44.17	275.21	0.18	30.98
806	1A4c	Agriculture	Gasoline		0.46	86.32	6899.22	16933.82	0.09	77.69
807	1A4c	Forestry	Diesel		2.34	678.30	80.88	376.58	0.18	68.25
807	1A4c	Forestry	Gasoline		0.46	200.51	1509.22	13278.13	0.10	14.57
808	1A2f	Industry	Diesel		0.00	1328.11	146.09	104.85	0.21	4.89
808	1A2f	Industry	Gasoline		0.46	90.65	2549.32	28132.76	0.09	25.05
808	1A2f	Industry	LPG		22.99	280.40	32.20	176.61		1.16
809	1A4b	Household and gardening	Gasoline		22.83	859.00	1242.60	6972.00	1.60	10.00
80501	1A3a	Air traffic, Copenhagen airport	Jet fuel	Dom. < 3000 ft	22.99	342.69	43.65	229.09	0.00	1.16
80501	1A3a	Air traffic, Copenhagen airport	Av. gasoline		22.83	859.00	1242.60	6972.00	1.60	10.00
80502	Memo item	Air traffic, Copenhagen airport	Jet fuel	Int. < 3000 ft	22.99	321.59	20.83	112.70	0.00	1.16
80502	Memo item	Air traffic, Copenhagen airport	Av. gasoline		22.99	314.27	11.22	34.26	0.00	1.16
80503	1A3a	Air traffic, Copenhagen airport	Jet fuel	Dom. > 3000 ft	0.47	492.21	30.61	140.33	0.35	26.76
80504	Memo item	Air traffic, Copenhagen airport	Jet fuel	Int. > 3000 ft	22.99	250.57	24.94	229.89	0.00	1.16

[1] References. SO_2: Country-specific; Military: Aggregated emission factors for road transport; Railways (NO_x, NMVOC and TSP): Danish State Railways; Agriculture, forestry, industry, household gardening and inland waterways (NO_x, VOC and TSP): IFEU (2004); National sea transport and fishing: MAN B&W (NO_x) and TEMA2000 (NMVOC, TSP); Aviation - jet fuel (NO_X, NMVOC and TSP): EMEP/CORINAIR; Aviation - av.gasoline: Aggregated emission factors for conventional gasoline cars.

3.3.4 Calculation method

Air traffic

For aviation, the domestic and international estimates are made separately for landing and take-off (LTOs < 3000 ft), and cruising (> 3000 ft).

The fuel consumption for one LTO cycle is calculated according to the following sum formula:

$$FC_{LTO}^{a} = \sum_{m=1}^{4} t_m \cdot ff_{a,m} \quad (13)$$

Where FC = fuel consumption (kg), m = LTO mode (approach/landing, taxiing, take off, climb out), t = times in mode (s), ff = fuel flow (kg pr s), a = representative aircraft type.

The emissions for one LTO cycle are estimated as follows:

$$E_{LTO}^{a} = \sum_{m=1}^{4} FC_{a,m} \cdot EI_{a,m} \quad (14)$$

Due to lack of specific airport data, for approach/descent, take off and climb out, standardised times-in-modes of 4, 0.7 and 2.2 mins are used as defined by ICAO (ICAO, 1995), whereas for taxiing the appropriate time interval is 13 mins in Copenhagen Airport and 5 mins in other airports present in the Danish inventory.

To estimate cruise results, fuel consumption and emissions for standard flying distances from EMEP/CORINAIR (2007) are interpolated or extrapolated – in each case determined by the great circle distance between the origin and the destination airports.

If the great circle distance, y, is smaller than the maximum distance for which fuel consumption and emission data are given in the EMEP/CORINAIR data bank the fuel consumption or emission E (y) becomes:

$$E(y) = E_{x_i} + \frac{(y - x_i)}{x_{i+1} - x_i} \cdot (E_{x_{i+1}} - E_{x_i}) \quad y<x_{max},\ i = 0,1,2\ldots.max\text{-}1 \quad (15)$$

In (5.3) x_i and x_{max} denominate the separate distances and the maximum distance, respectively, with known fuel use and emissions. If the flight distance y exceeds x_{max} the maximum figures for fuel use and emissions must be extrapolated and the equation then becomes:

$$E(y) = E_{x_{\max}} + \frac{(y - x_{\max})}{x_{\max} - x_{\max-1}} \cdot (E_{x_{\max}} - E_{x_{\max-1}}) \quad y>x_{max} \quad (16)$$

Total results are summed up and categorised according to each flight's airport and country codes.

The overall fuel precision in the model is around 0.8, derived as the fuel ratio between model estimates and statistical sales. The fuel difference

is accounted for by adjusting cruising fuel use and emissions in the model according to domestic and international cruising fuel shares.

Prior to 2001, the calculation procedure was first to estimate each year's fuel use and emissions for LTO. Secondly, total cruising fuel use was found year by year as the statistical fuel use total minus the calculated fuel use for LTO. Lastly, the cruising fuel use was split into a domestic and international part by using the results from a Danish city-pair emission inventory in 1998 (Winther, 2001a). For more details of this latter fuel allocation procedure, see Winther (2001b).

Non-road working machinery and recreational craft

Prior to adjustments for deterioration effects and transient engine operations, the fuel use and emissions in year X, for a given machinery type, engine size and engine age, are calculated as:

$$E_{Basis}(X)_{i,j,k} = N_{i,j,k} \cdot HRS_{i,j,k} \cdot P \cdot LF_i \cdot EF_{y,z} \quad (17)$$

where E_{Basis} = fuel use/emissions in the basic situation, N = number of engines, HRS = annual working hours, P = average rated engine size in kW, LF = load factor, EF = fuel use/emission factor in g pr kWh, i = machinery type, j = engine size, k = engine age, y = engine-size class and z = emission level. The basic fuel use and emission factors are shown in Annex 2.B.9.

The deterioration factor for a given machinery type, engine size and engine age in year X depends on the engine-size class (only for gasoline), y, and the emission level, z. The deterioration factors for diesel and gasoline 2-stroke engines are found from:

$$DF_{i,j,k}(X) = \frac{K_{i,j,k}}{LT_i} \cdot DF_{y,z} \quad (18)$$

where DF = deterioration factor, K = engine age, LT = lifetime, i = machinery type, j = engine size, k = engine age, y = engine-size class and z = emission level.

For gasoline 4-stroke engines the deterioration factors are calculated as:

$$DF_{i,j,k}(X) = \sqrt{\frac{K_{i,j,k}}{LT_i}} \cdot DF_{y,z} \quad (19)$$

The deterioration factors inserted in (18) and (19) are shown in Annex 2.B.9. No deterioration is assumed for fuel use (all fuel types) or for LPG engine emissions and, hence, DF = 1 in these situations.

The transient factor for a given machinery type, engine size and engine age in year X, relies only on emission level and load factor, and is denominated as:

$$TF_{i,j,k}(X) = TF_z \quad (20)$$

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

The transient factors inserted in (20) are shown in Annex 2.B.9. No transient corrections are made for gasoline and LPG engines and, hence, $TF_z = 1$ for these fuel types.

The final calculation of fuel use and emissions in year X for a given machinery type, engine size and engine age, is the product of the expressions 17-20:

$$E(X)_{i,j,k} = E_{Basis}(X)_{i,j,k} \cdot TF(X)_{i,j,k} \cdot (1 + DF(X)_{i,j,k}) \quad (21)$$

The evaporative hydrocarbon emissions from fuelling are calculated as:

$$E_{Evap,fueling,i} = FC_i \cdot EF_{Evap,fueling} \quad (22)$$

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

For tank evaporation, the hydrocarbon emissions are found from:

$$E_{Evap,\tan k,i} = N_i \cdot EF_{Evap,\tan k,i} \quad (23)$$

Where $E_{Evap,tank,i}$ = hydrocarbon emissions from tank evaporation, N = number of engines, i = machinery type and $EF_{Evap,fueling}$ = emission factor in g NMVOC pr year.

Ferries, other national sea transport and fisheries

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

$$E(X) = \sum_i N_i \cdot T_i \cdot S_{i,j} \cdot P_i \cdot LF_j \cdot EF_{k,l,y} \quad (24)$$

Where E = fuel use/emissions, N = number of round trips, T = sailing time pr round trip in hours, S = ferry share of ferry service round trips, P = engine size in kW, LF = engine load factor, EF = fuel use/emission factor in g pr kWh, i = ferry service, j = ferry, k = fuel type, l = engine type, y = engine year.

For the remaining navigation categories, the emissions are calculated using a simplified approach:

$$E(X) = \sum_i EC_{i,k} EF_{k,l,y} \quad (25)$$

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

The emission factor inserted in (25) is found as an average of the emission factors representing the engine ages which are comprised by the average lifetime in a given calculation year, X:

$$EF_{k,l,y} = \frac{\sum_{year=X}^{year=X-LT} EF_{k,l}}{LT_{k,l}} \quad (26)$$

Other sectors

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

$$E = FC \cdot EF \quad (27)$$

where E = emission, FC = fuel consumption and EF = emission factor. The calculated emissions for other mobile sources are shown in CollectER format in Annex 2.B.14 for the years 2007 and as time-series 1985-2007 in Annex 2.B.15 (NFR 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 2.B.13.

National sea transport and fisheries

For national sea transport in Denmark, the new fuel consumption estimates obtained by NERI (Winther, 2008a) are regarded as much more accurate than the DEA fuel sales data, since the large fluctuations in reported fuel sales cannot be explained by the actual development in the traffic between different national ports. As a consequence, the new bottom-up estimates replace the previous fuel based figures for national sea transport.

There are different potential reasons for the differences between estimated fuel consumption and reported sales for national sea transport in Denmark. According to the DEA, the latter fuel differences are most likely explained by inaccurate costumer specifications made by the oil suppliers. This inaccuracy can be caused by a sector misallocation in the sales statistics between national sea transport and fisheries for gas oil, and between national sea transport and industry for heavy fuel oil (Peter Dal, DEA, personal communication, 2007).

Following this, for fisheries and industry the updated fuel consumption time series for national sea transport lead, in turn, to changes in the fuel activity data for fisheries (gas oil) and industry (heavy fuel oil), so the national energy balance can remain unchanged.

For fisheries, fuel investigations made prior to the initiation of the work made by Winther (2008a) have actually pointed out a certain area of inaccuracy in the DEA statistics. No engines installed in fishing vessels use heavy fuel oil, even though a certain amount of heavy fuel oil is listed in the DEA numbers for some statistical years (H. Amdissen, Danish Fishermen's Association, personal communication, 2006). Hence, for fisheries small amounts of fuel oil are transferred to national sea transport, and in addition small amounts of gasoline and diesel are transferred to recreational craft.

Non road machinery and recreational craft

For diesel and LPG, the non-road fuel consumption estimated by NERI is partly covered by the fuel-use amounts in the following DEA sectors: agriculture and forestry, market gardening, and building and construction. The remaining quantity of non-road diesel and LPG is taken from the DEA industry sector.

For gasoline, the DEA residential sector, together with the DEA sectors mentioned for diesel and LPG, contribute to the non-road fuel consumption total. In addition, a certain amount of fuel from road transport is needed to reach the fuel-use goal.

The amount of diesel and LPG in DEA industry not being used by non-road machinery is included in the sectors, "Combustion in manufacturing industry" (0301) and "Non-industrial combustion plants" (0203) in the Danish emission inventory.

For recreational craft, the calculated fuel-use totals for diesel and gasoline are subsequently subtracted from the DEA fishery sector. For gasoline, the DEA reported fuel consumption for fisheries is far too small to fill the fuel gap, and hence the missing fuel amount is taken from the DEA road transport sector.

Bunkers

The distinction between domestic and international emissions from aviation and navigation should be in accordance with the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories. For the national emission inventory this, in principle, means that fuel sold (and associated emissions) for flights/sea transportation starting from a seaport/airport in the Kingdom of Denmark, with destinations inside or outside the Kingdom of Denmark, are regarded as domestic or international, respectively.

Aviation

For aviation, the emissions associated with flights inside the Kingdom of Denmark are counted as domestic. The flights from Denmark to Greenland and the Faroe Islands are classified as domestic flights in the inventory background data. In Greenland and the Faroe Islands, the jet fuel sold is treated as domestic. This decision can be considered sensi-

ble since in the real world almost no fuel is bunkered in Greenland/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, 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 used by vessels sailing to Greenland and the Faroe Islands should form 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 classifications subsequently be made.

Conclusively, the domestic/international fuel split (and associated emissions) for navigation is not determined with the same 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

Emission uncertainty estimates 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). However, for TSP the latter source indicates no uncertainty factor and, instead, this factor is based on own judgement.

The activity data uncertainty factor is assumed to be 2 and 10 % for road transport and other mobile sources, respectively, 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 2.B.16 for all emission components.

Table 3.35 Uncertainties for activity data, emission factors and total emissions in 2006 and as a trend.

	Emission factor uncertainties [%]		Emission uncertainties [%]	
Pollutant	Road	Other	Overall 2007	Trend
SO_2	50	50	48	3
NO_x	50	100	49	6
NMVOC	50	100	50	10
CO	50	100	52	13
NH_3	1000	1000	996	2517
TSP	50	100	46	11
PM_{10}	50	100	47	9
$PM_{2.5}$	50	100	49	7
Arsenic	1000	1000	1000	4
Cadmium	1000	1000	807	195
Chromium	1000	1000	808	205
Copper	1000	1000	832	105
Mercury	1000	1000	1000	9
Nickel	1000	1000	736	107
Lead	1000	1000	966	18
Selenium	1000	1000	717	208
Zinc	1000	1000	820	137
Dioxins	1000	1000	708	114
Flouranthene	1000	1000	808	28
Benzo(b) flouranthene	1000	1000	795	75
Benzo(k) flouranthene	1000	1000	832	94
Benzo(a) pyrene	1000	1000	867	75
Benzo(g,h,i) perylene	1000	1000	813	87
indeno(1,2,3-c,d) pyrene	1000	1000	794	203

As regards time-series consistency, background flight data cannot be made available on a city-pair level from 2000 or earlier. However, aided by LTO/aircraft statistics for these years and the use of proper assumptions, a sound level of consistency is still obtained in 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 use information for working equipment and machinery.

3.3.6 Quality assurance/quality control (QA/QC)

It is the intention to publish every second year a sector report for road transport and other mobile sources. The last sector report concerned the 2006 inventory (Winther, 2008b).

The QA/QC descriptions of the Danish emission inventories for transport are given in Nielsen et al. (2008).

3.3.7 Recalculations

The following recalculations and improvements of the emission inventories have been made since the emission reporting in 2008.

Road transport

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

Recalculations have been made from 1985-2006 resulting in minor emission differences between 0 and -1 %, for all emission components other than the fuel related ones. For these latter components, the emissions remain the same.

National sea transport

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

This has caused the fuel consumption and emissions to change from 1996 onwards. Most significantly the emission changes for NO_x are between -3 and -20 %, whereas the emission changes for other components are between -3 and 3 %. The fuel consumption increases are between 0 and 2 % in the period.

Fishery

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

Fishery is a part of the CRF-NFR code 1A4c consisting of agriculture, forestry and fisheries activities, and hence the fuel consumption and emission impacts are somewhat smaller for the sector as a whole.

From 1996-2005 the fuel consumption and emission changes are between 0 and -2 %. For 2006 the emission changes are between -3 and -1 %. For SO_2 though the emission change is -7 %, due to the relatively high sulphur content in marine gas oil.

Military

Emission factors derived from the new road transport simulations have caused minor emission changes from 1985-2006. The emission differences are between -1 and 2 %, for all emission components other than the fuel related ones. For these latter components, the emissions remain the same.

Residential

No changes have been made.

Railways

No changes have been made.

Aviation

No changes have been made.

3.3.8 Improvements

Heavy metals and POPs

It is the intention this year to update the heavy metal and POP emission inventories for mobile sources.

QA/QC

Based on the improved inventory QA/QC description for mobile sources, a list of work is planned to be carried out this year. For more information, please refer to Illerup et al., (2007).

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3.4 Fugitive emissions (NFR sector 1B)

This chapter includes fugitive emissions in the NFR sector 1B.

3.4.1 Source category description

According to the categorization in the reporting format for the UNECE LRTAP fugitive emissions is a sub-category under the main-category Energy (Sector 1). Fugitive emissions (Sector 1B) is segmented into sub-categories covering emissions from solid fuels (1B1), oil (1B2a), natural gas (1B2b) and from venting and flaring (1B2c). These NFR sub-sectors are shortly described below according to Danish conditions:

- 1B1c Fugitive emission from solid fuels: Emissions from solid fuels are only relevant for the Danish national emission inventories in the case of particle emissions. Other components are not occurring, as these emissions should be included in the inventory for the nation housing the coal mines.
- 1B2a Fugitive emissions from oil: The category "Fugitive emissions from oil (1B2a)" includes emissions from offshore activities and refineries.
- 1B2b Fugitive emissions from natural gas, transmission and distribution: The NFR sector 1B2b includes emissions from transmission and distribution of natural gas. Emissions from gas storage are included in transmission.
- 1B2c Flaring of gas: Emissions from flaring include both offshore flaring, flaring in the gas storage and gas treatment plants and in refineries. In Denmark venting of gas is assumed to be negligible because controlled venting enters the gas flare system.

Activity data end emissions are hold in the Danish emission database on SNAP sector categories (Selected Nomenclature for Air Pollution). An overview of the SNAP codes referring to fugitive emissions and the corresponding NFR categories are shown in Table 3.36.

Table 3.36 List of NFR sectors relevant for fugitive emissions, and the corresponding SNAP codes and emission sources. Sectors written in grey are not occurring in the Danish emission inventories.

NFR sector	SNAP ID	SNAP name	Source
	04	Production processes	
1 B 2 a	0401	Processes in petroleum industries	Oil
1 B 2 a	040101	Petroleum products processing	Oil
1 B 2 a	040103	Other	Oil
	0402	Processes in iron and steel industries and collieries	
1 B 1 b	040201	Coke oven (door leakage and extinction)	Solid fuel transformation
1 B 1 c	040204	Solid smokeless fuel	Other
	05	Extraction and distribution of fossil fuels and geothermal energy	
1 B 1 a	0501	Extraction and 1st treatment of solid fossil fuels	Coal mining
1 B 1 a	050101	Open cast mining	Coal mining
1 B 1 a	050103	Storage of solid fuel	Coal mining
1 B 2 a	0502	Extraction, 1st treatment and loading of liquid fossil fuels	Oil
1 B 2 a	050201	Land-based activities	Oil
1 B 2 a	050202	Off-shore activities	Oil
1 B 2 b	0503	Extraction, 1st treatment and loading of gaseous fossil fuels	Natural gas
1 B 2 b	050301	Land-based desulfuration	Natural gas
1 B 2 b	050302*	Offshore activities	Natural gas
1 B 2 b	050303	Off-shore activities	Natural gas
1 B 2 a	0504	Liquid fuel distribution (except petrol distribution)	Oil
1 B 2 a	050401	Marine terminals (tankers, handling and storage)	Oil
1 B 2 a	050402	Other handling and storage (including pipeline)	Oil
1 B 2 a	0505	Petrol distribution	Oil
1 B 2 a	050501	Refinery dispatch station	Oil
1 B 2 a	050503	Service stations (including refuelling of cars)	Oil
1 B 2 b	0506	Gas distribution networks	Natural gas
1 B 2 c	050601	Pipelines	Venting and flaring
1 B 2 b	050602	Distribution networks	Natural gas
	09	Waste treatment and disposal	
1 B 2 c	0902	Waste incineration	Venting and flaring
1 B 2 c	090203	Flaring in oil refinery	Venting and flaring
1 B 2 c	090206	Flaring in oil and gas extraction	Venting and flaring

*In the Danish emission inventory emissions from extraction of gas are united under “Extraction, 1st treatment and loading of liquid fossil fuels / Off-shore activities” (NFR 1B2a / SNAP 050202).

Table 3.37 summarizes the Danish fugitive emissions in 2007. The methodologies, activity data and emission factors used for calculation are described in the following chapters.

Table 3.37 Summary of the Danish fugitive emission in 2007. P refers to point source and A to area source.

NFR sector	SNAP	Source	Pollutant	Emission, tonnes
1B2a iv	040101	P	SO_2	0.00
1B2a iv	040101	P	NMVOC	3773.03
1B2a iv	040103	P	SO_2	609.70
1B1a	050103	A	TSP	1218.48
1B1a	050103	A	PM_{10}	487.39
1B1a	050103	A	$PM_{2.5}$	48.74
1B2a i	050201	A	NMVOC	5981.00
1B2a i	050202	A	NMVOC	2442.00
1B2a v	050503	A	NMVOC	968.59
1B2b	050601	A	NMVOC	2.26
1B2b	050601	P	NMVOC	18.00
1B2b	050603	A	NMVOC	26.78
1B2c	090203	P	SO_2	525.60
1B2c	090203	P	NO_x	22.39
1B2c	090203	P	NMVOC	28.39
1B2c	090203	P	TSP	1.72
1B2c	090203	P	PM_{10}	1.72
1B2c	090203	P	$PM_{2.5}$	1.72
1B2c	090203	P	dioxin	0.00
1B2c	090206	A	SO_2	1.81
1B2c	090206	A	NO_x	187.08
1B2c	090206	A	NMVOC	14.45
1B2c	090206	A	TSP	0.60
1B2c	090206	A	PM_{10}	0.60
1B2c	090206	A	$PM_{2.5}$	0.60
1B2c	090206	A	dioxin	0.00
1B2c	090206	A	fluoranthene	0.13
1B2c	090206	P	SO_2	0.02
1B2c	090206	P	NO_x	7.65
1B2c	090206	P	NMVOC	7.04
1B2c	090206	P	TSP	0.01
1B2c	090206	P	PM_{10}	0.01
1B2c	090206	P	$PM_{2.5}$	0.01
1B2c	090206	P	dioxin	0.00
1B2c	090206	P	fluoranthene	0.00

3.4.2 Methodological issues

The following chapters give descriptions on the methods of calculation used in the Danish emission inventory. Further, the activity data and emission factors that form the basis for the calculations are described according to data source and values.

Fugitive emissions from solid fuels

The emissions of particulate matter from storage of coal are estimated on basis of the imported amount of coal.

$$E_{coal_storage} = EMF_{coal_storage} \cdot I_{coal} \quad \text{(Eq. 28)}$$

where $EMF_{coal_storage}$ is the emission factor for storage of coal in coal piles and I_{coal} is the amount of coal imported in the actual year.

Fugitive emissions from oil

The emissions from oil derive from offshore activities, service stations and refineries. Emissions from offshore activities include emissions from extraction, onshore oil tanks and onshore and offshore loading of ships. In the case of service stations emissions from reloading of tankers and refuelling of vehicles are included. The emissions from refineries derive from petroleum products processing (oil refining). Emissions from flaring in refineries are included in the "Flaring" chapters.

Offshore activities

Fugitive emissions from oil include emissions from extraction, from onshore oil tanks and from onshore and offshore loading of ships.

The total emission can be expressed as:

$$E_{total} = E_{extraction} + E_{ship} + E_{oil\ tanks} \quad \text{(Eq. 29)}$$

Fugitive emissions from extraction

According to the EMEP/CORINAIR Guidebook (EEA, 2007) the total fugitive emissions of volatile organic carbon (VOC) from extraction of oil and gas can be estimated by means of Equation 30.

$$E_{extraction,VOC} = 40.2 \cdot N_P + 1.1 \cdot 10^{-2} P_{gas} + 8.5 \cdot 10^{-6} \cdot P_{oil} \quad \text{(Eq. 30)}$$

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

It is assumed that the VOC contains 25 % NMVOC and in consequence the total emission of NMVOC for extraction of oil and gas can be calculated as:

$$E_{extraction,NMVOC} = 0.25(40.2 \cdot N_P + 1.1 \cdot 10^{-2} P_{gas} + 8.5 \cdot 10^{-6} \cdot P_{oil}) \quad \text{(Eq. 31)}$$

Loading of ships

Fugitive emissions from loading of ships include the transfer of oil from storage tanks or directly from the well into a ship. The activity also includes losses during transport. When oil is loaded hydrocarbon vapour will be displaced by oil and new vapour will be formed, both leading to emissions. The emissions from ships are calculated by Equation 32.

$$E_{ships} = EMF_{ships} \cdot L_{oil} \quad \text{(Eq. 32)}$$

where EMF_{ships} is the emission factor for loading of ships off-shore and on-shore and L_{oil} is the amount of oil loaded.

Oil tanks

The emissions for storage of oil are given in the green accounts from DONG for 2006 (DONG, 2007). An implied emission factor is calculated for use in the NFR tables on basis of the amount of oil transported in pipelines according to Equation 33.

$$IEF_{tanks} = \frac{E_{tanks}}{T_{oil}} \qquad \text{(Eq. 33)}$$

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

Service stations

NMVOC emissions from service stations are estimated as outlined in Equation 34.

$$E_{service\ stations} = \left(EMF_{reloading} \cdot T_{fuel}\right) + \left(EMF_{refuelling} \cdot T_{fuel}\right) \qquad \text{(Eq. 34)}$$

where $EMF_{reloading}$ is the emission factor for reloading of tankers to storage tanks at the service stations, $EMF_{refuelling}$ is the emission factor for refuelling of vehicles and T_{fuel} is the amount of gasoline used for road transport.

Oil refining

When oil is processed in the refineries part of the volatile organic carbon hydrides (VOC) are emitted to the atmosphere. The VOC emissions from the petroleum refinery process include non-combustion emissions from handling and storage of feedstock (raw oil), from the petroleum product processing and from handling and storage of products. Emissions from flaring in refineries are included under "Flaring". In cases where only the total VOC emission is given by the refinery the emission of NMVOC is estimated due to the assumption that 99 % of VOC is NMVOC.

Both the non-combustion processes including product processing and sulphur recovery plants emit SO_2. The SO_2 emissions are calculated by the refineries and implemented in the emission inventory without further calculation.

Transmission and distribution of gas

The fugitive emission from transmission, storage and distribution is based on information from the gas companies. The only calculation added to the delivered data is estimation of NMVOC due to the gas quality measured by Energinet.dk.

Flaring

Emissions from flaring are estimated from the amount of gas flared offshore and in gas treatment/storage plants and from the corresponding emission factors. Offshore flaring amounts are given in Denmark's oil and gas production (Danish Energy Authority, 2008b) while flaring in treatment/storage plants are given in DONG Energy's green accounts (Dong Energy, 2008). The emission factors for flaring are based on the EMEP/CORINAIR Guidebook (EEA, 2007) and the calorific value for natural gas in Denmark which again is based on measurements in quality measuring station. SO_2 and NO_x emissions from flaring in refineries are given in the data set delivered by the individual refineries.

3.4.3 Activity data

Coal storage

The activity data origins from the "basic data" that lists the imported amounts and the calorific values of coal (Danish Energy Agency, 2008a). In 2007 the imported amount was 8 123 210 Mg. The yearly variations reflect the import/export of electricity and the outdoor temperature (Figure 3.64). Note that particulate matter was only included in the inventory from 2000.

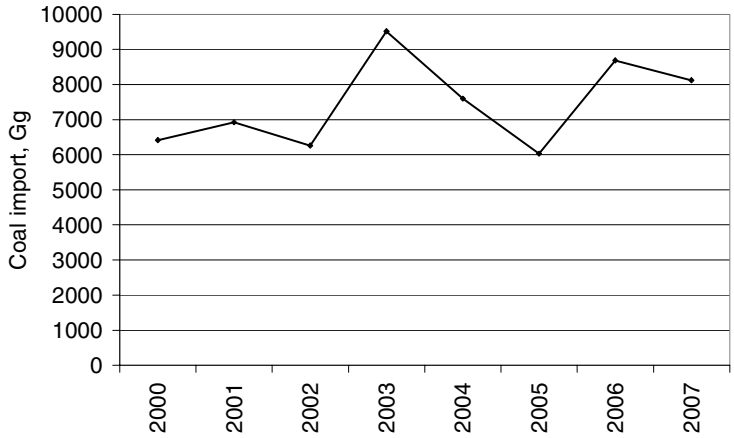

Figure 3.64 Amounts of imported coal.

Extraction of oil and gas and loading of ships

Activity data used in the calculations of the emissions from oil and gas production and loading of ships are shown in Table 3.38. Data are based on information from the Danish Energy Authority (Danish Energy Authority, 2008b) and from the green accounts from the Danish gas transmission company DONG Energy (DONG Energy, 2008).

Table 3.38 Activity data for 2007.

Activity	Symbols	Activity data	Data source
Number of platforms	N_p	55	Danish Energy Authority (2008b)
Produced gas, 10^6 Nm^3	P_{gas}	10 046	Danish Energy Authority (2008b)
Produced oil, 10^3 m^3	$P_{oil,vol}$	18 083	Danish Energy Authority (2008b)
Produced oil, 10^3 ton	P_{oil}	15 551	Danish Energy Authority (2008b)
Oil loaded, 10^3 m^3	$L_{oil\ off\text{-}shore}$	2 163	Danish Energy Authority (2008b)
Oil loaded, 10^3 ton	$L_{oil\ off\text{-}shore}$	1 860	Danish Energy Authority (2008b)
Oil loaded, 10^3 m^3	$L_{oil\ on\text{-}shore}$	12 000	DONG (2008)
Oil loaded, 10^3 ton	$L_{oil\ on\text{-}shore}$	10 320	DONG (2008)

Mass weight raw oil = 0.86 tonne pr m^3.

As seen in Figure 3.65a the production of oil and gas in the North Sea have generally increased in the years 1990-2004. Since 2004 the production has decreased. The number of platforms is yet still increasing Figure 3.65b). Five major platforms were completed in 1997-1999 which is the main reason for the great increase in the oil production in the years 1998-2000.

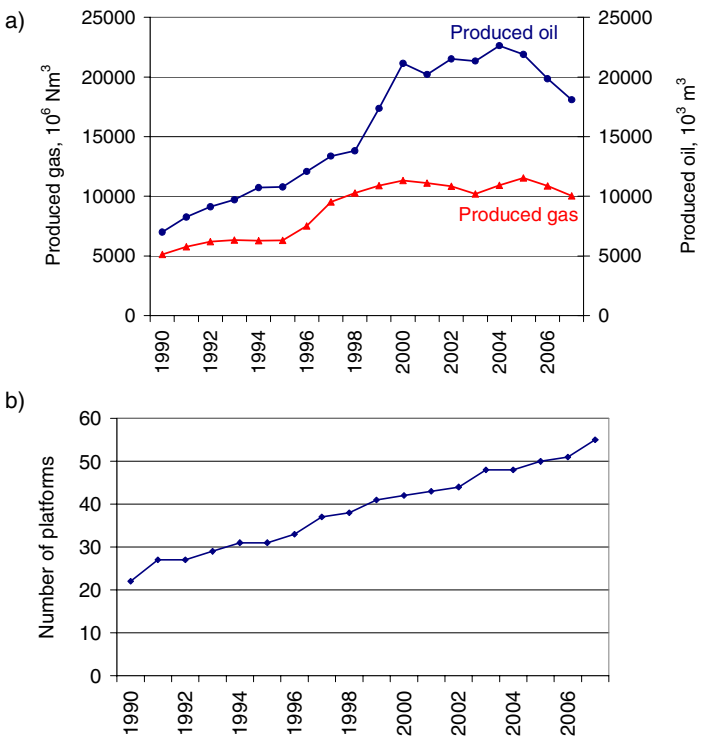

Figure 3.65 **a)** Production of oil and gas and **b)** the number of platforms in the Danish part of the North Sea.

The amounts of oil loaded offshore on ships roughly follow the trend of the oil and gas production (Figure 3.66). Data for offshore loading is not available until 1999. In case of onshore loading of ships the trend is more smoothed.

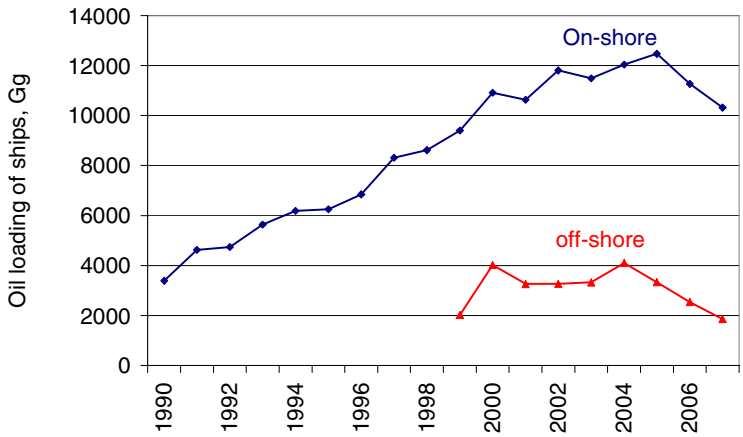

Figure 3.66 Onshore and offshore loading of ships.

Oil refining

Data on the amount of crude oil processed in refineries are given by the refineries in their annual green account and data are shown in Table 3.39. In the last years the amount of crude oil being processed has been slightly decreasing to 7 963 Gg in 2007.

Table 3.39 Oil refineries. Processed crude oil, emissions and emission factors.

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Crude oil, Gg	7 263	7 798	8 232	8 356	8 910	9 802	10 522	7 910	7 906	8 106
Continued	2000	2001	2002	2003	2004	2005	2006	2007		
Crude oil, Gg	8 406	8 284	8 045	8 350	8 264	8 033	8 179	7 963		

Service stations

The Danish Energy statistics holds data on the sale of gasoline which is the basis for estimating emissions of NMVOC from service stations. The gasoline sales show an increase from 1990-1998 and a slightly decreasing trend from 1999-2007 as shown in Figure 3.67. In 2007 the gasoline sale was 1 817 240 Mg.

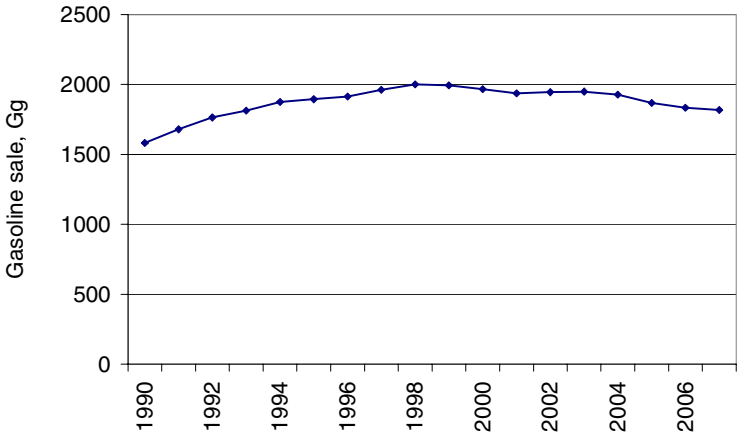

Figure 3.67 Gasoline sales in Denmark 1990-2007.

Transmission, storage and distribution of gas

The activity data used in the calculation of the emissions from natural gas is shown in Table 3.40. For 1990-2006 the data is collected from the gas companies by the Danish Gas Technology Centre, DGC. This data collection has stopped by 2007 and therefore data are collected directly from the gas companies and from DONG Energy's green accounts. Is has not been possible to get data on distribution for 2007 and therefore the distributed amount of gas has been extrapolated from the distributed amount in 2006 by the ratio between the transmitted amount in 2006 and 2007.

Table 3.40 Data on transmission and distribution of gas.

ACTIVITY DATA	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Transmission, Mm^3 *	2 739	3 496	3 616	3 992	4 321	4 689	5 705	6 956	6 641	6 795
Distribution, Mm^3 **	1 574	1 814	1 921	2 185	2 362	2 758	3 254	3 276	3 403	3 297
Continued	2000	2001	2002	2003	2004	2005	2006	2007		
Transmission, Mm^3 *	7 079	7 289	7 287	7 275	7 384	7 600	7 600	6 400		
Distribution, Mm^3 **	3 181	3 675	3 420	3 420	3 248	2 983	3 319	3 022		

* In 1990-1997 transmission rates refer to Danish energy statistics, in 1998 the transmission rate refers to the annual environmental report of DONG, in 1999-2006 emissions refer to DONG/Danish Gas Technology Centre (Karll 2003, Karll 2005, Oertenblad 2006, Oertenblad 2007). In 2007 transmission data refers to the annual environmental report 2008 by Energinet.dk.

**) In 1999-2006 distribution rates refer to DONG / Danish Gas Technology Centre / Danish gas distribution companies (Karll 2003, Karll 2005, Oertenblad 2006, Oertenblad 2007), In 1990-98 distribution rates are estimated from the Danish energy statistics. Distribution rates are assumed to equal total Danish consumption rate minus the consumption rates of sectors that receive the gas at high pressure. The following consumers are assumed to receive high pressure gas: town gas production companies, production plat-

forms and power plants. In 2007 distributions data is estimated according to 2006 and the rate between transmission in 2006 and 2007.

In 2007 the gas transmission was 6400 Mm^3 and the distribution is estimated to 3022 Mm^3 (Figure 3.68). This is a decrease according to last year owing to a mild winter and Denmark had a great import of electricity from Norway and Sweden.

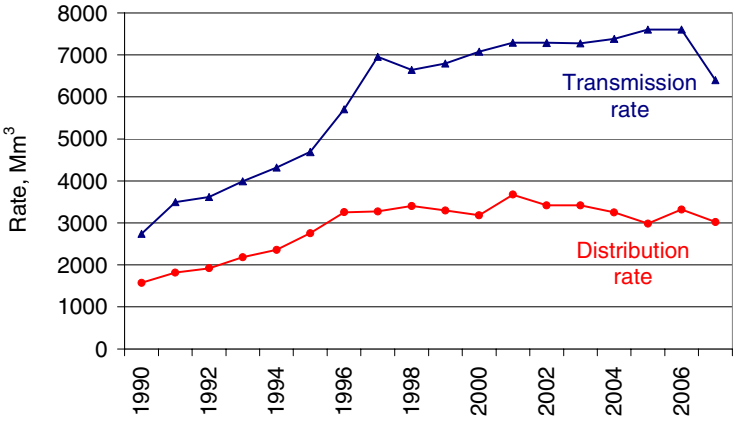

Figure 3.68 Transmission and distribution rates of gas.

Data on the transmission pipelines excluding offshore pipelines and on the distribution network are given by DGC and Energinet.dk concerning length and material. In 2007 the length of the transmission pipelines was 860 km. Because the distribution system in Denmark is relatively new most of the distribution network is made of PE. In 2007 the length of the distribution network was 18 959 km of which 0km was made of cast iron, 1 896 km was made of steel and 17 063 km made of plastic (PE). For this reason the fugitive emission is negligible under normal circumstances as the PE distribution system is basically tight with only minimal fugitive losses. The PE pipes are however vulnerable and therefore most of the fugitive emissions from the pipes are caused by losses due to excavation damages and construction and maintenance activities performed by the gas companies. These losses are either measured or estimated by calculation in each case by the gas companies.

In Denmark there are two natural gas storage facilities. Both are oblique to make a green account on annual basis. Data on gas input and withdrawal are included and were 746 Mm^3 and 581 Mm^3 in 2007, respectively. Until 2000 emissions from storage of gas were included in transmission in the inventories.

Flaring

The fuel consumption rates are shown in Table 3.41. Flaring rates in gas treatment and gas storage plants are not available until 1995. The mean value for flaring in treatment and storage facilities for the following ten years (1995 to 2004) has been adopted as basis for the emission calculation for the years 1990-1994.

The amount of flared gas is high in 2007 because of a greater maintenance work at the gas treatment plant. The flared amount is 1 972 491 Nm^3 in 2007 in contrast to 975 071 Nm^3 in 2006.

The offshore flaring amounts have been decreasing over the last 4 years in accordance with the exploration as seen in Table 3.41.

Table 3.41 Natural gas flaring rate (Danish Energy Authority, 2008b & DONG Energy, 2008).

Year	Flaring, offshore, TJ	Flaring, treatment and storage, TJ
1990	4 275	35
1991	8 827	35
1992	9 105	35
1993	7 877	35
1994	7 759	35
1995	6 017	45
1996	6 650	30
1997	9 619	35
1998	7 007	30
1999	15 280	32
2000	9 896	29
2001	10 688	35
2002	8 788	43
2003	9 105	32
2004	10 371	34
2005	7 323	42
2006	7 165	39
2007	6 096	79

3.4.4 Emission factors

Coal storage

Emissions of particulate matter from coal storage are estimated by the emission factors used in the emission inventory of Poland (Table 3.42.

Table 3.42 Emission factors used to estimate particulate emissions from coal storage.

Emission factor	TSP	PM_{10}	$PM_{2.5}$
Emission factor, g pr Mg	150	60	6

Loading of ships

In the EMEP/CORINAIR Guidebook (EEA, 2007) standard emission factors for different countries are given. In the Danish emission inventory the Norwegian emission factors are used for estimation of fugitive emissions from loading of ships onshore and offshore (EMEP/CORINAIR, 2007, Table 8.15). The emission factors are listed in Table 3.43.

Table 3.43 Emission factors.

	NMVOC, fraction of loaded	Reference
Ships off-shore	0.001	EEA, 2007
Ships on-shore	0.0002	EEA, 2007

Oil refining

The refineries deliver information on consumption of fuel gas and fuel oil. The calorific values given by the refineries are used when available. When not available standard calorific values given in the basic data tables from the Danish Energy Authority combined with the conversion

factor between fuel gas and fuel oil given by the refinery are used for calculation.

The emissions are given for SO_2, NO_x and VOC. Before 2004 the VOC emissions were not split in CH_4 and NMVOC. The assumption that 1 % of the VOC emission is CH_4 and the remaining 99 % is NMVOC is adapted for the years before 2004.

Service stations

NMVOC from service stations is calculated by use of different emission factors for the time series as shown in Table 3.44. In 1994 the emission factors for NMVOC from service stations were investigated by Fenhann and Kilde (1994) for the years 1990 1991 and 1992, individually. The emission factors reported for reloading and refuelling for 1990 were used for the years 1980-1990, while the emission factors for 1991 was used for that year only. For the years 1992-1995 only the emission factor for refuelling reported by Fenhann and Kilde (1994) was used in the Danish emission inventory. For Reloading of tankers the British emission factor was adopted for the years 1992-2007. For the years 1996-1999 emission factors for the sum of reloading and refuelling have been estimated using interpolation between 1995 and 2000.

Tabel 3.44 Emission factors used for estimating NMVOC from service stations.

EMF NMVOC	Reloading of tankers, kg NMVOC pr tonnes gasoline	Refuelling of vehicles, kg NMVOC pr tonnes gasoline	Sum of reloading and refuelling, kg NMVOC pr tonnes gasoline	Source
1980-1990	1.28	1.52	2.80	Fennmann & Kilde1994
1991	0.64	1.52	2.16	Fennmann & Kilde1994
1992-1995	0.08	1.52	1.60	GB EMF, Fennmann & Kilde1994
1996			1.38	Interpolation between 1995 and 2000
1997			1.17	Interpolation between 1995 and 2000
1998			0.96	Interpolation between 1995 and 2000
1999			0.75	Interpolation between 1995 and 2000
2000-2007	0.08	0.46	0.53	GB EMF

Transmission, storage and distribution of gas

The emission inventories make use of no emission factors in the case of transmission, storage and distribution of gas as the emitted amounts are reported by the gas companies.

Flaring

The emission factors for offshore flaring are shown in Table 3.45. The CO_2 emission factor follows the same time-series as for natural gas combusted in stationary combustion plants. The dioxin emission factor origins from a Danish study by Henriksen et al. (2006) and is, like emission factors for particulate matter, the same as the emission factors used for combustion of natural gas in Danish public power plants. The remaining emission factors are based on the EMEP/CORINAIR Guidebook and are constant for the years 1990-2006. In 2007 the emission factors have been recalculated, which gives a minor divergence according to earlier years. The divergence is caused by introducing a conversion factor of 1.055 between Sm^3 and Nm^3 in the 2007 inventory. Further, the NO_x emission factor has been updated due to the conclusion in a new Danish study of NO_x emissions from offshore flaring carried out by the Danish Ministry of the Environment (2008). The new NO_x emission factor (31.008 g pr GJ or 0.0015 tonnes NO_x pr tonnes gas) is around one

tenth of the old emission factor (300 g pr GJ or 0.015 tonnes NO_x pr tonnes gas) and corresponds well with the emission factors used to estimate NO_x emission in other lands with oil production in the North Sea (Netherlands (approximately 0.0014 tonnes NO_x pr tonnes gas) and United Kingdom (approximately 0.0013 tonnes NO_x pr tonnes gas)).

Table 3.45 Emission factors for offshore flaring of natural gas 2007.

Pollutant	Emission factor	Unit
SO_2	0.300	g pr GJ
NO_x	31.008	g pr GJ
NMVOC	2.395	g pr GJ
CO	23.947	g pr GJ
TSP	0.100	g pr GJ
PM_{10}	0.100	g pr GJ
$PM_{2.5}$	0.100	g pr GJ
Dioxin	0.025	ng pr GJ

3.4.5 Emissions

Coal storage

The emission from storage of coal is 1 219 Mg TSP in 2007 (487 Mg PM_{10} and 49 Mg $PM_{2.5}$). The emissions vary from year to year mainly due to the extent of electricity import/export and temperature variations. Note that particulate matter was only included in the inventory from 2000.

Table 3.46 PM_{10} from storage of solid fuels 2000-2007.

	2000	2001	2002	2003	2004	2005	2006	2007
PM_{10}, Mg	385	415	376	571	456	362	521	487

Extraction of oil and gas and loading of ships

From the activity data in Table 3.38 and Equation 31 the fugitive emissions of NMVOC from extraction are calculated. Corresponding emissions from loading of ships are estimated by Table 3.38, 3.43 and Equation 32. The emissions are listed in Table 3.47 along with the emissions from storage of oil given in the green accounts from DONG Energy (2008).

Table 3.47 NMVOC emissions for 2007.

	NMVOC, tonnes
Fugitive emissions from extraction	582
Oil tanks	3 917
Offshore loading of ships	1 860
Onshore loading of ships	2 064
Total	8 423

Oil refining

In Table 3.48 the emissions of NMVOC from oil refining at the two Danish refineries are listed for the years 1990-2007. Further, the emissions of SO_2 from oil refining and sulphur recovery in refineries are shown. The emission of SO_2 has shown a pronounced decrease since 1990 because of technical improvements at the refineries. Note that SO_2 from refining and recovery prior to 1994 was summarized and reported as an area source in category 1B2a vi. Note also that SO_2 from oil refining from 2001 are included in stationary combustion.

Table 3.48 Oil Refineries. Emissions of NMVOC and SO_2 from oil refining and SO_2 from sulphur recovery.

	1990[1]	1991[1]	1992[1]	1993[1]	1994	1995	1996	1997	1998	1999
NMVOC emission, Mg	3 667	3 937	4 203	4 219	5 855	4 546	5 875	4 547	4 558	4 558
SO_2, oil refining, Mg	3 335	2 713	3 147	2 526	934	585	167	216	253	234
SO_2, sulphur recovery, Mg					3 332	2 437	2 447	1 766	1 188	1 125
Continued	2000	2001[2]	2002[2]	2003[2]	2004[2]	2005[2]	2006[2]	2007[2]		
NMVOC emission, Mg	4 983	4 338	4 302	3 708	3 732	3 550	3 848	3 773		
SO_2, oil refining Mg	178									
SO_2, sulphur recovery Mg	803	672	332	246	119	255	679	610		

1) Prior to 1994 SO_2 emissions from oil refining and sulphur recovery are reported as area sources in category 1B2a vi.

2) From 2001 SO_2 emissions from oil refining are included in stationary combustion.

Service stations

Emissions from service stations are calculated using the emission factors in Table 3.44 and the sales of gasoline given by the Danish Energy statistics. The latter is listed in Table 3.49.

Table 3.49 Emissions of NMVOC from service stations 1990-2007.

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
NMVOC emission, Mg	4 432	3 629	2 817	2 894	2 994	3 026	2 648	2 298	1 918	1 488
Continued	2000	2001	2002	2003	2004	2005	2006	2007		
NMVOC emission, Mg	1 048	1 033	1 037	1 039	1 027	996	977	969		

Transmission, storage and distribution of gas

Emissions of CH_4 are given by the gas companies. The CH_4 emissions for transmission are estimated on basis of registered loss in the transmission grid and the emission from the natural gas consumption in the pressure regulating stations (Ørtenblad, 2007) and CH_4 emissions from gas distribution are estimated by use of emission factors from the Danish EPA and OPG as well as from the gas composition. It includes flaring, discharge and blasting of gas, emissions from production and consumption of energy (electricity, gas, diesel, gasoline and diesel for cars) (Ørtenblad, 2007).

The emissions of NMVOC are calculated on basis of the CH_4 emission according to the gas quality measured by Energinet.dk (Equation 35).

$$E_{NMVOC} = E_{CH_4} \cdot (0.225 / 0.738) \qquad \text{(eq. 35)}$$

For the years before 2000 emissions from transmission and storage have not been estimated separately and storage is included in transmission. The decrease in NMVOC emission from transmission from 2006 to 2007 owe to completion of a greater construction work and rerouting of a major pipeline (Table 3.50). As mentioned the pipelines in Denmark are relatively new and most emissions are due to construction and maintenance. There have been no appreciable construction work in 2007 and therefore a low emission.

The increased emission from distribution in 2004 owe to venting of the distribution network.

Table 3.50 NMVOC emission from transmission, storage and distribution. The notes below the table refer to the CH_4 emission, which is the basis for calculation of NMVOC.

NMVOC emission*	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Transmission, Mg**	30	49	15	31	25	96	32	72	48	58
Storage, Mg***										
Distribution, Mg***						80	95	23	24	43
Continued	2000	2001	2002	2003[1),2)]	2004[1)]	2005[1)]	2006[1)]	2007[3)]		
Transmission, Mg**	52	48	24	27	26	43	46	2		
Storage, Mg***		22	20	21	26	16	20	22		
Distribution, Mg***	15	17	12	12	43	19	29	27		

*NMVOC emissions are estimated from the CH_4 emission according to the gas quality given by Energinet.dk.

**In 1991-95 CH4 emissions are based on the annual environmental report from DONG for the year 1995. In 1996-99 the CH_4 emission refers to the annual environmental reports from DONG for the years 1996-99. In 2000-2006 the CH_4 emission refers to DONG/Danish Gas Technology Centre (Karll 2003, Karll 2005, Oertenblad 2006, Oertenblad 2007). In 2007 the CH_4 emission refers to the annual environmental reports from Energinet.dk for 2008.

***Danish Gas Technology Centre / DONG/ Danish gas distribution companies (Karll 2003, Karll 2005, Oertenblad 2006, Oertenblad 2007. Emissions from storage are included in transmission 1990-1999.

[1)] Data from Naturgas Fyn not included until 2007 as data has not been available.

[2)] Assumed same emission as in 2002.

[3)] Distribution data are extrapolated from 2006 according to change in transmission data.

Flaring

As shown in Figure 3.69 there was a marked increase in the amount of offshore flaring in 1997 and 1999. The increase in 1997 was due to the new field Dan and the completion of the Harald field. The increase in 1999 was due to the opening of the three new fields Halfdan, Siri and Syd Arne.

The time-series for the emission of CO_2 from offshore flaring of natural gas fluctuates due to the fluctuations in the fuel rate and to a minor degree due to the CO_2 emission factor. The latter rests on gas quality measurements. Fuel rate and CO_2 emission are shown in Figure 3.69.

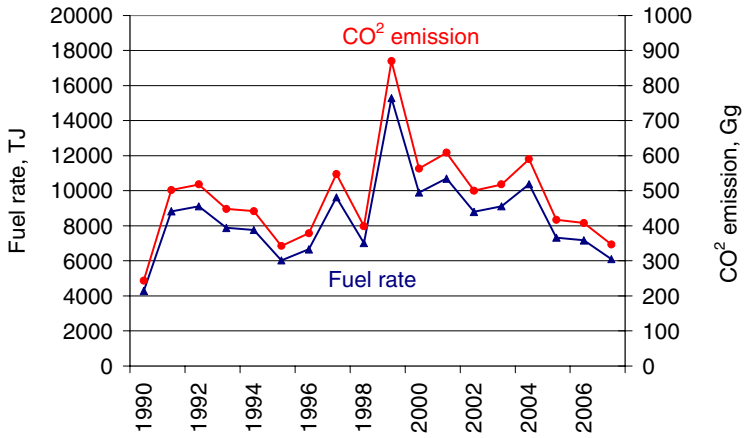

Figure 3.69 Fuel rate and CO_2 emission from offshore flaring of gas 1990-2007.

Besides in the offshore sector flaring also takes place in refineries and gas treatment/storage plants. In case of SO_2 flaring in refineries is the most significant emission source (Table 3.51 and Table 3.52). In 1990-1993 emissions from petroleum product processing were included in emissions from flaring in refineries (1B2c). From 1994 the data delivery format was changed which made it possible to split the emissions into

contributions from flaring and processing, respectively. Emissions from processing are from 1994 included in 1B2a iv.

The decreasing emissions of SO_2 in 1995 and 1997 are due to technical improvements of the sulphur recovery system at one of the two Danish refineries (Table 3.51). The increase in SO_2 from flaring in refineries in 2005 and 2007 was due to shutdown for inspection and maintenance.

Table 3.51 Emissions from flaring in refineries.

	1990*	1991*	1992*	1993*	1994	1995	1996	1997	1998	1999
SO_2, tonnes	943	926	935	1 190	520	203	218	138	70	50
NO_x, tonnes	41	41	41	41	235	26	41	27	34	31
NMVOC, tonnes	34	34	34	34	34	34	34	22	28	27
CO, tonnes	5	5	5	5	5	5	5	3	4	4
Continued	2000	2001	2002	2003	2004	2005	2006	2007		
SO_2, tonnes	51	46	68	96	53	296	257	526		
NO_x, tonnes	33	21	39	24	31	26	21	22		
NMVOC, tonnes	28	18	33	20	26	34	28	28		
CO, tonnes	5	3	6	3	4	6	5	5		

* In 1990-1993 emissions from petroleum product processing were included in flaring in refineries due to the data delivery form. From 1994 emissions from petroleum product processing were given in 1B2a iv.

Table 3.52 Emissions from flaring offshore and in gas treatment/storage plants.

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
SO_2, tonnes	1	3	3	2	2	2	2	3	2	5
NO_x, tonnes	131	270	278	242	239	197	208	302	218	480
NMVOC, tonnes	13	26	27	23	23	22	22	32	24	49
CO, tonnes	105	217	224	195	193	157	170	247	181	391
Continued	2000	2001	2002	2003	2004	2005	2006	2007		
SO_2, tonnes	3	3	3	3	3	2	2	2		
NO_x, tonnes	313	338	279	292	322	230	225	195		
NMVOC, tonnes	33	35	31	31	34	25	24	21		
CO, tonnes	256	276	230	239	263	190	186	160		

3.4.6 Uncertainties and time-series consistency

Uncertainty estimates are included in the uncertainty estimate for stationary combustion plants.

3.4.7 Source specific QA/QC and verification

In relation to fugitive emissions the following procedures are carried out to ensure the data quality:

- Checking of time-series in the IPCC and SNAP source categories. Considerable changes are controlled and explained.
- Comparison with the inventory of the previous year. Any major changes are verified.
- Total emission, when aggregated to IPCC and LRTAP reporting tables, is compared with totals based on SNAP source categories (control of data transfer).
- A manual log table in the emission databases is applied to collect information about recalculations.

- The emission from the large point sources (refineries, gas treatment and gas storage plants) are compared with the emission reported the previous year.
- Some automated checks have been prepared for the emission databases:
  - Check of units for fuel rate, emission factor and plant-specific emissions
  - Check of emission factors for large point sources. Emission factors for pollutants that are not plant-specific should be the same as those defined for area sources.
  - Additional checks on database consistency
- Most emission factor references are now incorporated in the emission database, itself.
- Most data sources are implemented in the fugitive emission model.
- Annual environmental reports are kept for subsequent control of plant-specific emission data.

The QC work will continue in future years.

Data deliveries

Table 3.53 lists the external data deliveries used for the inventory of fugitive emissions. Further the table holds information on the contacts at the data delivery companies.

Table 3.53 List of external data deliveries.

Dataset	Description	Activity data, emission factors or emissions	Reference	Contact(s)	Data agreement/ Comment
Data for offshore extraction	Gas and oil production. Dataset for production of oil, gas and number of platforms. NFR 1B2a	Activity data	The Danish Energy Agency (DEA)	Jan H. Andersen	No formal data agreement.
Gas distribution	Natural gas from the distribution company, sales and losses (meter differences)	Activity data	DONG Energy, HNG and MN, Naturgas Fyn	Finn Adser, Ole B. Hansen & Sofie Faaborg-Andersen, Ron Cronin	No formal data agreement.
Gas transmission	Natural gas from the transmission company, sales and losses (meter differences)	Activity data	Energinet.dk	Christian Friberg B. Nielsen	
Environmental report from DONG	Gas and oil production. The amount of oil loaded onshore and emissions from raw oil tanks. NFR 1B2a	Activity data and emission data	DONG, 2007	Mike Robson	No formal data agreement.
Air emissions from refinery (Statoil and Shell)	Fuel consumption and emission data. NFR 1B2a.	Activity data and emission data	Statoil, Shell	Claus Stefan Kock, Lis Rønnow Rasmussen	No formal data agreement.
Environmental indicators of the gas industry	Data for natural gas transmission/distribution and storage. NFR 1B2b.	Activity data and emission data	DONG Energy, HNG and MN, Naturgas Fyn	Finn Adser, Ole B. Hansen, Sofie Faaborg-Andersen	No formal data agreement.
Service stations	Data on gasoline sales	Activity data	The Danish Energy Agency (DEA)		
CO_2 quota reports	Reports according to the CO_2 emission trading scheme	Activity data			Not necessary due to obligation by law
Emissions from storage and treatment of gas	Green accounts from plants defined as large point sources (Lille Torup, Stenlille, Nybro, Oil terminal)	Activity data	Various plants.		Not necessary due to obligation by law
Off shore flaring		Activity data	The Danish Energy Authority		
Emission factors	Emission factors origin from a large number of sources	Emission factors	See chapter regarding emission factors		

3.4.8 Source specific recalculations

Offshore flaring: Recalculations have been made for fugitive emissions 1985-2006 according to emission of NO_X from flaring. The Danish Ministry of the Environment has leaded an evaluation on NO_X emissions from flaring with the aim to improve the emission factor that is used in the Danish national emission inventory. The evaluation concluded that it is more representative to make a change from using the standard NO_X emission factor given in the EMEP/CORINAIR guidebook to use an emission factor that is in accordance with the guidelines by the British (UKOOA), the American (OGP) and the Norwegian (OLF) oil and gas producers. The changed emission factor causes the estimated NO_X

emission from flaring to reduce by a factor of 10. The new implemented emission factor is 0.0015 tonnes NO_X pr tonnes gas.

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

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

Flaring in natural gas storage plants: The data have been relocated from NFR 1B2b iv to 1B2b iii for the year 2000 to make the time-series consistent.

3.4.9 Source specific planned improvements

The following future improvements are suggested:

- **Emissions from storage of fuels in tank facilities:** The recent edition of the Danish emission inventory holds emissions from extraction of fuels, combustion of fuels and from service stations. To make the inventory complete emissions from storage of fuels in tank facilities should be included in the future if data is available. Work is going on to locate greater tank facilities in Denmark and collect the available data. In cases where no emission estimates or measurements are available a set of emission factors have to be set up.
- **Emissions from town gas:** Work is going on to add an improvement to the Danish inventories by including emissions from town gas production and distribution. In earlier years town gas was used in Denmark to a great extend, but most plants were closed during the seventies owing to the oil crises. Since 1985 only four plants have had town gas production. Two gas plants were shut down in January 2004 and November 2005, respectively leaving only two cities with a town gas supply today. Collection of data on town gas, including production, distribution, networks and gas loss is in process.
- **Emissions from offshore extraction of oil and gas:** The fugitive emissions from extraction of oil and gas are based on a standard formula. If possible a better estimate should be implemented.

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4 Industrial processes (NFR sector 2)

4.1 Overview of the sector

The present sector *"Industrial processes"* (NFR sector 2) comprises combustion processes combined with *"process emissions"* (combustion in manufacturing industry - processes with contact) as well as process emissions without any contact with energy-related emissions. This means that the energy source may be power from central power plants or process heat from e.g. natural gas-fired boilers, turbines or stationary engines. The presentation is outlined as follows:

- Mineral products (NFR 2A) including "Other" (NFR 1A2f)
- Chemical industry (NFR 2B)
- Metal production (NFR 2C) including "Iron and steel" (NFR 1A2a) and "Non-ferrous metals" (NFR 1A2b)
- Other production (NFR 2D)

The industrial processes included in the Danish inventory are those in large companies, e.g. cement factories or steelworks, as well as a number of smaller companies e.g. iron foundries. Furthermore, asphalt concrete plants are to be included in future.

Table 4.1 presents a survey of sources and groups of pollutants included in the present survey as well as pollutants and sources that will be included in the survey. Explanations to the abbreviations are given below the table. Table 4.1 indicates that some groups of substances are planned to be included in the inventory. In addition to the indicated groups of substances some groups do not include all relevant substances or the time-series are not complete. Detailed information on this subject can be found in the following table with an indication of which substances that will be completed/improved in the inventory.

Table 4.1 Survey of industrial sector with SNAP-code and NFR-code included in the Danish inventory.

Industrial sector	SNAP	NFR	Energy	SO_X/ NO_X/ NH_3	NMVOC/CO	TSP/ $PM_{10/2.5}$	HM	POP
Grey iron foundries	030303	1A2a	ie	+	+	x	x	-
Secondary lead production	030307	1A2b	ie	-	-	x	x	-
Secondary zinc production	030308	1A2b	ie	-	-	x	+	-
Secondary aluminium production	030310	1A2b	ie	-	-	x	+	-
Cement	030311	1A2f	y	x	x	x	x	-
Lime (incl. iron, steel and paper pulp industry)	030312	1A2f	ie	+	-	x	+	-
Asphalt concrete plants	030313	1A2f	+	+	+	+	-	+/?
Container glass	030315	1A2f	y	x	x	x	x	-
Glass wool	030316	1A2f	ie	x/+	-	x	+	-
Mineral wool	030318	1A2f	y	x/+	x	x	+	-
Paper mill industry	030321	1A2d	y	-	+	x	-	-
Electric arc furnace	040207	2C1	-	-	-	x	x	+/?
Allied metal manufacturing	040306	2C5	-	-	-	+	x	-
Sulphuric acid	040401	2B5	-	x	-	-	-	-
Nitric acid	040402	2B2	y	x	-	x	-	-
NPK-fertiliser	040407	2B5	-	x	ie	x	ie	-
Other (catalysts)	040416	2B5	y	x	-	x	-/?	-
Pesticide production	040525	2B5	-	+	x	+	-	+/?
Bread	040605	2D2	-	-	+	-	-	
Beer	040607	2D2	-	-	x	-	-	
Roof covering with asphalt materials	040610	2A5	-	-	x	-	-	+/?
Road paving with asphalt	040611	2A6	-	+	x	-	-	+/?
Cement (decarbonising)	040612	2A1	-	ie	-	-	+	-
Glass (decarbonising)	040613	2A7	-	ie	-	-	+	-
Lime (decarbonising)	040614	2A2	-	ie	-	-	+	-
Other (sugar, chemical ingredients, slaughterhouse waste)	040617	2A7	y	x/+	x	x	-	+/?
Limestone and dolomite use	040618	2A3	-	ie	+	ie	ie	-

x Included in the present inventory.
+ Will be included.
- Not included/not relevant.
ie Included elsewhere.
y Included in the present inventory.

4.2 Mineral products (NFR 1A2f/2A)

4.2.1 Source category description

The sub-sector *Mineral products* (NFR 1A2f/2A) cover the following processes:

- Production of cement (SNAP 030311/040612)
- Production of lime (quicklime) (SNAP 030312/040614)
- Production of container glass/glass wool (SNAP 030315/030316/ 040613)
- Production of mineral wool (SNAP 030318)
- Limestone and dolomite use (SNAP 040618)
- Roof covering with asphalt (SNAP 040610)
- Road paving with asphalt (SNAP 040611)
- Other (SNAP 040617; Danisco sugar/Danisco ingredients/ Slaughterhouse waste)

The time-series for emission of acidifying substances, heavy metals, NMVOC and particulate matter from *Mineral products* (NFR 1A2f/2A) are presented in Table 4.2 and Table 4.3.

The emission of SO_2, NO_X and CO from the production of cement depends on raw materials, fuels and combustion conditions. Emissions of NO_X are, among other things, a consequence of high temperature processes and the emission shows only minor fluctuations. The emission follows the activity, with a minor decrease in recent years. The emission of SO_2 depends on the S-content in fuels and raw materials. However, the process acts as a sink for acidifying gases due to the alkaline conditions in the rotary kiln; see Figure 4.1. The emission of CO displays significant fluctuations that cannot be explained by known factors.

The emission of NO_X from production of container glass is increasing slightly until 2004 and the decreasing significantly whereas the emission of CO is decreasing in the period 1990-2006 followed by a significant increase in 2007. In the same period of time, the activity is nearly constant. Emissions of both substances are related to combustion/process conditions and will be investigated further. Emissions of the heavy metals lead, selenium and zinc are related to the raw materials used. Recycled glass constitutes a considerable part of raw materials and, therefore, the quality/purity of the glass is a determining factor. Emission of lead shows a decreasing trend that is in accordance with the attempts to avoid lead in glass as well as in wine bottle seals.

Production of glass wool is expected to result in emission of approximately the same pollutants as in production of container glass. NH_3 shows a decreasing trend from 1996-2007 as can be verified by the decreasing emission pr amount produced. Potential emissions of NO_X, CO and heavy metals are planned to be investigated and included in the inventory.

Table 4.2 Time-series for pollutants from *Mineral products 1A2f* (combustion/process emissions; metals: kg and other pollutants: tonnes).

Pollutants	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
SO_2	2 128	2 467	2 655	2 680	2 682	2 706	2 804	3 631	3 372	2 186
NO_x	6 953	8 468	9 329	9 450	9 443	9 569	10 138	10 306	10 478	9 583
NMVOC	98.3	116	124	125	131	136	132	136	129	113
NH_3	489	489	489	489	489	489	475	561	552	560
CO	12 260	12 601	12 795	12 822	12 820	12 848	12 462	13 506	16 993	15 353
TSP										
PM_{10}										
$PM_{2.5}$										
As	52.1	78.1	79.1	78.6	80.9	82.1	68.0	57.4	58.3	54.5
Cd	35.9	61.7	59.0	57.9	60.8	58.0	38.0	19.1	19.4	18.0
Cr	410	783	718	697	743	697	362	29.3	29.9	28.0
Cu	115	211	196	191	203	194	111	30.1	30.7	28.8
Hg	105	136	147	149	150	152	154	165	167	155
Ni	344	644	595	579	616	582	318	58.5	59.5	55.7
Pb	1 180	1 101	950	879	879	1 540	730	205	452	594
Se	339	316	276	255	271	464	227	290	91.8	236
Zn	245	243	227	211	217	292	200	171	187	184
Continued	2000	2001	2002	2003	2004	2005	2006	2007		
SO_2	1 692	2 156	1 431	1 470	1 929	1 827	2 209	2 161		
NO_x	10 451	10 300	9 417	8 624	8 685	8 660	8 378	7 348		
NMVOC	118	108	107	89	102	103	106	105		
NH_3	497	444	358	334	363	335	337	353		
CO	15 302	13 545	10 340	9 574	10 754	9 927	9 654	11 028		
TSP	532	567	446	429	422	368	427	381		
PM_{10}	467	497	386	373	369	321	374	332		
$PM_{2.5}$	270	287	235	234	232	203	224	196		
As	55.3	56.0	56.5	53.1	59.8	56.5	59.3	61.7		
Cd	18.4	18.7	19.0	17.9	20.1	19.0	20.0	20.7		
Cr	28.3	28.6	28.8	27.1	30.5	28.8	30.2	31.5		
Cu	29.1	29.4	29.4	27.6	31.1	29.4	30.8	32.2		
Hg	158	161	163	154	173	164	172	178		
Ni	56.4	57.1	57.4	54.0	60.8	57.4	60.2	62.8		
Pb	362	204	204	302	470	179	45.0	50.7		
Se	359	290	290	252	245	126	79.3	74.1		
Zn	198	167	168	160	177	168	175	182		

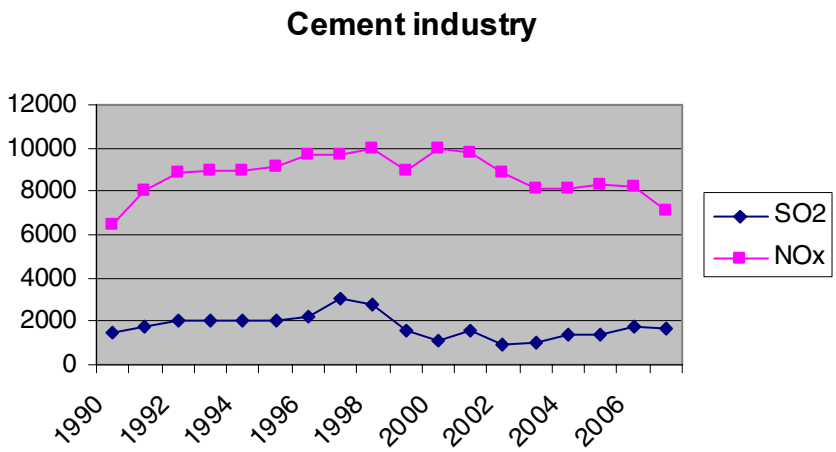

Figure 4.1 Emission of NO_x and SO_2 from cement production.

Table 4.3 Time-series for pollutants from *Mineral products 2A* (process emissions; tonnes).

Polluntants	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
CH_4	16.0	16.0	16.8	17.5	15.8	16.3	16.3	16.3	14.3	15.5
CO	241	241	252	263	237	245	245	245	215	234
NMVOC	654	655	656	658	654	655	656	648	654	617
NH_3	24.2	32.4	32.2	35.1	32.1	31.5	31.2	30.0	31.4	36.3
TSP										
PM_{10}										
$PM_{2.5}$										

Continued	2000	2001	2002	2003	2004	2005	2006	2007
CH_4	14.8	13.0	13.0	13.3	18.5	18.2	18.2	23.1
CO	223	196	196	199	278	275	274	347
NMVOC	594	565	563	561	578	576	577	588
NH_3	34.0	31.9	47.9	157	167	132	96.4	112
TSP	191	189	172	-[1]	-[1]	-[1]	-[1]	-[1]
PM_{10}	47.8	47.3	43.0	-[1]	-[1]	-[1]	-[1]	-[1]
$PM_{2.5}$	7.64	7.56	6.88	-[1]	-[1]	-[1]	-[1]	-[1]

Emission of TSP, PM_{10}, $PM_{2.5}$ are related to energy consumption from 2003.

The emission of NMVOC from production of chemical ingredients shows a decreasing trend and can probably be explained by the decreasing emission pr amount produced.

4.2.2 Methodological issues

The emissions of SO_2, NO_X, CO and TSP from the production of cement are measured yearly from 1997 to 2007 (TSP from 2000 to 2007) (Aalborg Portland, 2008). PM_{10} and $PM_{2.5}$ are estimated from the distribution between TSP, PM_{10} and $PM_{2.5}$ from CEPMEIP (2003). For the years 1990-1996, the emission has been estimated from the production of cement, expressed as TCE (total cement equivalents[9]), and emission factors from the company Aalborg Portland (Aalborg Portland, 2008). The emissions of heavy metals are measured in 1997 (Illerup et al., 1999) and estimated for the other years from emission factors (based on the measurements) and TCE. The activity has varied from 1.6 million tonne TCE in 1990 to 2.95 million tonne TCE in 2007.

The emission of NO_X, CO, TSP, lead, selenium, and zinc from production of container glass is measured yearly from 1997 to 2007 (TSP from 2000 to 2007) (Rexam Glass Holmegaard, 2008). PM_{10} and $PM_{2.5}$ are estimated from the distribution between TSP, PM_{10} and $PM_{2.5}$ from CEPMEIP (2003). For 1990 to 1996, emissions of arsenic, cadmium, chromium, copper, mercury and nickel are estimated from standard emission factors and activity data. For 1997 to 2007, the energy related emissions are estimated from emission factors and the actual energy consumption. This change in methodology results in inconsistency in the emission trend that cannot be explained by natural factors. Emission factors for lead, selenium, and zinc from 1990 to 1996 are estimated by interpolation from the 1990 and 1997 figures (Illerup et al., 1999).

[9] TCE (total cement equivalent) express the total amount of cement produced for sale and the theoretical amount of cement from the produced amount of clinker for sale.

The emission of NH_3 and TSP from the production of glass wool has been measured yearly from 1996 to 2007 (TSP from 2000 to 2007) (Saint-Gobain Isover, 2008). PM_{10} and $PM_{2.5}$ are estimated from the distribution between TSP, PM_{10} and $PM_{2.5}$ from CEPMEIP (2003). The activity has varied between 33 600 and 40 995 tonnes glass wool from 1996 to 2007 and, during the same period, the emission decreased from approximately 300 to 109 tonne NH_3.

The emission of NMVOC from production of chemical ingredients has been measured from 1996 to 2007 (Danisco Grindsted, 2008). The emission has decreased from 100 to 15 tonnes NMVOC in this period. However, no explanation can be given on these conditions, as information on activity is not available.

The emissions from asphalt roofing and road paving have been estimated from production statistics compiled by Statistics Denmark and default emission factors presented by IPCC/Corinair. The default emission factors are presented in Table 4.4.

Table 4.4 Default emission factors for application of asphalt products.

		Road paving with asphalt	Use of cutback asphalt	Asphalt Roofing
CH_4	g pr tonnes	5	0	0
CO	g pr tonnes	75	0	10
NMVOC	g pr tonnes	15	64 935	80
Carbon content fraction of NMVOC	%	0.667	0.667	0.8

4.2.3 Uncertainties and time-series consistency

The time-series are presented in Table 4.2 and Table 4.3. The methodologies applied for the different sources within *Mineral products* are considered to be consistent either as measurements or emission factors based on the measurements. However, not all the sources are considered to be complete regarding pollutants and these are expected to be completed in the next inventory, either by use of company-specific information or by application of general emission factors.

The time-series for emissions from production of cement are based on measurements combined with emissions factors based on the measurements.

4.2.4 Source specific QA/QC and verification

The emission factors have been verified and the order of magnitude confirmed by comparison with standard emission factors (EMEP/CORINAIR, 2007; CEPMEIP, 2003). Detailed discussion of QA/QC can be found in Nielsen et al. (2008).

4.2.5 Source specific recalculations

No source specific recalculation has been performed for the sector *Mineral products*.

4.2.6 Source specific planned improvements

The inventory will be improved regarding coverage of pollutants included. Especially glass wool, mineral wool, chemical ingredients and production of sugar will be extended. The incomplete time-series will also be completed. The inconsistent methodology applied for emission of As, Cd, Cr, Cu, Hg, and Ni from glass production will be improved.

4.3 Chemical industry (NFR 2B)

4.3.1 Source category description

The sub-sector *Chemical industry* (NFR 2B) covers the following processes:

- Production of nitric acid/fertiliser (SNAP 040402/040407)
- Production of catalysts/fertilisers (SNAP 040416/040407)
- Production of pesticides (SNAP 040525)

The time-series for emission of acidifying substances, NMVOC and particulate matter from *Chemical industry* (NFR 2B) are presented in Table 4.5.

Table 4.5 Time-series for pollutants from *Chemical industry 2B* (tonnes).

Pollutant	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
SO_2	636	496	600	461	514	406	247	397	408	487
NO_x	842	778	691	619	636	648	543	611	472	509
NH_3	25.0	35.0	48.0	62.0	104	75.0	75.0	50.0	25.0	33.0
NMVOC	390	150	62.0	40.0	54.0	57.0	113	44.0	40.0	41.0
TSP										
PM_{10}										
$PM_{2.5}$										
Continued	2000	2001	2002	2003	2004	2005	2006	2007		
SO_2	421	449	436	321	340	402	258	36.0		
NO_x	447	422	419	475	302	30.2	37.0	18.0		
NH_3	27.0	101	93.0	113	101	79.0	88.0	107		
NMVOC	29.0	29.0	26.7	25.4	31.4	25.7	25.3	24.0		
TSP	362	346	310	323	192	-[1]	-[1]	-[1]		
PM_{10}	290	277	248	258	153	-[1]	-[1]	-[1]		
$PM_{2.5}$	217	208	186	194	115	-[1]	-[1]	-[1]		

1 Nitric acid production ceased in 2004.

The time-series for SO_2 follows the amount of sulphuric acid produced, i.e. the fluctuation follows the activity until the activity ceased in 1997. The same is the case for NO_X from production of nitric acid; however, the emission of NO_X pr amount produced is decreasing from 1994 to 2004; see Figure 4.2. The emission of NH_3 does not follow the activity as it appears from the fluctuation in the emission pr amount produced. The production of nitric acid and fertiliser stopped in the middle of 2004.

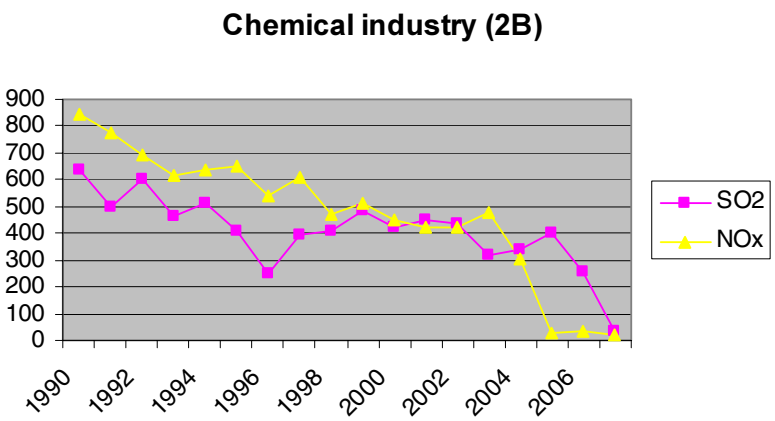

Figure 4.2 Emission of NO_x and SO_2 from Chemical industry (2B).

The emission of NO_X from production of catalysts/fertilisers decreases from 1996 to 2007, whereas the emission of NH_3 increases. Fluctuations and the increase in the "emission factor" can explain the increase in NH_3 emission.

The emission of NMVOC from production of pesticides reduced significantly from 1990 to 2007 (Cheminova, 2008). The decrease can probably be explained by introduction of flue gas cleaning equipment rather than any decrease in activity. The emission of SO_2 is from the sulfur regeneration plant (Claus plant).

The time-series will be explained further in the following section.

4.3.2 Methodological issues

The emission of SO_2, NO_X, NH_3 and TSP from production of sulfuric acid, nitric acid and fertiliser is measured yearly or estimated, from 1990 to 2004 (TSP from 2000 to 2004) (Kemira GrowHow, 2005). PM_{10} and $PM_{2.5}$ are estimated from the distribution between TSP, PM_{10} and $PM_{2.5}$ from CEPMEIP (2003). The emission for SO_2 and NO_X for 1991 to 1993 was estimated by using interpolated emission factors and activity data. Production of sulphuric acid was stopped in 1997. The emission factor for SO_2 fluctuated and the emission factor for NO_X decreased from 1990 to 2004. Production of sulphuric acid decreased from approximately 150 000 to 60 000 tonnes from 1990 to 1996, and production of nitric acid decreased from approximately 450 000 to 229 000 tonnes from 1990 to 2004. Overall, production of fertiliser decreased from approximately 800 000 to approximately 395 000 tonnes from 1990 to 2004.

The emission of NH_3, NO_X and TSP from production of catalysts and fertilisers is measured yearly from 1996 to 2007 (TSP from 2000 to 2007) (Haldor Topsøe, 2008). PM_{10} and $PM_{2.5}$ are estimated from the distribution between TSP, PM_{10} and $PM_{2.5}$ from CEPMEIP (2003). The process-related NO_X emission has been estimated as 80 % of the total NO_X emission; Haldor Topsøe reports this assumption in their environmental report. The emission of NH_3 shows an increasing trend and varies between 13 and 107 tonne from 1990 to 2006. In the same period, the production of catalysts and fertilisers increased from approximately 33,000 to 45,000 tonnes.

The emission of NMVOC from production of pesticides is measured yearly from 1990 to 2000 (Cheminova, 2008) and estimated for 2001 to

2007. An emission factor based on 2000 figures is used for estimation of 2001 to 2007 emissions. The emission of NMVOC shows a decreasing trend from 1990 to 2007.

4.3.3 Uncertainties and time-series consistency

The time-series are either based on specific measurements or by using company-specific emission factors and activity data. Therefore, the time-series are considered to be consistent.

4.3.4 Source specific QA/QC and verification

The emission factors for production of nitric acid and sulphuric acid have been verified by comparison with standard emission factors (EMEP/CORINAIR, 2007). Detailed discussion of QA/QC can be found in Nielsen et al. (2008).

4.3.5 Source specific recalculations

No source specific recalculation has been performed for the sector *Chemical industry*.

4.3.6 Source specific planned improvements

No source specific improvements are planned.

4.4 Metal production (NFR 1A2/2C)

4.4.1 Source category description

The sub-sector *Metal production* (NFR 1A2/2C) covers the following processes:

- Steelworks (SNAP 040207)
- Iron foundries (SNAP 030303)
- Secondary lead production (SNAP 030307)
- Secondary zinc production (SNAP 030308)
- Secondary aluminium production (SNAP 030310)
- Allied metal manufacturing (SNAP 040306)

The time-series for emission of heavy metals and particulate matter from *Metal production* (NFR 1A2/2C) are presented in Table 4.6 and Table 4.7.

The emission inventory for metal production is based on specific emissions from steelworks and secondary aluminium manufacturing as well as average emission factors for iron foundries, secondary lead and zinc manufacturing, and allied metal manufacturing. Regarding the steelworks that use iron and steel scrap as raw material, the emissions to a large degree depend on the quality of the scrap. This fact may result in large annual variations for one or more of the heavy metals. This may be the case for iron foundries, as they also use scrap as raw material, but they have not been subject to the same requirements to analyse emissions of heavy metals to air.

Table 4.6 Time-series for pollutants from *Metal production 1A2ab* (combustion/process emissions; metals: kg and other pollutants: tonnes).

Pollutant	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
TSP										
PM_{10}										
$PM_{2.5}$										
As	30.9	30.1	29.3	28.6	27.8	27.1	26.3	25.5	25.7	25.8
Cd	14.5	14.1	13.8	13.4	13.1	12.7	12.3	12.0	12.1	12.1
Cr	113	110	108	105	102	99.2	96.4	93.6	94.4	94.6
Cu	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10
Hg	ne	ne	ne	ne	ne	ne	ne	ne	ne	ne
Ni	134	131	127	124	121	117	114	111	112	112
Pb	750	732	713	695	676	658	639	621	627	628
Se	515	502	489	477	464	451	438	426	429	430
Zn	515	502	489	477	464	451	438	426	429	430
Continued	2000	2001	2002	2003	2004	2005	2006	2007		
TSP	227	206	207	200	204	205	192	187		
PM_{10}	88.7	82.6	81.8	75.6	74.9	79.7	78.7	79.4		
$PM_{2.5}$	22.8	22.0	21.3	18.6	17.8	20.6	21.7	22.8		
As	28.9	25.7	26.2	26.2	27.2	26.2	23.6	22.2		
Cd	13.6	12.1	12.3	12.3	12.8	12.3	11.1	10.5		
Cr	106	94.3	96.0	96.0	100	96.0	86.4	81.5		
Cu	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10		
Hg	ne	ne	ne	ne	ne	ne	ne	ne		
Ni	125	111	113	113	118	113	102	96		
Pb	703	626	637	637	661	637	574	542		
Se	482	429	437	437	453	436	393	371		
Zn	482	429	437	437	453	436	393	371		

ne not estimated

Table 4.7 Time-series for pollutants from *Metal production 2C* (process emissions; metals: kg and other pollutants: tonnes).

Pollutant	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
TSP										
PM_{10}										
$PM_{2.5}$										
Cd	42.6	42.7	42.8	46.3	49.8	49.5	46.4	34.5	42.6	6.96
Cr	6.75	6.75	6.75	7.35	7.95	7.89	7.00	0.00	1.00	0.00
Cu	39.0	39.9	40.8	41.7	42.6	43.5	44.0	45.3	45.3	45.3
Hg	136	136	136	148	160	158	147	84.0	60.6	49.5
Ni	272	272	272	296	320	318	294	228	112	86.1
Pb	731	733	734	795	856	851	794	704	441	735
Zn	5 891	5 905	5 917	6 404	6 892	6 852	6 398	5 656	3 050	2 755
Continued	2000	2001	2002	2003	2004	2005	2006	2007		
TSP	41.0	93.0	-[1]	-[1]	-[1]	32.5	-[1]	-[1]		
PM_{10}	39.0	88.0	-[1]	-[1]	-[1]	30.8	-[1]	-[1]		
$PM_{2.5}$	25.0	56.0	-[1]	-[1]	-[1]	19.6	-[1]	-[1]		
Cd	24.5	40.5	4.53	4.53	4.53	4.53	4.53	4.53		
Cr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0,00		
Cu	45.3	45.3	45.3	45.3	45.3	45.3	45.3	45.3		
Hg	90.0	184	-[1]	-[1]	-[1]	63.9	-[1]	-[1]		
Ni	60.0	123	-[1]	-[1]	-[1]	42.6	-[1]	-[1]		
Pb	508	939	68.0	68.0	68.0	370	68.0	68.0		
Zn	2 024	3 420	634	634	634	1 600	634	634		

1 Steelwork was closed 2002-2004 and in 2006.

The steelworks closed in the beginning of 2002 and re-opened at the end of 2004.

4.4.2 Methodological issues

The emission of heavy metals and TSP from the production of steel bars and sheets from steel scrap are based on measurements from the company Stålvalseværket (Stålvalseværket, 2002). PM_{10} and $PM_{2.5}$ are estimated from the distribution between TSP, PM_{10} and $PM_{2.5}$ from CEPMEIP (2003). The distribution of metals for 1995/96 (Illerup et al., 1999) is used in estimation of the different metals for the following years. The activity has varied between approximately 600 000 and 800 000 tonnes from 1990 to 2001. The production ceased in the beginning of 2002 and restarted at the end of 2004 with regard to melting of steel scrap in the electric arc furnace. The production of steel bars at the steelwork is assumed to be 1/3 of the production in 2001; the steelwork has been closed from end of 2005/beginning of 2006.

The emission of heavy metals from iron foundries is based on standard emission factors and yearly production statistics from The Association of Danish Foundries. The emission of TSP and distribution between TSP, PM_{10} and $PM_{2.5}$ is obtained from CEPMEIP (2003).

The emission of heavy metals from production of secondary lead and allied metal manufacturing is based on average emission factors for Danish producers (Illerup et al., 1999) and activity data from Statistics Denmark. The emission of TSP and distribution between TSP, PM_{10} and $PM_{2.5}$ is obtained from CEPMEIP (2003).

4.4.3 Uncertainties and time-series consistency

The time-series are either based on specific measurements, company-specific emission factors combined with activity data or on standard emission factors combined with public statistics. The same methodology has been applied for the entire time-series and, therefore, the time-series are considered to be consistent.

4.4.4 Source specific recalculations

No source specific recalculation has been performed for the sector *Metal production*.

4.4.5 Source specific QA/QC and verification

Detailed discussion of QA/QC can be found in Nielsen et al. (2008)

4.4.6 Source specific planned improvements

The time-series will be completed and new emission factors for the latest years will be established, if possible. Especially for secondary aluminium and zinc production, potential emissions of heavy metals will be investigated.

4.5 Other production (NFR 2D)

4.5.1 Source category description

The sub-sector *Other production* (NFR 2D) covers the following process:

- Beer (SNAP 040607)

Table 4.8 Time-series for emission of NMVOC from *Other production 2D2* (tonnes).

Year	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
NMVOC	582	604	611	590	588	619	599	574	503	502
Continued	2000	2001	2002	2003	2004	2005	2006	2007		
NMVOC	466	452	513	522	534	543	511	503		

The time-series for emission of NMVOC from *Other production* (NFR 2D) is presented in Table 4.8.

The emission of NMVOC from production of beer follows the activity as the same emission factor has been used for the entire period.

4.5.2 Methodological issues

The emission of NMVOC from breweries is estimated from production statistics (Statistics Denmark) and standard emission factors from the IPCC guidelines (IPCC (1997) Vol. 3, Table 2-24).

4.5.3 Uncertainties and time-series consistency

The time-series is based on the same methodology throughout, using public statistics and standard emission factors. Therefore, the time-series is considered to be consistent.

4.5.4 Source specific recalculations

No source specific recalculation has been performed for the sector *Other production*.

4.5.5 Source specific QA/QC and verification

No source specific QA/QC and verification has been performed for the sector *Other production*.

4.5.6 Source specific planned improvements

The time-series for emission of NMVOC from production of beer is planned to be completed. Furthermore, production of bread and other food products are planned to be included in the next inventory.

4.6 Uncertainty estimates

Uncertainty estimates for industrial processes (SNAP 04) are presented in Table 4.9. The uncertainty estimates are based on standard uncertainty factors (EMEP/CORINAIR, 2007).

Table 4.9 Uncertainty estimates for industrial processes (%).

	Activity data uncertainty	Emission factor uncertainty	Overall 2005	Trend
SO_2	2	20	20.100	0.460
NO_x	2	50	50.040	0.060
NMVOC	2	50	50.040	2.612
CO	50	100	50.040	4.077
NH_3	2	1000	1000.002	12.58
Cadmium	2	1000	1000.002	0.299
Copper	2	1000	1000.002	3.291
Lead	2	1000	1000.002	0.064
Zinc	2	1000	1000.002	0.149

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5 Solvents and other product use (NFR sector 3)

5.1 Overview of the sector

Non-methane volatile hydrocarbons (NMVOCs) are not considered direct greenhouse gases but once emitted in the atmosphere they will over a period of time oxidise to CO_2. Furthermore NMVOCs act as precursors to the formation of ozone.

Use of solvents and other organic chemicals in industrial processes and households are important sources of evaporation of NMVOCs, and are related to the source categories Paint application (NFR sector 3A), Degreasing and dry cleaning (NFR sector 3B), Chemical products, manufacture and processing (NFR sector 3C) and Other (NFR sector 3D). In this section the methodology for the Danish NMVOC emission inventory for solvent use is presented and the results for the period 1995 – 2007 are summarised. The method is based on a chemical approach, and this implies that the SNAP category system is not directly applicable. Instead emissions will be related to specific chemicals, products, industrial sectors and households and to the NFR sectors mentioned before.

5.2 Paint application (NFR Sector 3A), Degreasing and dry cleaning (NFR Sector 3B), Chemical products, Manufacture and processing (NFR Sector 3C) and Other (NFR Sector 3D)

5.2.1 Source category description

Table 5.1 and Figure 5.1 show the emissions of chemicals from 1985 to 2007, where the used amounts of single chemicals have been assigned to specific products and NFR sectors. The methodological approach for finding emissions in the period 1995 - 2007 is described in the following section. A linear extrapolation is made for the period 1985 – 1994. A general decrease is seen throughout the sectors. Table 5.2 shows the used amounts of chemicals for the same period. Table 5.1 is derived from Table 5.2 by applying emission factors relevant to individual chemicals and production or use activities. Table 5.3 showing the used amount of products is derived from Table 5.2, by assessing the amount of chemicals that is comprised within products belonging to each of the four source categories. The conversion factors are rough estimates, and more thorough investigations are needed in order to quantify the used amount of products more accurately.

In Table 5.4 the emission for 2007 is split into individual chemicals. The most abundantly used solvents are ethanol, turpentine, or white spirit defined as a mixture of stoddard solvent and solvent naphtha and propylalcohol. Ethanol is used as solvent in the chemical industry and as windscreen washing agent. Turpentine is used as thinner for paints,

lacquers and adhesives. Propylalcohol is used in cleaning agents in the manufacture of electrical equipment, flux agents for soldering, as solvent and thinner and as windscreen washing agent. Household emissions are dominated by propane and butane, which are used as aerosols in spray cans, primarily in cosmetics. For some chemicals the emission factors are precise but for others they are rough estimates, e.g. from SFT (1994). Emission factors are divided into four categories: 1) chemical industry (lowest EF), 2) other industry, 3) non-industrial activities, 4) domestic and other diffuse use (highest EF). This implies that high emission factors are applicable for use of solvent containing products and lower emission factors are applicable for use in industrial processes.

Table 5.1 Emission of chemicals in Gg pr year.

Total emissions Gg pr year	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	
Paint application (3A)	27.1	26.4	25.7	25.0	24.3	23.6	22.9	22.2	21.5	20.8	16.3	
Degreasing and dry cleaning (3B)	11.2	11.0	10.7	10.4	10.1	9.87	9.60	9.33	9.06	8.78	6.96	
Chemical products, manufacturing and processing (3C)	4.15	4.11	4.07	4.03	3.98	3.94	3.90	3.85	3.80	3.76	3.61	
Other (3D)	23.4	22.7	22.1	21.4	20.8	20.1	19.5	18.9	18.2	17.6	18.3	
Total NMVOC	65.9	64.2	62.5	60.9	59.2	57.6	55.9	54.2	52.6	50.9	45.2	
Total CO_2'[a]	205	200	195	190	185	179	174	169	164	159	141	
Continued	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Paint application (3A)	19.8	20.1	17.6	16.6	17.4	15.4	14.5	13.3	12.6	12.6	11.5	11.4
Degreasing and dry cleaning (3B)	8.77	7.78	7.00	7.77	7.42	6.20	6.70	6.33	5.60	5.25	4.78	4.84
Chemical products, manufacturing and processing (3C)	4.02	3.42	3.31	3.44	3.18	3.03	3.39	2.62	3.00	3.19	3.15	2.18
Other (3D)	17.0	13.5	13.3	12.9	12.6	11.5	12.3	11.0	10.6	10.8	10.2	9.52
Total NMVOC	49.5	44.7	41.2	40.7	40.6	36.1	36.9	33.3	31.8	31.9	29.5	27.9
Total CO_2'[a]	154	139	128	127	127	113	115	104	99.2	99.4	92.1	87.1

[a] 0.85*3.67*total NMVOC.

Table 5.2 Used amounts of chemicals in Gg pr year.

Used amounts of chemical Gg pr year	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	
Paint application (3A)	38	40	41	43	45	47	48	50	51	52	52	
Degreasing and dry cleaning (3B)	20	21	22	23	24	25	25	25	25	25	26	
Chemical products, manufacturing and processing (3C)	61	64	66	69	71	76	78	81	84	86	95	
Other (3D)	24	25	26	27	28	29	30	31	32	33	42	
Total NMVOC	144	150	156	161	167	177	182	187	191	196	214	
Continued	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Paint application (3A)	56	87	55	49	52	47	48	53	70	82	75	79
Degreasing and dry cleaning (3B)	27	26	23	26	26	24	25	24	26	26	28	36
Chemical products, manufacturing and processing (3C)	93	97	93	97	103	105	106	91	110	122	130	136
Other (3D)	36	38	33	33	35	36	35	35	44	46	52	51
Total NMVOC	212	248	203	204	216	211	213	203	250	277	284	302

Table 5.3 Used amounts of products in Gg pr year.

Used amounts of products Gg pr year	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	
Paint application (3A)	255	265	276	286	297	314	322	330	339	347	344	
Degreasing and dry cleaning (3B)	40	42	44	45	47	50	50	50	50	50	52	
Chemical products, manufacturing and processing (3C)	307	319	332	345	357	378	391	404	418	431	473	
Other (3D)	119	124	129	134	139	147	152	156	160	165	211	
Total products	722	751	781	811	841	888	914	941	967	993	1079	
Continued	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Paint application (3A)	370	579	364	324	345	315	317	351	469	544	499	529
Degreasing and dry cleaning (3B)	53	52	46	52	51	47	50	48	52	53	55	72
Chemical products, manufacturing and processing (3C)	467	487	463	484	513	523	529	455	549	612	651	678
Other (3D)	182	190	167	164	177	179	173	176	222	232	259	256
Total products	1072	1308	1039	1024	1087	1064	1068	1030	1291	1441	1464	1534

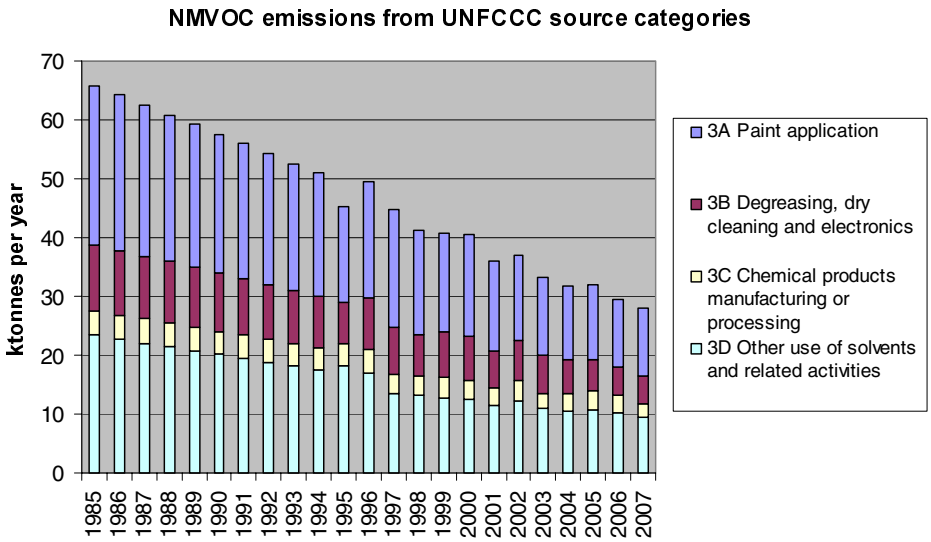

Figure 5.1 Emissions of chemicals in ktonnes pr year (equal to Gg pr year). The methodological approach for finding emissions in the period 1995 – 2007 is described in the text, and a linear extrapolation is made for 1985 – 1994. Figures can be seen in Table 5.1.

Table 5.4 Chemicals with highest emissions 2007.

Chemical	Emissions 2007 (tonnes)
ethanol	6311
turpentine (white spirit: stoddard solvent and solvent naphtha)	5186
propylalcohol	4537
pentane	2524
methanol	1499
acetone	1124
toluene	1118
xylene	989
butanone	690
propane	667
butane	667
glycolethers	658
propylenglycol	565
formaldehyde	380
1-butanol	249
cyclohexanones	114
methyl methacrylate	105
phenol	98.0
butanoles	96.4
butylacetate	71.7
ethylenglycol	65.7
styrene	57.1
ethylacetate	49.4
tetrachloroethylene	41.9
acyclic aldehydes	27.3
triethylamine	20.9
naphthalene	17.4
acyclic monoamines	5.66
acrylic acid	4.55
Total 2007	27939

5.2.2 Other use (N_2O)

Five companies sell N_2O in Denmark and only one company produces N_2O. N_2O is primarily used in anaesthesia by dentists, veterinarians and in hospitals and in minor use as propellant in spray cans and in the production of electronics. Due to confidentiality no data on produced amount are available and thus the emissions related to N_2O production are unknown. An emission factor of 1 is assumed for all uses, which equals the sold amount to the emitted amount.

Total reported and estimated sales (emissions) of NO_2 are:

2007: 0.12 Gg N_2O

5.2.3 Uncertainties and time-series consistency

An estimate of the overall uncertainty in EMEP/CORINAIR of 165 % is used.

5.2.4 Methodological issues

The emissions of Non-Methane Volatile Organic Compounds (NMVOC) from industrial use and production processes and household use in Denmark have been assessed. Until 2002 the NMVOC inventory in Denmark was based on questionnaires and interviews with different industries, regarding emissions from specific activities, such as lacquering, painting impregnation etc. However, this approach implies large uncertainties due to the diverse nature of many solvent-using processes. For example, it is inaccurate to use emission factors derived from one printwork in an analogue printwork, since the type and combination of inks may vary considerably. Furthermore the employment of abatement techniques will result in loss of validity of estimated emission factors.

A new approach has been introduced, focusing on single chemicals instead of activities. This will lead to a clearer picture of the influence from each specific chemical, which will enable a more detailed differentiation on products and the influence of product use on emissions.

The procedure is to quantify the use of the chemicals and estimate the fraction of the chemicals that is emitted as a consequence of use. Mass balances are simple and functional methods for calculating the use and emissions of chemicals

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

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

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 in-depth investigation in order to include all relevant emissions from the large amount of chemicals. The method for a single chemical approach is shown in Figure 5.2.

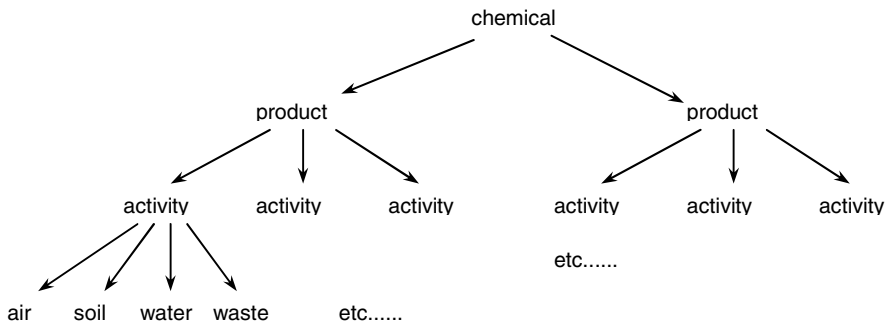

Figure 5.2 Methodological flow in a chemical based emission inventory.

The tasks in a chemical focused approach are

- Definition of chemicals to be included
- Quantification of use amounts from Eq. 1
- Quantification of emission factors for each chemical

In principle all chemicals that can be classified as NMVOC must be included in the analysis, which implies that it is essential to have an explicit definition of NMVOC. The definition in solvent directive (1999/13/EC) of VOCs is as follows: "Volatile organic compound shall mean any organic compound having at 293,15 K a vapour pressure of 0,01 kPa or more, or having a corresponding volatility under the particular condition of use". A list of 650 single chemicals and a few chemical groups described in "National Atmospheric Emission Inventory", cf. Annex 3.F, is used. Probably the major part will be insignificant in a mass balance, but a detailed investigation must be made before any chemicals can be excluded. It is important to be aware that some chemicals are comprised in products and will not be found as separate chemicals in databases, e.g. 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 double-count.

Production, import and export figures are extracted from Statistics Denmark, from which a list of 427 single chemicals, a few groups and products is generated. For each of these a *use* amount in tonnes pr. year (from 1995 to 2006) is calculated. It is found that 34 different NMVOCs comprise over 95 % of the total use, and it is these 34 chemicals that are investigated further.

In the Nordic SPIN database (Substances in Preparations in Nordic Countries) information for industrial use categories and products specified for individual chemicals, according to the NACE and UCN coding systems is available. This information is used to distribute the *use* amounts of individual chemicals to specific products and activities. The product amounts are then distributed to the CRF sectors 3A – 3D.

Emission factors, cf. Eq. 2, are obtained from regulators or the industry and can be provided on a site by site basis or as a single total for whole sectors. Emission factors can be related to production processes and to use. In production processes the emissions of solvents typically are low and in use it is often the case that the entire fraction of chemical in the product will be emitted to the atmosphere. Each chemical will be associated with four emission factors; 1) chemical industry (lowest EF), 2) other industry, 3) non-industrial activities, 4) domestic and other diffuse use (highest EF). This implies that high emission factors are applicable for use of solvent containing products and lower emission factors are applicable for use in industrial processes.

Outputs from the inventory are

- a list where the 34 most predominant NMVOCs are ranked according to emissions to air,
- specification of emissions from industrial sectors and from households,
- contribution from each NMVOC to emissions from industrial sectors and households,
- yearly trend in NMVOC emissions, expressed as total NMVOC and single chemical, and specified in industrial sectors and households.

5.2.5 Uncertainties and time-series consistency

Important uncertainty issues related to the mass-balance approach are

(i) Identification of chemicals that qualify as NMVOCs. Although a tentative list of 650 chemicals from the "National Atmospheric Emission Inventory" has been used, it is possible that relevant chemicals are not included, e.g. chemicals that are not listed with their name in Statistics Denmark but as a product.

(ii) Collection of data for quantifying production, import and export of single chemicals and products where the chemicals are comprised. For some chemicals no data are available in Statistics Denmark. This can be due to confidentiality or that the amount of chemicals must be derived from products wherein they are comprised. For other chemicals the amount is the sum of the single chemicals *and* product(s) where they are included. The data available in Statistics Denmark is obtained from Danish Customs & Tax Authorities and they have not been verified in this assessment.

(iii) Distribution of chemicals on products, activities, sectors and households. The present approach is based on amounts of single chemicals. To differentiate the amounts into industrial sectors it is necessary to identify and quantify the associated products and activities and assign these to the industrial sectors and households. No direct link is available between the amounts of chemicals and products or activities. From the Nordic SPIN database it is possible to make a relative quantification of products and activities used in industry, and combined with estimates and expert judgement these products and activities are differentiated into sectors. The contribution from households is also based on estimates. If the household contribution is set too low, the emission from industrial sectors will be too high and vice versa. This is due to the fact that the total amount of chemical is constant. A change in distribution of chemicals between industrial sectors and households will, however, affect the total emissions, as different emission factors are applied in industry and households, respectively.

A number of activities are assigned as "other", i.e. activities that can not be related to the comprised source categories. This assignment is based on expert judgement but it is possible that the assigned amount of chemicals may more correctly be included in other sectors. More detailed information from the industrial sectors is continuously being implemented.

(iv) Rough estimates and assumed emission factors are used for some chemicals. For some chemicals more reliable information has been obtained from the literature and from communication with industrial sectors. In some cases it is more appropriate to define emission factors for sector specific activities rather than for the individual chemicals.

A quantitative measure of the uncertainty has not been assessed. Single values have been used for emission factors and activity distribution ratios etc. In order to perform a stochastic evaluation more information is needed.

5.2.6 QA/QC and verification

Please refer to the Danish National Inventory Report reported to the UNFCCC (Illerup et al., 2006)

5.2.7 Recalculations

The previous method was based on results from an agreement between the Danish Industry and the Danish Environmental Protection Agency (DEPA). The emissions from various industries were reported to the Danish EPA. The reporting was not annual and linear interpolation was used between the reporting years. It is important to notice that not all use of solvents was included in this agreement and no activity data were available. It is not possible to perform direct comparison of methodologies or to make corrections to the previous method, due to the fundamental differences in structure. But an increase in total emissions was expected due to the more comprehensive list of chemicals.

Improvements and additions are continuously being implemented in the new approach, due to the comprehensiveness and complexity of the use and application of solvents in industries and households. The main improvements in the 2007 reporting include revisions of the following:

- The following chemicals and groups have been removed, compared to the 2006 inventory, due to vapour pressures below 0.01kPa: aminooxygen groups, glycerol, toluendiisocyanate, dioctylphthalate, diethylenglycol.
- Emission factors (EFs) have been adjusted for all chemicals, with most predominant effect for the following chemicals: ethanol, formaldehyde, turpentine, xylene, toluene and ethylenglycol.
- A differentiation of EFs in four different categories has been implemented: 1) chemical industry (lowest EF), 2) other industry, 3) non-industrial activities, 4) domestic and other diffuse use (highest EF). In previous inventories there was only a differentiation in two categories.
- More detailed and reliable information on use amounts and emission factors has been obtained from importers and producers for the following chemicals: methanol, ethanol in windscreen washing agent, naphthalene, propane and butane.
- Acrylic acid has been included in the inventory.

5.2.8 Planned improvements

In 2008 a joint Nordic project was performed regarding sharing of activity data and emission factors and allocation of activity data to source codes. Furthermore methodological issues were discussed. This will lead to thorough improvements in the coming Danish solvent inventory, regarding methodology, EFs and NMVOC to CO_2 conversion factors for chemicals, source allocation and inclusion of more chemicals that are listed as products in Statistics Denmark.

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6 Agriculture (NFR sector 4)

6.1 Overview of the sector

6.1.1 Ammonia

The majority of the Danish ammonia emission, corresponding to 97 %, originates from the agricultural sector. The remaining 3 % originates from traffic and industrial process. Figure 6.1 shows the distribution of sources of NH_3 emission from the agricultural sector 2007. The main part of the agricultural emission is related to manure management, corresponding to 87 %. Emissions from use of synthetic fertiliser and crops contribute with 6 % and 7 %, respectively. Emissions from "Other" as ammonia-treated straw and sewage sludge used as fertiliser amount to less than 1 %.

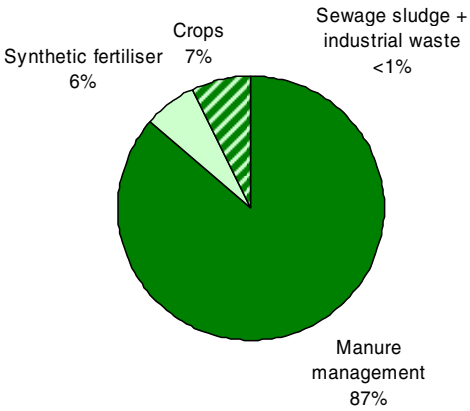

Figure 6.1 Ammonia emissions from the agricultural sector (2007).

From 1985 to 2007, the emission of ammonia from the agricultural sector decreased from 126.89 Gg NH_3 to 72.63 Gg NH_3, which corresponds to a 43 % reduction (Table 6.1). This is due to the active national environmental policy of the last twenty years. A series of measures have been introduced to prevent loss of nitrogen from agriculture to the aquatic environment. The measures include improved utilisation of nitrogen in livestock manure, requirements with regard to storage and application of livestock manure, increased area with winter green fields to catch nitrogen, a maximum number of animals pr hectare and maximum nitrogen application rates to agricultural crops.

The main part of the emission from the agricultural sector is related to livestock production and, hence, the management of manure. The result of the active environmental policy has brought about a decrease in the N-excretion, a decrease of emission pr produced animal and a fall in use of mineral fertilizer, which all has reduced the overall ammonia emission significant.

Table 6.1 Total ammonia emissions from the agricultural sector 1985 to 2007, Gg NH_3.

NFR		1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
		Gg NH_3											
4.	Agricultural Sector - total	126.87	127.74	124.20	121.43	121.69	121.36	117.13	115.31	112.62	108.28	101.29	97.20
4B	Manure Management	105.83	105.64	101.44	100.40	98.95	96.50	94.20	93.90	91.82	87.08	82.00	80.56
4D	Agricultural Soils - total	24.45	25.40	25.91	24.10	25.87	27.73	25.86	24.33	23.74	24.08	22.23	19.59
	Synthetic Fertiliser	8.48	8.04	7.83	7.83	7.80	8.68	8.33	7.81	7.34	7.64	7.27	6.16
	Grassing animals	3.15	3.08	2.95	2.92	2.91	2.93	3.00	3.00	3.05	2.99	3.04	3.06
	Crops	5.97	5.97	5.96	5.91	5.88	5.92	5.88	5.85	5.77	5.36	5.28	5.31
	NH_3 treated straw	6.54	8.04	8.92	7.25	9.00	10.19	8.64	7.67	7.58	8.10	6.63	5.06
4F	Field burning of Agricultural Waste	0.31	0.27	0.25	0.20	0.28	NO	NO	NO	NO	NO	NO	NO
4G	Other - Sewage Sludge used as fertiliser	0.05	0.05	0.05	0.05	0.06	0.07	0.07	0.09	0.11	0.10	0.11	0.10

Continued NFR		1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
		Gg NH_3										
4.	Agricultural Sector - total	96.57	97.70	92.86	92.68	91.34	88.79	80.56	80.29	75.84	73.22	72.63
4B	Manure Management	80.97	82.88	80.22	79.85	79.73	78.36	70.37[a]	70.10[a]	65.89[a]	63.47[a]	62.81[a]
4D	Agricultural Soils - total	18.47	17.69	15.42	15.63	14.46	13.17	12.62	12.41	11.94	11.55	11.67
	Synthetic Fertiliser	5.59	5.63	5.23	5.07	4.66	4.15	4.06	4.31	4.27	4.33	4.48
	Grassing animals	2.97	2.95	2.87	2.88	2.93	2.82	2.51	2.30	2.08	1.89	1.93
	Crops	5.44	5.41	5.25	5.21	5.25	5.26	5.24	5.27	5.34	5.34	5.26
	NH_3 treated straw	4.48	3.70	2.08	2.47	1.62	0.94	0.80	0.53	0.26	0.00	0.00
4F	Field burning of Agricultural Waste	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
4G	Other - Sewage Sludge used as fertiliser	0.09	0.09	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08

[a)] Calculations partly adjusted to TAN (2003-2007)

Particulate matter

In NFR, the emission of particulate matter (PM) is registered for the years 2000 to 2007. The emission from the agricultural sector includes the emission of dust from ventilated animal housing systems, which include emission from cattle, pigs, poultry and horses.

Change in emission factor has been preformed due to updated information in the EMEP-CLRTAP Emission Inventory Guidebook. Chapter B1100 covers PM emission from animal husbandry and recommended emission factor for Swine, poultry, cattle and horses. These categories are subdivided into subcategories and into solid- or slurry based stable systems.

Due to lack of data the PM emission due not include emission from plant production, which means activities related to field operations as harvesting and cultivation of the soil. At present, first draft to guidelines is preformed (Hinz 2004, Hinz 2006). When the final paper is confirmed, the PM emission will be implemented in the inventory and registered under NFR Tables 4.D Agricultural soils.

Given in TSP, emission from animal housing systems contributes with 28 % of the national PM emission in 2007.

From 2000 to 2007 the PM emission from agricultural activities, given in TSP, has decreased by 8 % mainly due to a fall in the production of broilers (Figure 6.2). The same emission factor is used for all years. The changes in the total emission for each livestock category is mainly re-

flected the changes in number of animal, but also effected by the distribution of the subcategories and changes in the stable type.

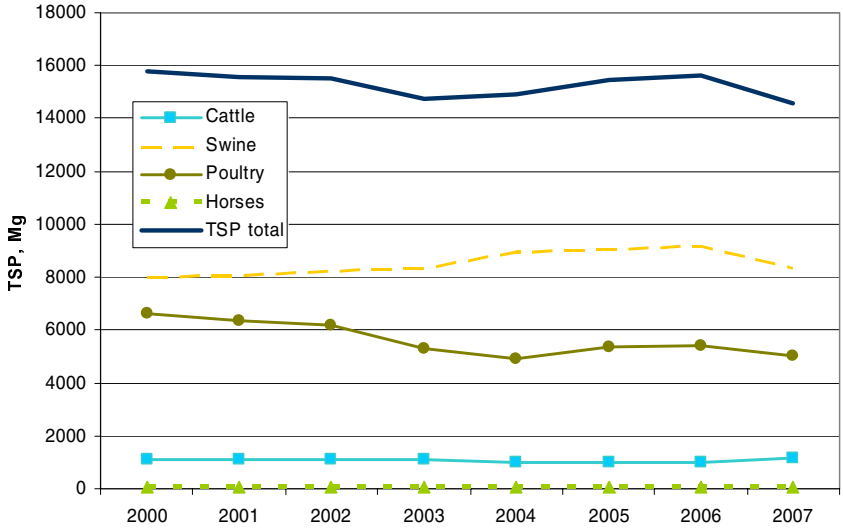

Figure 6.2 Emission of particulate matter (TSP) from the agricultural sector 2000 to 2007.

6.1.2 References – sources of information

Data on activity and emissions are collected, evaluated and discussed in cooperation with Statistics Denmark, the Danish Institute of Agricultural Sciences, the Danish Agricultural Advisory Centre, Danish Environmental Protection Agency and the Danish Plant Directorate. It means that both the data and the methods used are evaluated continuously according to latest knowledge and information. Table 6.2 shows the source of data input from the different institutes.

Table 6.2 List of institutes involved in the emission inventory.

References	Abbreviation	Data / information
National Environmental Research Institute, University of Aarhus (http://www.dmu.dk)	NERI	-reporting -data collecting
Statistics Denmark - Agricultural Statistics (http://www.dst.dk)	DS	-livestock production -milk yield -slaughtering data -land use
Faculty of Agricultural Sciences, University of Aarhus (http://www.agrsci.dk)	FAS	-N-excretion -feeding situation -NH_3 emissions factor -PM emissions factor - stable type (from 2007)
The Danish Agricultural Advisory Centre (http://www.lr.dk)	DAAC	-stable type -grazing situation -manure application time and methods
Danish Environmental Protection Agency (http://www.mst.dk)	EPA	-sewage sludge used as fertiliser
The Danish Plant Directorate (http://www.plantedirektoratet.dk)	PD	-organic farming -synthetic fertiliser -stable type (from 2005)

6.1.3 Methods

The calculation of the emission is based on the EMEP-CLRTAP Emission Inventory Guidebook.

The emissions from agricultural activities include NFR Table 4B Manure Management and Table 4D Agricultural Soils. Table 4F with regard to field burning of agricultural wastes is only registered until 1989. Burning of straw has been prohibited since 1989 and may only take place in connection with cultivation of seed grass. It is assumed that the emission is insignificant and, hence, is not included in the emission inventory from 1990.

The emission is calculated as the sum of activities (a_i) multiplied by the implied emission factor (IEF) for each activity, *i*.

$$E_{total} = \sum a_i \bullet IEF_i$$

The emissions from the agricultural sector are calculated in a comprehensive agricultural model complex called IAD (Inventory Agriculture Data), based on the model DIEMA (Danish Integrated Emission Model for Agriculture). This model, as shown in Figure 6.3, is implemented in great detail and it is used to cover emissions of ammonia, particulate matter and greenhouse gases (N_2O and CH_4). Thus, there is direct coherence between the ammonia emission and the emission of N_2O. A more detailed description of DIEMA is published in Mikkelsen et al. (2006).

The National Environmental Research Institute (NERI), which is responsible for the emission inventory, has established data agreements with the institutes and organisations to assure that the necessary data is available for timely completion of the emission inventory. The main part of the emission is related to livestock production and much of the data is based on Danish standards. The Faculty of Agricultural Sciences, University of Aarhus (FAS) delivers Danish standards relating to feeding consumption, manure type in different stable types, nitrogen content in manure, etc. Previously, the standards were updated and published every third or fourth year – the last one is Poulsen et al. from 2001. From year 2001, NERI receives updated data annually directly from FAS in the form of spreadsheets. These standards have been described and published in English in Poulsen & Kristensen (1998).

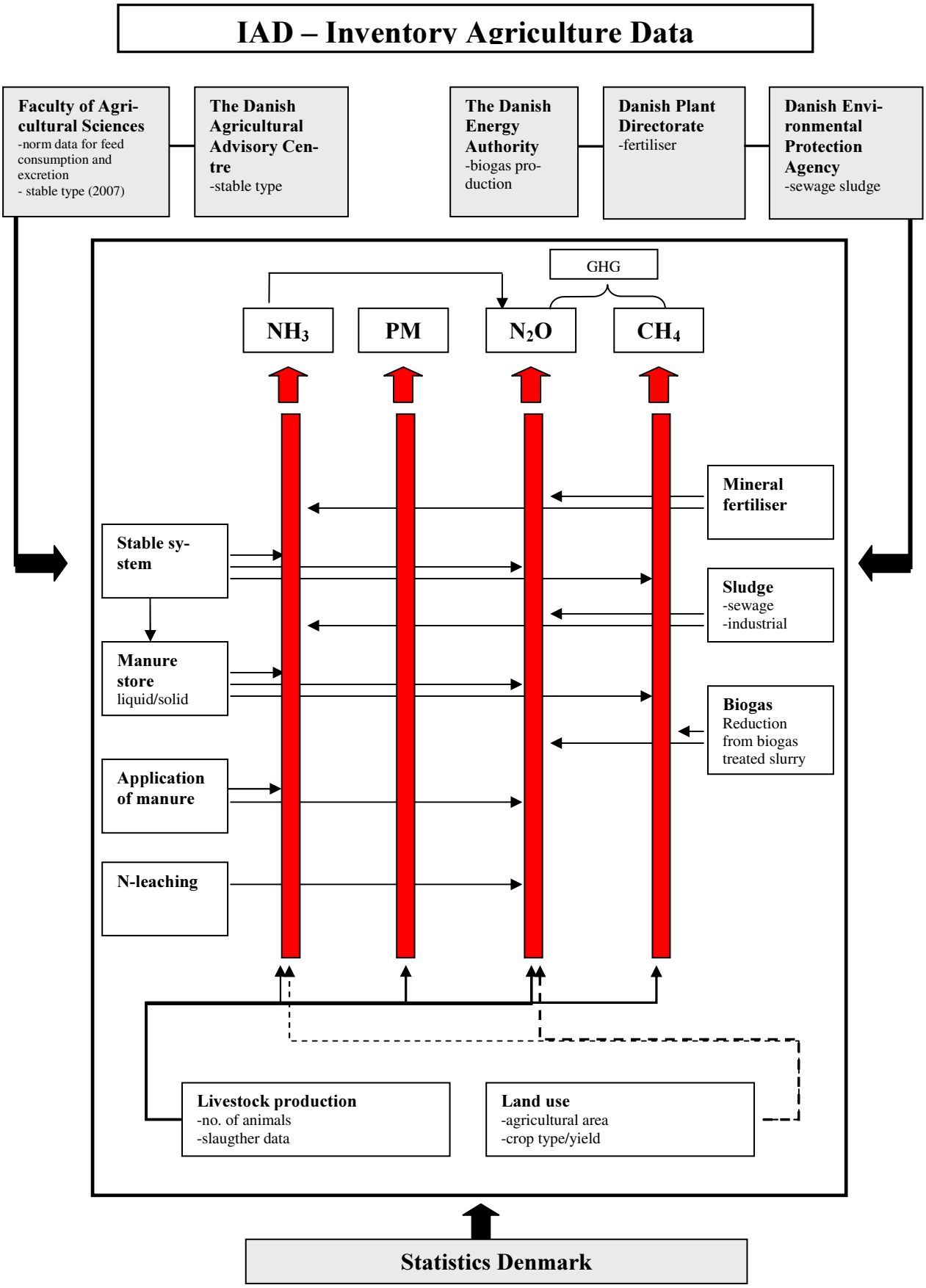

Figure 6.3 IAD – Inventory Agriculture Data.

IAD includes approximately 32 different livestock categories, dependent on livestock category, weight class and age. Each of these subcategories is subdivided according to stable type and manure type, which results in the region of 200 different combinations of subcategories and stable type (Table 6.3). The emission is calculated from each of these subcategories and then aggregated in accordance with the livestock categories given in the NFR. It is important to point out that changes in the emission and the implied emission factor over the years are not only a result of changes in the number of animals, but also depend on changes in the allocation of subcategories, changes in feed consumption, changes in stable type and changed practices with regard to the handling of livestock manure in relation to storage and application.

Table 6.3 Livestock categories and subcategories.

NFR 4B	Animal categories	Includes	No. of subcategories in DIEMA, animal type/stable system
4B 1a	Dairy Cattle[1]	Dairy Cattle (heavy breeding and Jersey)	13
4B 1b	Non-dairy Cattle[1]	Calves, heifers, bulls, suckling cattle (heavy breeding and Jersey)	37
4B 3	Sheep	including lambs	1
4B 4	Goats	Including kids (meet, dairy and mohair)	3
4B 6	Horses	200 kg, 400 kg, 600 kg, 800 kg	4
4B 8	Swine	Sows, piglets, slaughtering pigs	17
4B 9	Poultry	Hens, pullet, broilers, turkey, geese, ducks	25
4B 13	Other	Fur farming + Sewage sludge	4

[1)] For all subcategories distinguish between large breed and the smaller Jersey cattle

6.2 NH_3 emission from Manure Management – NFR 4.B

6.2.1 Description

Figure 6.4 shows the emission from manure management (NFR category 4.B) distributed according to the different livestock categories in 2007. The main part of the emission is related to cattle and pig production, corresponding to 79 %.

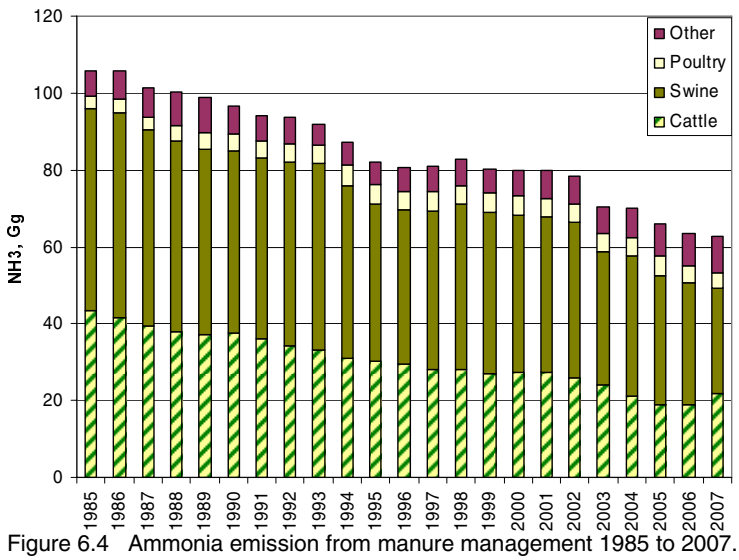

Figure 6.4 Ammonia emission from manure management 1985 to 2007.

6.2.2 Methodological issues

Activity data

Table 6.4 shows the development in livestock production 1985-2006 based on the Agricultural Statistics (Statistics Denmark). The emission from pigs and poultry is based on slaughter data from the Agricultural Statistics. Only farms larger than 5 hectares are included in the annual census. An approximation of number of the horses, goats and sheep on small farms is added to the numbers in the Agricultural Statistics, in agreement with DAAC. The largest difference is found for horses. In the agricultural census, the number of horses is estimated at 52 702 in 2007. The total number of horses in 2007, however, including horses placed at small farms and riding schools, is approximately 173 000.

Since 1985, the production of pigs has increased practically. This is contrary to the production of cattle, which has decreased as a result of rising milk yields. Buffalo, camels and llamas, mules and donkeys do not occur in Denmark.

Table 6.4 Livestock production 1985 to 2007, 1000 head - NFR category 4B.

NFR	Animal category	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
4B 1a	Dairy Cattle	896	864	811	774	759	753	742	712	714	700	702	701
4B 1b	Non-dairy cattle	1721	1631	1540	1488	1462	1486	1480	1478	1481	1405	1388	1 393
4B 3	Sheep*	40	52	59	73	83	92	107	102	88	80	81	94
4B 4	Goats*	8	8	8	8	8	8	9	9	9	9	9	9
4B 6	Horses*	140	139	138	137	136	135	137	138	140	141	143	144
4B 8	Swine	9 089	9 321	9 266	9 217	9 190	9 497	9 783	10 455	11 568	10 923	11 084	10 842
4B 9	Poultry	15 219	15 220	15 540	15 524	17 194	16 249	15 933	19 041	19 898	19 852	19 619	19 888
4B 13	Other (fur farming)	1 906	2 194	2 402	2 877	3 055	2 264	2 112	2 283	1 537	1 828	1 850	1 918

Continued

NFR	Animal category	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
4B 1a	Dairy Cattle	670	669	640	636	623	610	596	563	564	550	545
4B 1b	Non-dairy cattle	1 334	1 308	1 247	1 232	1 284	1 187	1 128	1 082	1 006	984	1021
4B 3	Sheep*	78	83	83	81	92	74	83	79	94	102	87
4B 4	Goats*	10	10	10	10	11	11	12	12	14	13	28
4B 6	Horses*	146	147	149	150	152	153	155	155	156	157	173
4B 8	Swine	11 383	12 095	11 626	11 922	12 608	12 732	12 949	13 233	13 534	13 361	13 723
4B 9	Poultry	18 994	18 674	21 010	21 830	21 236	20 580	17 796	16 598	17 530	17 249	16 741
4B 13	Other (fur farming)	2 212	2 345	2 089	2 199	2 304	2 422	2 361	2 471	2 552	2 708	2 837

* Includes animals on small farms (less than 5 ha), which are not included in Statistics Denmark figures.

Implied emission factor

Table 6.5 shows the implied emission factor for each NFR livestock category from 1990 to 2007. The implied emission factor expresses the average emission of ammonia pr animal (from the census) pr year. The implied emission factor is changing from year to year depending on a combination of several factors, such as:

- change in the livestock production level or change in the share of different subcategories
- change in fodder condition and N-excretion
- change in stable type
- change in handling of manure in relation to storage and application

In Annex 2C1, more detailed information about N-excretion and stable type for each livestock category, 1990–2007, used in the Danish emission inventory are given. Furthermore, tables show the Danish standards for emission factors used to calculate the ammonia emission in stables and in relation to storage and application of manure.

For most of the animal categories, the implied emission factor has decreased from 1985 to 2007, which is the result of measures in relation to implementation of the action plans for the aquatic environment and the Ammonia Action Plan. Increasingly strict requirements to improve the utilisation of nitrogen in manure have resulted in reduction of N-excretion, especially for slaughter pigs. Changes in manure management in relation to spreading are another important factor which has reduced the emission. Measures include a requirement for a minimum 9-month manure storage capacity, requirement that manure applied to soil be ploughed down within six hours, a ban on the spreading of manure in winter and, from 1 August 2003, broad spreading is no longer allowed.

Table 6.5 Implied emission factor from – manure management 1985 to 2007, kg NH_3 pr hd pr yr (NFR category 4B).

NFR	Animal category	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
4b 1a	Dairy cattle	30.35	30.67	30.98	31.31	31.63	31.91	30.92	29.95	28.97	28.02	27.07	26.27
4b 1b	Non-dairy cattle	7.71	7.61	7.55	7.45	7.41	7.47	7.17	6.95	6.72	6.41	6.15	6.06
4B 3	Sheep	1.91	1.90	1.88	1.87	1.85	1.86	1.86	1.87	1.87	1.88	1.89	1.73
4B 4	Goats	1.91	1.90	1.88	1.87	1.85	1.86	1.86	1.87	1.87	1.88	1.89	1.73
4B 6	Horses	8.35	8.29	8.22	8.15	8.08	7.89	7.69	7.50	7.31	7.12	6.93	6.91
4B 8	Swine	5.80	5.73	5.50	5.41	5.23	4.98	4.80	4.59	4.18	4.08	3.69	3.70
4B 9	Poultry	0.21	0.22	0.22	0.24	0.25	0.27	0.27	0.24	0.25	0.27	0.26	0.25
4B 13	Other animals (fur farming)	2.63	2.59	2.55	2.52	2.47	2.46	2.42	2.40	2.38	2.35	2.33	2.33

Continued

NFR	Animal category	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
4b 1a	Dairy cattle	26.37	26.48	26.29	27.02	26.91	26.42	26.88	24.29	23.99	24.95	25.95
4b 1b	Non-dairy cattle	5.97	5.93	6.12	6.40	6.43	6.10	5.23	5.13	3.90	3.88	5.97
4B 3	Sheep	1.58	1.43	1.29	1.45	1.43	1.41	1.21	1.21	1.20	1.20	1.15
4B 4	Goats	1.58	1.43	1.29	1.45	1.43	1.36	1.17	1.17	1.16	1.16	1.05
4B 6	Horses	6.87	6.84	6.99	6.86	6.76	6.68	5.70	5.69	5.68	5.68	4.93
4B 8	Swine	3.62	3.56	3.61	3.40	3.19	3.17	2.68	2.76	2.48	2.38	2.01
4B 9	Poultry	0.26	0.26	0.24	0.23	0.24	0.24	0.26	0.29	0.28	0.24	0.23
4B 13	Other animals (fur farming)	2.33	2.32	2.32	2.34	2.35	2.34	2.38	2.53	2.69	2.60	2.91

6.2.3 Time-series

The emission of NH_3 from manure management is estimated to 62.81 Gg NH_3 in 2007 (Table 6.6). From 1985 to 2007, the emission is reduced by 41 %. As mentioned, this development is mainly due to an active environmental policy to reduce nitrogen losses in agricultural production. The emission of NH_3 is partly adjusted to TAN for the years 2003-2007 and adjustment for the rest of the years is planned when data is available. The emission of NH_3 from non dairy cattle is in 2007 increased considerably this is mainly due to a rise in feed intake with heifers.

The number of cattle has decreased as a result of a growth in milk yield. In 2007, cattle production contributes with 23 % of the total emis-

sion from manure management. The pig production contributes with a still increases share of the emission – in 2007, 44 % of the total emission from manure management. The production of slathering pigs has increased by more than 50 % compared with 1985. However, despite this development the emission from pigs is still decreasing. This is due to measures focused on the biological development and improvement in fodder efficiency.

Table 6.6 Emission of NH_3 from manure management 1985 to 2007, Gg NH_3.

NFR	Animal category	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
4b 1a	Dairy cattle	28.59	27.86	26.43	25.51	25.29	25.28	24.15	22.48	21.85	20.72	20.14	19.52
4b 1b	Non-dairy cattle	14.67	13.74	12.88	12.34	12.06	12.37	11.95	11.67	11.42	10.46	10.02	9.93
4B 3	Sheep	0.13	0.17	0.19	0.23	0.26	0.29	0.34	0.33	0.28	0.26	0.26	0.28
4B 4	Goats	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
4B 6	Horses	1.47	1.45	1.43	1.41	1.39	1.35	1.33	1.31	1.29	1.27	1.25	1.26
4B 8	Swine	52.75	53.41	50.97	49.83	48.10	47.31	46.97	48.04	48.41	44.63	40.94	40.16
4B 9	Poultry	3.18	3.30	3.39	3.81	4.27	4.31	4.31	4.56	4.89	5.41	5.05	4.93
4B 13	Other - fur farming	5.02	5.69	6.13	7.25	7.55	5.57	5.12	5.49	3.66	4.30	4.31	4.46
Manure Management - total emission		105.83	105.64	101.44	100.40	98.95	96.50	94.20	93.90	91.82	87.08	82.00	80.56

Continued

NFR	Animal category	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
4b 1a	Dairy cattle	18.75	18.78	17.85	18.18	17.77	17.10	16.85	14.36	14.10	14.16	14.47
4b 1b	Non-dairy cattle	9.44	9.21	9.04	9.30	9.72	8.62	7.14	6.73	4.98	4.81	7.24
4B 3	Sheep	0.21	0.20	0.18	0.20	0.23	0.18	0.19	0.18	0.21	0.23	0.19
4B 4	Goats	0.03	0.02	0.02	0.02	0.03	0.03	0.03	0.03	0.03	0.03	0.06
4B 6	Horses	1.27	1.28	1.31	1.31	1.30	1.30	1.16	1.17	1.17	1.18	1.14
4B 8	Swine	41.25	43.13	42.02	40.66	40.24	40.48	34.78	36.59	33.61	31.82	27.69
4B 9	Poultry	4.89	4.81	4.95	5.01	5.03	4.98	4.60	4.81	4.92	4.22	3.78
4B 13	Other - fur farming	5.14	5.45	4.84	5.15	5.41	5.66	5.62	6.25	6.86	7.04	8.24
Manure Management - total emission		80.97	82.88	80.22	79.85	79.73	78.36	70.37	70.10	65.89	63.47	62.81

Figure 6.5 shows the percentage distribution of the NH_3 emission in stables, storage, spreading of manure in fields and in deposits to grass. The main part of the reduction in ammonia emission has taken place in connection with the spreading of manure in fields, due to changes in manure application practice. There has been a reduction in emissions in relation to storage as a result of improved covering of slurry tanks. From 1985 to 2006, the emission relating to manure management in stables increased from 36 % to 50 %. In future, the possibilities for ammonia reduction will be likely to be focused on measurements in stables.

It should be mentioned here that the emission from manure deposited by grazing animals is included in the emission from agricultural soils (NFR – 4.D).

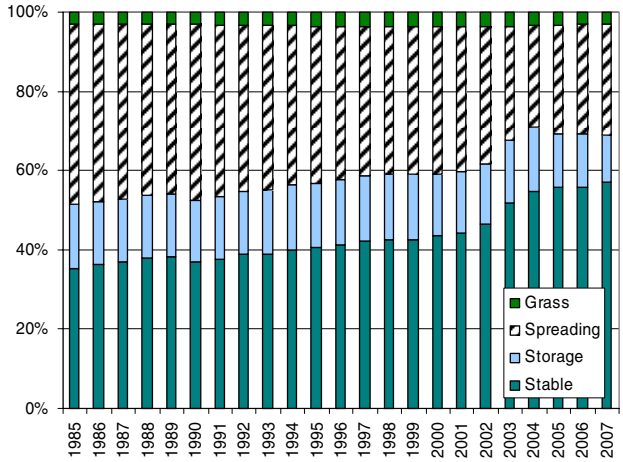

Figure 6.5 The percentage distribution of the NH_3 emission in the agricultural production 1985 to 2007.

6.3 NH_3 emission from agricultural soils – NFR 4.D

6.3.1 Description

Figure 6.6 shows the different emission sources from agricultural soils (NFR Table 4.D). The majority of the ammonia emission from agricultural soils originates from crops, which in 2006 corresponds to 45 %. Another 38 % is related to use of synthetic fertiliser and the remaining part comes from nitrogen deposited by grazing animals and from ammonia-treated straw used as feed.

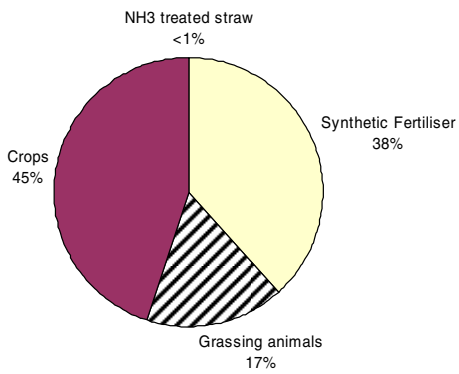

Figure 6.6 Ammonia emissions from agricultural soils 2007.

6.3.2 Methodological issues

More detailed description covering the calculation of the different emission sources and information about activity data and emission factors used is given in Annex 2C2.

Activity data

At present, farmed area covers about 60 % of the total land area in Denmark. In recent decades, farmed area has decreased, being replaced by forest, semi-natural, road and built-up areas and this development is expected to continue. Table 6.7 shows the activity data used in calculation of the ammonia emission from agricultural soils. Information on farmed area and cultivation of different crop types is collected by Sta-

tistics Denmark. The amount of nitrogen used in synthetic fertiliser is based on information from the Danish Plant Directorate. The use of fertiliser has decreased considerably – consumption in 2007 is more than half that in 1985.

Table 6.7 Activity data used to estimate the NH_3 emission from agricultural soils 1985 to 2007.

NFR 4.D													
Activity data	Unit	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
Cultivated area	1000 ha	2 834	2 819	2 798	2 787	2 774	2 788	2 770	2 756	2 739	2 691	2 726	2 716
N in fertiliser	M kg N	398	382	381	367	377	400	395	370	333	326	316	291
N deposit on grass	M kg N	37	36	35	34	34	34	35	35	36	35	36	36
NH_3 treated straw	M kg N	10	12	14	11	14	16	13	12	12	12	10	8
NFR 4.D													
Activity data	Unit	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	
Cultivated area	1000 ha	2 688	2 672	2 644	2 647	2 676	2 666	2 658	2 645	2 707	2 711	2 663	
N in fertiliser	M kg N	288	283	263	251	234	211	201	207	206	192	195	
N deposit on grass	M kg N	35	35	34	34	34	33	30	27	24	22	23	
NH_3 treated straw	M kg N	7	6	3	4	2	1	1	1	0	0	0	

Implied emission factor

The implied emission factors, 1985-2007, in relation to agricultural soils are given in Table 6.8.

The implied emission factors relating to crops are expressed as total emission divided by total area under cultivation, and are decreasing due to the growth in set-a-side area. The implied emission factors relating to use of synthetic fertiliser depend on consumption and type of fertiliser and remain almost the same for all years. The implied emission factors for grazing animals and ammonia used for straw treatment remain unaltered.

Table 6.8 Implied emission factors used to estimate the NH_3 emission from agricultural soils.

NFR 4.D													
Source	Unit	1985	1985	1987	1988	1999	1990	1991	1992	1993	1994	1995	1996
Crops	Kg NH_3 pr hectare	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.0	1.9	2.0
Fertiliser	% of total N	1.8	1.7	1.7	1.8	1.7	1.8	1.7	1.7	1.8	1.9	1.9	1.7
N grass	% of total N	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0
NH_3. straw	% of total NH_3-N	65	65	65	65	65	65	65	65	65	65	65	65
NFR 4.D													
Source	Unit	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	
Crops	Kg NH_3 pr hectare	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	
Fertiliser	% of total N	1.6	1.6	1.6	1.7	1.6	1.6	1.7	1.7	1.7	1.9	1.9	
N grass	% of total N	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	
NH_3. straw	% of total NH_3-N	65	65	65	65	65	65	65	65	65	65	65	

6.3.3 Time-series

From 1985 to 2007 the ammonia emission from agricultural soils decreased from 24.45 Gg NH_3 to 11.67 Gg NH_3, which corresponds to a 52 % reduction (Table 6.9). A considerable increase in the use of fertiliser and ammonia used for straw treatment has, in particular, been important for this development.

As mentioned, there has been an active effort in recent decades to reduce nitrogen leaching by means of action plans. This focus on envi-

ronmental impact in agricultural production has led to an improvement in the utilisation of nitrogen in manure. A consequence of this development is that the use of fertiliser and, in turn, the NH_3 emission has been reduced.

Table 6.9 Emission of NH_3 from Agricultural Soils from 1985 to 2007, Gg NH_3.

NFR 4.D Agricultural Soils	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
Crops	5.97	5.97	5.96	5.91	5.88	5.92	5.88	5.85	5.77	5.36	5.28	5.31
Use of fertiliser	8.48	8.04	7.83	7.83	7.80	8.68	8.33	7.81	7.34	7.64	7.27	6.16
N deposit on grass	3.15	3.08	2.95	2.92	2.91	2.93	3.00	3.00	3.05	2.99	3.04	3.06
NH_3 treated straw	6.54	8.04	8.92	7.25	9.00	10.19	8.64	7.67	7.58	8.10	6.63	5.06
Emission - total	24.45	25.40	25.91	24.10	25.87	27.73	25.86	24.33	23.74	24.08	22.23	19.59

NFR 4.D Agricultural Soils	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Crops	5.44	5.41	5.25	5.21	5.25	5.26	5.24	5.27	5.34	5.34	5.26
Use of fertiliser	5.59	5.63	5.23	5.07	4.66	4.15	4.06	4.31	4.27	4.33	4.48
N deposit on grass	2.97	2.95	2.87	2.88	2.93	2.82	2.51	2.30	2.08	1.89	1.93
NH_3 treated straw	4.48	3.70	2.08	2.47	1.62	0.94	0.80	0.53	0.26	0.00	0.00
Emission - total	18.47	17.69	15.42	15.63	14.46	13.17	12.62	12.41	11.94	11.55	11.67

6.4 NH_3 emission from sewage sludge – NFR 4.G

Around half of the sludge from wastewater treatment is used as fertiliser and applied on agricultural soils. The NH_3 emission from sewage sludge is included under the NFR category 4G "Other". The emission from sewage sludge contributes with less than ½ % of the total emission from agricultural emissions.

Information on amount of sludge, N-content and ammonia emission factor is obtained from reports prepared by the Danish Protection Agency. It is assumed that the ammonia emission is 1.9 kg NH_3-N pr kg N. The amount of sewage sludge has increased from 1985 until 1995. In the following years to 2007 the amount of sludge used as fertiliser has fallen as a result of increasing request from the industrial sector. The sludge is used in industrial process e.g. in the cement production and production of sandblasting material.

Table 6.10 Emission of NH_3 from sewage sludge 1985 to 2007, Gg NH_3.

NFR 4.G Sewage sludge	Unit	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
Amount of sludge applied on soil	Tonnes of dry matter	50 000	50 000	52 380	58 200	69 840	77 883	80 181	96 174	123 382	111 155	112 235	104 010
N-content	Percent	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4,00	4.00	4.13	4.37
N applied on soil	Kg N	2 000	2 000	2 095	2 328	2 794	3 115	3 207	3 847	4 935	4 446	4 635	4 545
Emission - total	Gg NH_3	46	46	48	53	64	71	73	88	113	101	106	104

NFR 4.G Sewage sludge	Unit	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Amount of sludge applied on soil	Tonnes of dry matter	90 701	87 209	85 733	83 727	80 877	81 623	81 000	78 000	78 000	68 000	78 000
N-content	Percent	4.38	4.30	4.28	4.33	4.35	4.41	4.41	4.41	4.62	4.62	4.62
N applied on soil	Kg N	3 973	3 750	3 669	3 625	3 518	3 600	3 572	3 440	3 604	3 604	3 604
Emission - total	Gg NH_3	91	86	84	83	80	82	81	78	82	82	82

6.5 PM emission from stables – NFR 4.B

6.5.1 Description

Investigations have shown that farmers, as well as livestock, are subject to an increased risk of developing lung and respiratory related diseases due to the particulate emissions (Hartung and Seedorf. 1999). This is since the particles are able to carry bacteria, viruses and other organic compounds. Presently, only the emission from 2000 to 2007 is given in NFR.

In 2007 the PM emission from stables, given in TSP, is estimated to 14562. Of this, 57 % relates to swine production. The emission from poultry and cattle contributes with 34 % and 8 %, respectively.

6.5.2 Methodological issues

The estimation of PM emission is based on the EMEP-CLRTAP Emission Inventory Guidebook chapter B1010, where the scientific data mainly is based on an investigation of PM emission in North European stables (Takai et al. 1998).

The particle emission includes primary particles in the form of dust from ventilated stables. Three main types of stables cattle, swine and poultry stables are included in this inventory (Table 6.11). These are divided into subcategories and for each category it is distinguished between solid and slurry based stable systems.

The PM emission is related to the number of stable places and to the time the animal is housed. The PM emission from grassing animals is considered as negligible.

Table 6.11 Livestock categories used in the PM emission inventory.

Livestock categories as given in NFR	Subcategories as given in the EMEP-CLRTAP Emission Inventory Guidebook	Danish inventory	Grassing days
Cattle			
Dairy Cattle	Dairy cattle	Dairy cattle	18
Non-Dairy Cattle	Calves	Calves < ½ yr	0
	Beef cattle	Bulls	0
		Heifer	132
		Suckling cattle	224
Swine	Sows	Sows (incl piglets until 7 kg)	0
	Weaners	Weaners (7-30 kg)	0
	Fattening pigs	Fattening pigs (30-105 kg)	0
Poultry	Laying hens	Laying hens	0
	Broilers	Broilers	0
Horses	Horses	Horses	183

Due to considerable uncertainties and lack of data, this inventory only includes emission from stables. The PM emission from the handling of fertiliser and crops in the field are not taken into account. This will be included when preformed draft on PM chapter of new guidelines is final committed (Hinz 2004, Hinz 2006).

Activity data

Livestock production data is based on Statistics Denmark, Agricultural Statistics (www.dst.dk) – Table 6.12.

Table 6.12 Livestock production 2000 – 2007, 1000 head.

NFR	Animal category	2000	2001	2002	2003	2004	2005	2006	2007
4B 1[a)]	Dairy Cattle	636	623	610	596	563	564	550	545
4B 1[b)]	Non-dairy cattle	1 868	1 907	1 796	1 724	1 646	1 570	1 535	1 566
4B 6	Horses	150	152	153	155	155	156	157	173
4B 8	Swine[1]	10 489	10 489	10 706	10 826	11 257	10 886	11 166	11 074
4B9	Poultry[2]	20 982	20 347	19 734	17 152	16 136	17 074	16 826	15 967

[1)] Includes sows. weaners (7-30 kg) and fattening pigs (30-105 kg).

[2)] Includes laying hens and broilers.

Emission factor

Emission factor for PM_{10} and $PM_{2.5}$ recommended in the EMEP-CLRTAP emission inventory guidebook Table 4.1 are used. The same emissions factors are used for all years.

In Takai et al. (1998), dust emission from stables is estimated as ”inhalable dust”. This is defined as particles that can be transported into the body via the respiratory system. Approximately, “inhalable dust” equates to TSP (Hinz. T., 2002). Estimation of TSP is based on the transformation factors for the conversion of inhalable dust into PM_{10} given in inventory guidebook Table B3 in appendix B.

Table 6.13 Emission factor for particle emission from animal housing system.

Livestock category	Stable system	Emission factor PM_{10} kg pr hd pr yr	$PM_{2.5}$ kg pr hd pr yr	TSP kg pr hd pr yr	Transformation factor PM_{10} to TSP kg pr hd pr yr
Cattle:					
Dairy cattle	Solid	0.36	0.23	0.78	0.46
	Slurry	0.70	0.45	1.52	0.46
Calves < ½ yr	Solid	0.16	0.10	0.35	0.46
	Slurry	0.15	0.10	0.33	0.46
Beef cattle	Solid	0.24	0.16	0.52	0.46
	Slurry	0.32	0.21	0.70	0.46
Heifer[1)]	Solid	0.26	0.17	0.57	0.46
	Slurry	0.43	0.28	0.93	0.46
Suckling cattle[2)]	Solid	0.24	0.16	0.52	0.46
	Slurry	0.32	0.21	0.70	0.46
Swine:					
Sows	Solid	0.58	0.094	1.29	0.45
	Slurry	0.45	0.073	1.00	0.45
Weaners	Solid[3)]	0.18	0.029	0.40	0.45
	Slurry	0.18	0.029	0.40	0.45
Fattening pigs	Solid	0.50	0.081	1.11	0.45
	Slurry	0.42	0.069	0.93	0.45
Poultry:					
Laying hens	Solid	0.017	0.0021	0.017	1.0
	Slurry	0.27	0.052	0.27	1.0
Broilers	Solid	0.35	0.045	0.35	1.0
Horses	Solid	0.18	0.12	0.39	0.46

[1)] Average of “calves” and “dairy cattle”.

[2)] Assumed the same value as “Beef cattle”.

[3)] Same as slurry based systems.

6.5.3 Time-series

Table 6.14 shows the PM emission, given in TSP, PM_{10} and $PM_{2.5}$ for each animal category in the period 2000 to 2007. It is seen that the main part of the emission originates from swine stables. In the period 2000 to 2007, the total agricultural emission has decreased by 8 % due to a fall in production of broilers.

Table 6.14 PM emission 2000 – 2007, Mg PM_{10}, $PM_{2.5}$ and TSP.

	Mg TSP	2000	2001	2002	2003	2004	2005	2006	2007
NFR	Animal Category								
4B 1a	Dairy	706	704	700	700	630	664	648	728
4B 1b	Non-dairy	400	424	395	378	349	330	323	449
4B 6	Horses	29	30	30	30	30	31	31	34
4B 8	Swine	8 024	8 051	8 228	8 316	8 966	9 050	9 189	8 331
4B9	Poultry	6 605	6 359	6 171	5 300	4 936	5 373	5 409	5 020
	TSP total	15 765	15 567	15 524	14 724	14 911	15 448	15 599	14 562
	Mg PM_{10}	2000	2001	2002	2003	2004	2005	2006	2007
NFR	Animal Category								
4B 1a	Dairy	325	324	322	322	290	306	298	335
4B 1b	Non-dairy	184	195	182	174	161	152	149	207
4B 6	Horses	14	14	14	14	14	14	14	16
4B 8	Swine	3 611	3 623	3 702	3 742	4 035	4 072	4 135	3 749
4B9	Poultry	6 605	6 359	6 171	5 300	4 936	5 373	5 409	5 020
	PM_{10} total	10 738	10 514	10 391	9 552	9 435	9 917	10 004	9 326
	Mg $PM_{2.5}$	2000	2001	2002	2003	2004	2005	2006	2007
NFR	Animal Category								
4B 1a	Dairy	209	208	207	207	186	196	191	215
4B 1b	Non-dairy	118	125	117	112	103	97	95	134
4B 6	Horses	9	9	9	9	9	9	9	10
4B 8	Swine	589	591	604	611	656	662	672	612
4B9	Poultry	911	873	848	746	696	767	751	702
	$PM_{2.5}$ total	1 836	1 807	1 785	1 684	1 651	1 732	1 720	1 673

6.6 Uncertainties

Table 6.15 shows the estimated uncertainties for ammonia sources. The figures are primarily based on the expert judgement of the Faculty of Agricultural Sciences, University of Aarhus. The uncertainties for the number of animals and hectares under cultivation with different crops are very small. The Danish Normative System for animal excretions is based on data from the Danish Agricultural Advisory Centre (DAAC), which is the central office for all Danish agricultural advisory services.

DAAC engages in a great deal of research as well as the collection of efficacy reports from Danish farmers for dairy production, meat production, swine production, etc to optimise productivity in Danish agriculture. In total, feeding plans from 15-18 % of Danish dairy production, 25-30 % of pig production. 80-90 % of poultry production and approximately 100 % of fur production are collected annually. These basic feeding plans are used to develop the standard values of the "Danish Normative System".

The system of standard values has been updated annually from 2000. For dairy cows, approximately 800 feeding plans are used to develop the normative figures. The normative figures (Poulsen et al. 2001) are comprised of arithmetic means. Based on 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). However, due to the large number of farms included in the norm figures the arithmetic mean, it can be assumed as a very good estimate with a low uncertainty. All cattle, sheep and goats have their own ID-number (ear

tags) and, hence, uncertainty with regard to their numbers is almost absent. 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 as a whole. The major uncertainty, therefore, relates to the emission factors.

Table 6.15 Estimated uncertainty associated with activities and emission factors for NH_3 and PM.

Source	Emission Gg NH_3	Activity data %	Emission factor %	Combined uncertainty %	Total uncertainty %	Uncertainty 95 % Gg NH_3
4 Agriculture – NH_3 total	72.63				12	9
4B NH_3 Manure Management	60.96	3.3	13.3	13.7	14	8
Stable	35.78	5	20	20.6		
Storage	7.54	5	20	20.6		
Spreading	17.57	5	20	20.6		
4.D Agricultural Soils	11.67	1.0	15.2	15.2	15	2
Grazing animal	1.93	5	20	20.6		
Synthetic fertiliser	4.48	1	25	25.0		
Crops	5.26	1	25	25.0		
Ammonia treated straw	0.00	10	25	26.9		
4.G Other – Sewage Sludge	0.08	2	20	20.1	20	0.01
Source	Emission Mg	Activity data %	Emission factor %	Combined uncertainty %	Total uncertainty %	Uncertainty 95 % Mg TSP
4 Agriculture – total TSP	14 562	2	500	500	500	72 812
4 Agriculture – total PM_{10}	9 326	2	500	500	500	46 631
4 Agriculture – total $PM_{2.5}$	1 673	2	500	500	500	8 366

6.7 Quality assurance and quality control (QA/QC)

A general QA/QC and verification plan for the agricultural sector is still under development, but some measures have been formulated as general lines for the further work. The objectives for the quality planning, as given in the CLRTAP Emission Inventory Guidebook, which is closely related to the IPCC Good Practice Guidance, are to improve the transparency, consistency, comparability, completeness and confidence.

To ensure consistency in the inventory, certain time-series have been prepared for both the activity data and the emission factors, 1985 - 2007. Considerable variation between years can reveal miscalculations or changes in methods. These variations are checked and errors have been rectified.

Activity data and emission factors are collected and discussed in cooperation with specialists and researchers at different institutes and research sections. As a consequence, both data and methods are evaluated continuously according to latest knowledge and information. A more detailed description of quality assurance and quality control is given in the Denmark´s National Inventory Report 2006 - submitted under the United Nations Framework Convention on Climate Change (http://www.dmu.dk/Pub/FR667.pdf).

6.8 Recalculations

Compared with the previous NH_3 and PM emissions inventory (submission 2007), some changes and updates have been made. These changes cause a decrease in the NH_3 emission (1985 – 2006) and an increase in the PM emission (2004 – 2006), see Table 6.16.

Table 6.16 Changes in NH_3 emission in the agricultural sector compared to NFR reported last year.

NH_3 emission (Gg NH_3)	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
Previous	139.24	139.02	135.08	130.78	131.00	132.95	129.03	126.60	125.65	120.37	112.81
Updated	126.87	127.74	124.20	121.43	121.69	121.36	117.13	115.31	112.62	108.28	101.29
Difference (pct)	-8.9	-8.1	-8.1	-7.2	-7.1	-8.7	-9.2	-8.9	-10.4	-10.1	-10.2
NH_3 emission (Gg NH_3)	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Previous	108.54	107.30	108.11	103.42	102.62	101.15	98.22	93.73	95.30	90.36	87.05
Updated	97.20	96.57	97.70	92.86	92.68	91.34	88.79	80.56	80.29	75.84	73.22
Difference (pct)	-10.4	-10.0	-9.6	-10.2	-9.7	-9.7	-9.6	-14.1	-15.7	-16.1	-15.9
PM emission (Mg TSP)					2000	2001	2002	2003	2004	2005	2006
Previous					15 765	15 567	15 524	14 724	14 621	14 688	14 838
Updated					15 765	15 567	15 524	14 724	14 911	15 448	15 599
Difference (pct)					0.0	0.0	0.0	0.0	2.0	5.2	5.1

There have been no changes in the methodology.

Emission factors for synthetic fertilizers the have been changed to the values given by EMEP/EEA (2009) and recalculations is done for 1985-2006. This results in a decrease in the ammonia emission from synthetic fertilizers of 10-26 %.

The emission factors for crops are lowered from 5 to 2 % for crops and from 3 to 0.5 % for grass based on a literary survey (Gyldenkærne and Albrektsen, 2009). Recalculations have been done for the years 1985-2006. This results in a decrease in the ammonia emission from crops of 62-64 %.

Updated data from The Danish Environmental Protection Agency for the use of sewage sludge as fertilizers for the years 2004-2006 have been received and therefore recalculations. This results in an increase in the emission from sewage sludge used as fertilizer of 11 – 25 %.

Emission factors for fur farming have been raised from 25 to 36 % in agreement with Poulsen, H. D (pers. comm. 2008) and recalculation is done for the years 1985-2006.

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

Calculations of nitrogen loss from livestock have partly been adjusted to TAN for the years 2003-2006. This together with the changes in time on pasture is the main cause to the additional decrease in the total NH_3 emission.

Planned improvements

Until now the number of bulls is based on the annually census. Instead, it is planned to use information on slaughtering data received from Statistics Denmark, which better reflects the year production. At the same time the exported animals will be included.

In recent years, there has been focus on reduction of the ammonia emission and especially the possibilities for emission reduction in stables. A number of investigations to estimate the effects from technical measures on the emission have been initiated. However, very few stables have implemented ammonia reduction technologies, although these probably will be an important issue in future. When data is available, it is planned to implement the reduction effect in the emission inventory.

For PM emission, it is planned to include dust emission from stables for the years 1985 to 1999. It is also planned to include the dust emission from arable farming – i.e. harvesting and field preparation by machines. First draft to guidelines is preformed but not yet final confirmed. The inventory from Finland shows that dust emission from arable farming contributes with approximately 25 % of the total emission from the agricultural sector (Karvosenoja et al., 2001 and Louhekainen et al., 1987), which indicates the potential of a relevant PM emission source.

Calculations for the loss of nitrogen from livestock in the period from 1985 and forward will be adjusted to TAN when data is available.

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7 Waste (NFR sector 6)

The waste sector consists of the four main NFR categories 6A Solid waste disposal on land, 6B Waste-Water handling, 6C Waste incineration and 6D Other waste. Table 7.1 below shows the relevant SNAP codes for the waste sector.

Table 7.1 Link between SNAP codes and NFR sectors.

SNAP code	SNAP name	NFR code
090401	Managed Waste Disposal on Land	6A
090402	Unmanaged Waste Disposal Sites	6A
090403	Other	6A
091001	Waste water treatment in industry	6B
091007	Latrines	6B
091002	Waste water treatment in residential/commercial sect.	6B
090201	Incineration of domestic or municipal wastes	6C
090202	Incineration of industrial wastes (except flaring)	6C
090204	Flaring in chemical industries	6C
090205	Incineration of sludge from waste water treatment	6C
090207	Incineration of hospital wastes	6C
090208	Incineration of waste oil	6C
090901	Incineration of corpses	6C
090902	Incineration of carcasses	6C
090700	Open burning of agricultural wastes	6C
091008	Other production of fuel (refuse derived fuel)	6D
091003	Sludge spreading	6D
091005	Compost production	6D
091006	Biogas production	6D

Incineration of waste in Denmark is done with energy recovery and therefore the emissions are included under the relevant sectors under NFR sector 1A.

The waste sector is presently only a key source for dioxin due to the emissions from accidental fires. It is unsure whether NMVOC from waste disposal and waste-water handling, which is to be included in the inventory, will be key categories in the future.

7.1 Solid waste disposal on land

Major emissions from waste disposal are emissions of greenhouse gases. It is assumed that waste disposal also leads to emission of small quantities of NMVOC, CO, NH_3 and NO_x. PM emissions are emitted from waste handling as well, but no emission factors are available.

For the 2009 submission Denmark has not estimated emissions of air pollutants from solid waste disposal. The draft EMEP/EEA Guidebook contains a default NMVOC emission factor, and emission estimates will be implemented in the 2010 submission.

7.2 Waste-water handling

According to the draft EMEP/EEA Guidebook waste-water handling can be a source for emissions of POPs, NMVOC, NH_3 and CO. Of these pollutants only NMVOC is thought to be significant.

For the 2009 submission Denmark has not estimated emissions of air pollutants from waste-water handling. The draft EMEP/EEA Guidebook contains a default NMVOC emission factor for latrines and waste-water handling and emission estimates will be implemented in the 2010 submission.

7.3 Waste incineration

Incineration of municipal, industrial and clinical waste take place with energy recovery, therefore the emissions are included in the relevant subsectors under NFR sector 1A. Flaring off-shore and in refineries are included under NFR sector 1B2c. No flaring in chemical industry occurs in Denmark.

7.3.1 Cremation

The incineration of human bodies is a common practice that is performed on an increasing part of the yearly deceased. All Danish incineration facilities use optimised and controlled combustions, with temperatures reaching 800-850 °C, secondary combustion chambers, controlled combustion air flow and regulations for coffin materials.

However the emissions of especially Hg caused by cremations can still contribute to a considerable part of the total national emissions. In addition to the most frequently discussed emissions of Hg and PCDD/Fs (dioxins and furans), are the emissions of compounds like SO_X, NO_X, VOC, CO, other heavy metals (As, Cd, Cr, Co, Ni, Pb, Se, Zn) and particulate matter.

Crematoria are usually located within cities, close to residential areas and normally, their stacks are relatively low. Therefore environmental and human exposure is likely to occur as a result of emissions from cremation facilities.

Methodology

There are 31 crematoria in Denmark, some with multiple furnaces, 21 facilities are run by the church and 10 by the local authorities (KM, 2006).

During the 1990es all Danish crematoria were rebuilt to meet new standards. This included installation of secondary combustion chambers and in most cases, replacement of old primary incineration chambers (Schleicher, O. et al., 2001). All Danish cremation facilities are therefore performing controlled incinerations with a good burn-out of the gases, and a low production of pollutants. But only a very few crematoria are equipped with flue gas cleaning (bag filters with activated carbon).

Following the development of new technology, the emission limits for crematoria are lowered again in 1/2009. Table 7.2 shows a comparison of the emission limits from 2/1993 and the new standard limits.

Table 7.2 Emission limit values mg pr normal m^3 at 11 % O_2 (Schleicher & Gram, 2008).

Component	Report 2/1993	Standard terms (1/2009)
	Emission limit value mg/normal m^3 at 11 % O_2	
Total dust	80	10
CO	50	50
CO_2	500	500
Hg	No demands	0.1
Other demands:		
Stack height	3 m above rooftop	3 m above rooftop
Temperature in stack	Minimum 150 °C	Minimum 110 °C
Flue gas flow in stack	8 – 20 m/s	No demands
Temperature in after burner	850 °C	800 °C
Residence time in after burner	2 seconds	2 seconds
Odour	The crematory must not cause noticeable odour in the surroundings	The crematory must not cause odour nuisance outside the crematory perimeter, that is significant according to the supervisory authority

The use of air pollution control devices, and activated carbon, for the removal of Hg is expected to reduce the flue gas concentration of dioxins, PAH's and odour. Existing knowledge on the reduction efficiencies justifies that no emission limits are necessary (Schleicher & Gram, 2008).

Activity data

Table 7.3 shows the development in total number of cremations and the fraction of cremated corpses of the total number of deceased. The data runs from 1990 to 2007 and is gathered by the Association of Danish Crematoria (DKL, 2008).

Table 7.3 Activity data (DKL 2008).

Year	Total cremations	% of total deceased	Year	Total cremations	% of total deceased
1990	40991	67.28	1999	42299	74.44
1991	40666	68.25	2000	41651	71.81
1992	41455	68.16	2001	41707	71.47
1993	43194	68.77	2002	42539	72.57
1994	42762	69.99	2003	41997	72.94
1995	43847	69.46	2004	41555	74.47
1996	43262	70.82	2005	40758	74.16
1997	42891	71.55	2006	41233	74.32
1998	41660	69.10	2007	41766	75.11

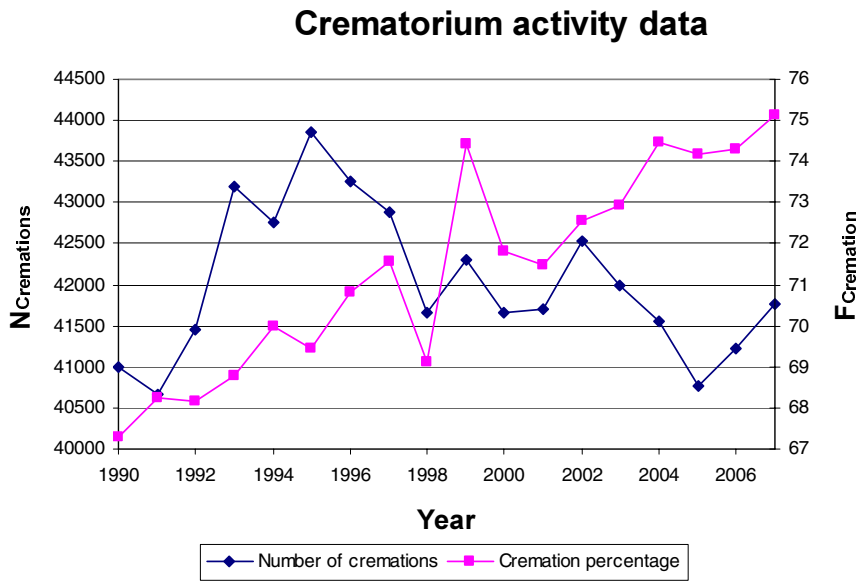

Figure 7.1 Illustration of the development in cremations (DKL 2008), where the number of cremations, $N_{cremations}$, is shown at the left Y-axis. The cremation percentage, $F_{cremations}$, shows the percent of cremation deceased of the total deceased from the year 1990 to 2007.

Even though the total number of yearly cremations is fluctuating, the cremation percentage has been increasing since 1990, and is likely to continue to increase.

Emission factors

For crematoria, emissions are calculated by multiplying the total number of cremations by the emission factors. Since there are no measurements available of the yearly emission from Danish crematoria, the estimation of emissions is based on emission factors from literature. The estimation is based on the measurements performed in countries that are comparable with Denmark. By comparable is meant countries that use similar incineration processes, similar cremation techniques including support fuel and have a similar composition of sources to lifetime exposure, lifetimes and coffins.

Table 7.4 lists the emission factors and their respective references.

Table 7.4 Emission factors used in the Danish inventory and references.

Pollutant name	Unit	Emission factor*	Reference
CO_2	kg/body	50.1	Fontelle et al.
SO_2	g/body	54.4	US-EPA
NO_X	g/body	308.5	US-EPA
NMVOC	g/body	13.0	CANA, 1993
CH_4	g/body	11.8	Aasestad
CO	g/body	10.8	Schleicher et al., 2001
Nitrous oxide	g/body	14.7	Aasestad
NH_3		NA	
TSP	g/body	43.5	WEBFIRE
PM_{10}	g/body	39.2	WEBFIRE
$PM_{2.5}$	g/body	39.2	WEBFIRE
Hg	g/body	1.12	Kriegbaum et al.
Se	g/body	0.0223	WEBFIRE
Zn	g/body	0.181	WEBFIRE
As	µg/body	10.98	US-EPA
Cd	µg/body	3.11	US-EPA
Cr	µg/body	8.44	US-EPA
Cu	µg/body	7.71	US-EPA
Ni	µg/body	10.8	US-EPA
Pb	µg/body	18.6	US-EPA
PCB	µg/body	413.5	Eisaku TODA
HCB	µg/body	151.6	Eisaku TODA
Benzo(b)flouranthene	µg/body	8.14	WEBFIRE
Benzo(k)flouranthene	µg/body	7.27	WEBFIRE
Benzo(g,h,i)perylene	µg/body	14.9	WEBFIRE
Indeno(1,2,3-c-d)pyrene	µg/body	7.88	WEBFIRE
Benzo(a)pyrene	µg/body	0.0103	US-EPA
Flouranthene	µg/body	0.0590	US-EPA
PCDD/F	µg I-TEQ/body**	0.950	Henriksen et al.

*NA = not available.

** I-TEQ: International Toxicity Equivalents.

Danish measurements of dioxin emissions from 3 furnaces in 2 different crematoria in 2001 showed concentration ranges of 0.2 – 0.7 ng I-TEQ pr m³ (n.t.10 % O_2) and emission factor in the range of 180 - 930 ng I-TEQ pr cremation. The calculated average emission factor is 350 ng I-TEQ pr cremation, and the average concentration is 0.3 ng I-TEQ pr m³ (n.t.10 %O_2). The measurements are assumed representative for all Danish crematory furnaces (Schleicher & Gram, 2008).

A Danish substance flow analysis from 2003 estimated the dioxin emission factor from crematoria to be in the range of 6-70 mg I-TEQ pr year (90 % confidence level), with an average value of 950 ng I-TEQ pr cremation (Henriksen et al., 2006). The estimate from Henriksen et al., 2006 is the based on the latest dated measurements and is the one chosen for this inventory.

It has not been possible to find data for ammonia. Ammonia might appear in lesser amounts, but will most likely be converted to NO_X at the high incineration temperatures.

For the compounds CH_4, CO_2, N_2O, Se, PCB, HCB, benzo(b)- and (k)-flouranthene, benzo(g,h,i)perylene and indeno(1,2,3-c-d)pyrene, it has not been possible to find any additional data to validate the emission factors. Only in the case of PCB, Thomsen et al. (2009) provides an emission factor for PCB of 0.4 mg pr tonnes and assuming a body mass of 70 kg this gives an emission factor of 28 µg pr body. The Japanese reference (Eisaku TODA, 2006) may be overestimated due to differences in sources to the total exposure in Japan and in Denmark and due to a higher technological development and use of air pollution devices. Still, the Japanese emission factor was selected in the inventory of this year as this data source represents newest knowledge and refers to real measurements.

For the compounds As, Cd, Cr, Cu, Ni, benzo(a)pyrene and flouranthene, the emission factors from US EPA 1996 were compared with data found in the database provided by US EPA (WEBFIRE, 1992). The two data sources present emission factors that differ significantly for these compounds. Since no other data is available, the most resent estimated emission factor is chosen.

In addition to the two US data sources (WEBFIRE and US-EPA, 1996), emission factors for Pb and Zn were found in a scientific paper by Santarsiero et al. (2005) and, for Pb, also in a Swiss report (Heldstab et al., 2008). These data corresponds well with the emission factors of the WEBFIRE database, which are therefore applied for Pb and Zn.

Since emission factors are country specific, Danish estimated data is selected whenever available. Ten data sources were found providing emission factors for CO, Hg and PCDD/F and amongst these were data from the Danish EPA and the National Environmental Research Institute (NERI). The selected Danish emission factors were verified by comparability to values provided by the US database WEBFIRE and the Swiss report by Heldstab et al., 2008.

Five data sources to information and estimates of emission factors for SO_2, NO_x and NMVOC showed very similar values. Since none of these data sources are based on Danish estimates, the most common (US-EPA, 1996) and (CANA, 1993) referenced by the EMEP/Corinair Guidebook are selected.

There are also several data sources to the emission factor of TSP. The WEBFIRE database provides the one referred to in most of the scientific literature, and was therefore selected for this inventory. The particulate matter fractions of PM_{10} and $PM_{2.5}$ are both calculated from TSP, as it is assumed that PM_{10} and $PM_{2.5}$ are 90 % of the total TSP (Fontelle et al., 2008).

Emissions

Table 7.5 shows the total national emissions from the year 2007. The dioxin emission is given in I-TEQ; i.e. International Toxicity Equivalents which is a weighted addition of congener toxicity with reference to 2,3,7,8-TCDD (Seveso-dioxin).

Table 7.5 Total national emissions in 2007.

Pollutant name	Emission	Unit
CO_2	2.09	kt/year
SO_X	2.27	t/year
NO_X	12.88	t/year
NMVOC	0.543	t/year
CH_4	0.491	t/year
CO	0.450	t/year
Nitrous oxide	0.614	t/year
NH_3	NA	
TSP	1.82	t/year
PM_{10}	1.64	t/year
$PM_{2.5}$	1.64	t/year
Hg	46.74	kg/year
Se	0.932	kg/year
Zn	7.55	kg/year
As	0.458	g/year
Cd	0.130	g/year
Cr	0.352	g/year
Cu	0.322	g/year
Ni	0.449	g/year
Pb	0.777	g/year
PCB	17.27	g/year
HCB	6.33	g/year
Benzo(b)flouranthene	0.340	g/year
Benzo(k)flouranthene	0.304	g/year
Benzo(g,h,i)perylene	0.622	g/year
Indeno(1,2,3-c-d)pyrene	0.329	g/year
Benzo(a)pyrene	0.432	mg/year
Flouranthene	2.46	mg/year
PCDD/F	39.68	mg I-TEQ/year

The emission of CO_2 much exceeds the sum of all other emissions. With an averages body weight of 65 kg and an emission factor of 50 kg pr body, CO_2 delivers 99 wt% of the total emitted off gas. This massive amount of CO_2 is possibly contributed to by a support fuel.

Uncertainties and time-series consistency

The uncertainty of the number of cremations is miniscule, however for the purpose of the calculation it has been set to 1 %. The uncertainties on the emission factors used in this inventory, and at the present level of available information, are shown in Table 7.6

Table 7.6 Estimated uncertainties on activity data and emission factors.

Pollutant	Activity data [%]	Emission factor [%]
CO_2	1	150
SO_2	1	100
NO_x	1	150
NMVOC	1	50
CH_4	1	300
CO	1	150
N_2O	1	1000
TSP	1	1000
PM_{10}	1	1000
$PM_{2.5}$	1	1000
Mercury	1	1000
Selenium	1	1000
Zinc	1	1000
Arsenic	1	1000
Cadmium	1	1000
Chromium	1	1000
Copper	1	1000
Nickel	1	1000
Lead	1	1000
PCB	1	1000
HCB	1	1000
benzo(b)flouranthene	1	1000
benzo(k)flouranthene	1	1000
benzo(g,h,i)perylene	1	1000
indeno(1,2,3-c,d)pyrene	1	1000
benzo(a)pyrene	1	1000
flouranthene	1	1000
PCDD/F	1	1000

Source-specific QA/QC and verification

The specific QA/QC activities for this sector are under development.

Source-specific recalculations

None

Source-specific planned improvements

None

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7.4 Other waste

This category is a catch all for the waste sector. Emissions in this category could stem from sludge spreading, compost production, biogas production and accidental fires, at the moment only emissions from accidental fires are estimated in the Danish inventory.

7.4.1 Accidental fires

In the Danish inventory dioxin emissions from accidental fires are included. In the 2009 submission these emissions have been reported under NFR category 7 Other. The emissions will be reallocated for the 2010 submission.

Accidental fires cover fires in vehicles, buildings and landfill fires. The emission from accidental fires in buildings in Denmark is estimated to be 5.3 g I-TEQ pr year. Accidental fires in vehicles are, with 1 000 fires each year, estimated to give rise to a dioxin emission of 0.05 g I-TEQ pr year. The dioxin emission from landfill fires is estimated at 0.75 g I-TEQ pr year. (Henriksen et al., 2006)

New knowledge on emission factors are available from the new EMEP/EEA Guidebook and will be implemented in the future.

References

Henriksen, T.C., Illerup, J.B. & Nielsen, O.-K. 2006: Dioxin Air Emission Inventory 1990-2004. National Environmental Research Institute, Denmark. 90 pp. – NERI Technical report no 602. Available at:
http://www.dmu.dk/Pub/FR602.pdf

8 Reporting spatially distributed emissions on grid

8.1 Background for reporting

Geographically distributed emissions, has been reported in 2007 to the UNECE LRTAP Convention for the years 1990, 1995, 2000 and 2005. Emission data are disaggregated to the standard EMEP grid with a resolution of 50km x 50km. Mandatory reporting are following 14 air pollutants: SO_x, NO_x, NH_3, NMVOC, CO, TSP, PM_{10}, $PM_{2.5}$, Pb, Cd, Hg, DIOX, PAH and HCB. The reporting includes gridded data for sector totals as well as totals for all sectors together. Guidelines for reporting air emissions on grid are given in UN (2003). Gridded emission data are used in integrated European air pollution models, e.g. RAINS/GAINS and EMEP's chemical transport models. Table 8.1 lists the categories (sectors) used for reporting emission data on grid based on the Danish inventories.

Table 8.1 Categories used for reporting gridded emission data according to the guidelines from United Nations.

Categories for Gridding		UN categories used for DK reporting
01	Combustion in Power Plants and Industry	√
02a	Transport above 1000m	√
02b	Transport below 1000m	√
03	Commercial Residential and Other Stationary Combustion	√
04	Fugitive Emissions from Fuels	√
05	Industrial Processes	√
06	Solvents and other product use	√
07	Agriculture	√
08	Waste	√
09	Other	-
	Natural	-

The gridded emission data for the 2007 reporting are available at the EU eionet homepage that can be linked from either the NERI homepage http://www.dmu.dk or the homepage of the European Environment Agency http://www.eea.europa.eu.

8.2 Methods and data for disaggregation of emission data

In the present work geographic data was used as proxies positioning the activity, which causes the emission. As an example we used a geographic data set for land cover of forest for distributing emissions from forest machinery.

Based on the theme of forest land cover, fractions of forest in each grid cell were calculated, and the total emission from forest machinery was distributed in harmony with the fractions of forest in each grid cell. A

similar methodology was used for distributing emissions from other categories.

An explanation of the applied methodology in greater detail is available in Jensen et al. (2008). A wide range of different geographic data sets has been applied in the mapping procedure. The most essential data are listed in Table 8.2.

Table 8.2 List of different geographic data used in the mapping exercise.

Data owner	Data set	Contents
The National Survey and Cadastre	Topographic map	Geo-referenced basic map layers on administrative units, Land cover, territorial borders, coastline and infrastructure.
National Agency for Enterprise and Construction	Central Dwelling and Building Register (Danish abbreviation BBR)	Geo-referenced information on dwellings and buildings
The Directorate for Food, Fisheries and Agri Business	The Central Husbandry Register (CHR)	Geo-referenced information on stock of livestock at farm level
The Directorate for Food, Fisheries and Agri Business	The General Agricultural Register (GLR)	Geo-referenced information on agricultural fields
National Environmental Research Institute	Large Point Sources (LPS)	Geo-referenced information on power plants and large industrial plants
Danish Forest and Nature Agency	Military training terrain	Geo-referenced information on military training terrains

The disaggregation was as far as possible done at the SNAP level within the different reporting categories listed in Table 7.1. The disaggregation at the highly detailed SNAP level was later aggregated to the reporting categories (sector totals), and these were again further aggregated to national totals for all sectors. It is worth to mention that the composition of the predefined reporting categories for gridded emission data are not fully compatible with the categories used in the NFR-schemes for annual reporting of emission data[10] to UNECE.

8.3 Maps with geographical distributed emission data

It is not possible in this section to present all maps for all reporting years and sectors. Therefore, we choose to show national totals for selected air pollutants from the latest reporting year (2005). The selected air pollutants are: Ammonia (NH_3), sulphur dioxide (SO_2), nitrogen dioxide (NO_2) and small particulate matter ($PM_{2.5}$). Figure 8.1 shows the geographical distributed emissions for these air pollutants. Even from the national distributed totals, spatial patterns from the major sectors are recognisable.

[10] The annual reporting of emission data to UNECE includes all air pollutants except greenhouse gases.

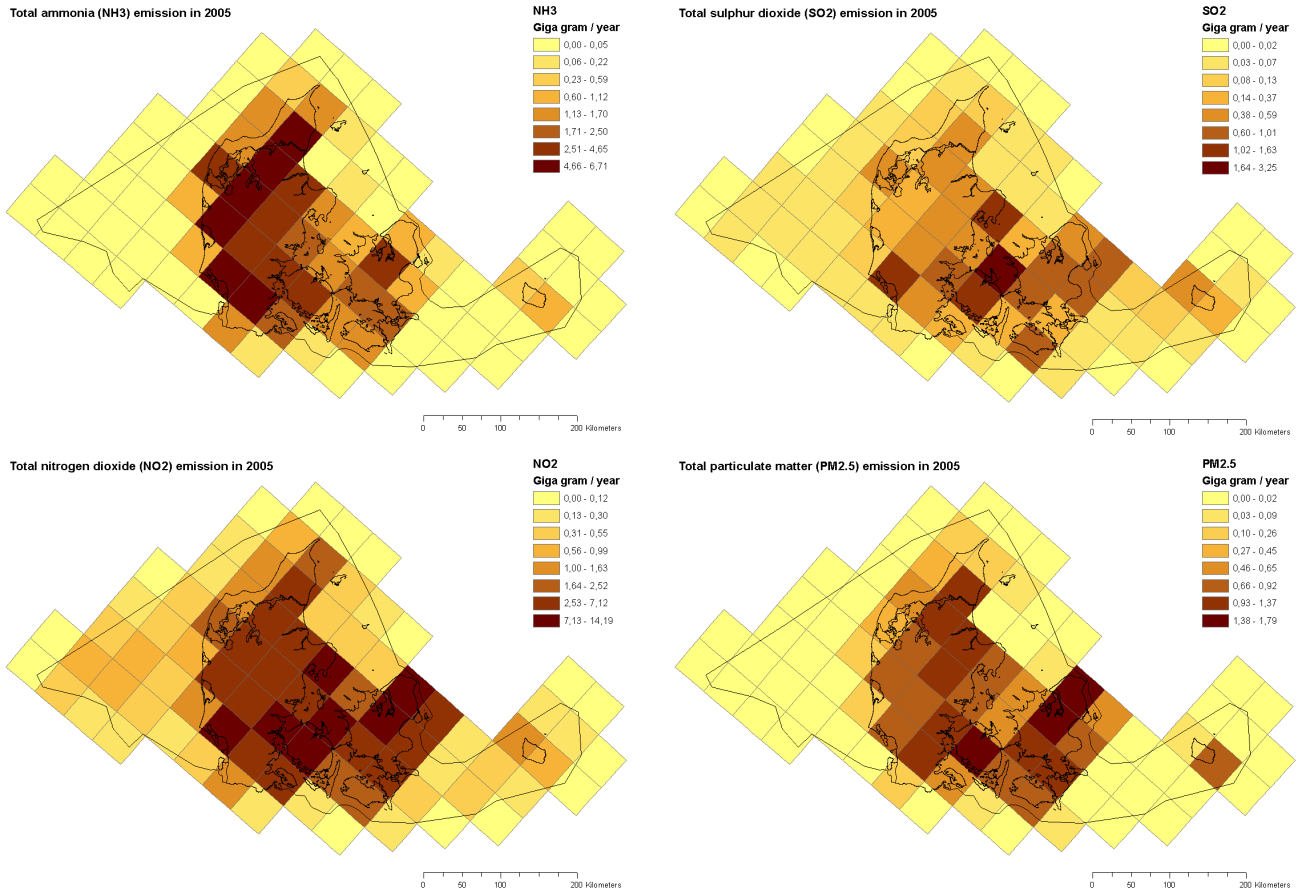

Figure 8.1 Geographical distribution of national emissions of NH_3, SO_2, NO_2 and $PM_{2.5}$ in 2005.

The agricultural sector is the major contributor to the national total NH_3 emission. Emission of NH_3 is mainly related to livestock farming and especially to the handling of manure from the animals. Emissions of NH_3 are therefore related to storage and spreading of manure as well as emissions from stables (Mikkelsen et al., 2006). The geographical pattern of the NH_3 emission is in good agreement with the localisation and concentration of the Danish livestock farming in the northern and western part of Jutland.

The geographical distribution of SO_2 reflects mainly the localisation of large power plants in Denmark, because these are the overall sources of SO_2 emissions. During the 4 reporting years, this pattern has become weaker, due to the implementation of techniques for reduction of sulphur in the outlet smoke from the power plants. Even though the SO_2 emission has decreased dramatically it still produces a distinct pattern reflecting the localisation of large power plants in Denmark.

For NO_2 the pattern is not that distinct as for SO_2, because it reflects a combination of emission contributions from both power plants and industry, commercial and residential plants and as well transport – mainly road transport. This means that the geographic pattern to a certain point reflects the localisation of infrastructure, dwellings and power plants and industry in Denmark.

The distribution of $PM_{2.5}$ is mainly related to road transport and emissions from residential wood use. Therefore the emissions of $PM_{2.5}$ fol-

low the localisation of the Danish road network and the large residential areas with single family houses.

As already mentioned the total SO_2 emission for Denmark has decreased significantly since 1990. The total emission of SO_2 in 2005 corresponds to approx. 12 percent of the total SO_2 emission in 1990. The spatially distributed pattern of SO_2 in 1990 is illustrated in Figure 8.2. For making comparisons between the two reporting years – see also Figure 8.1.

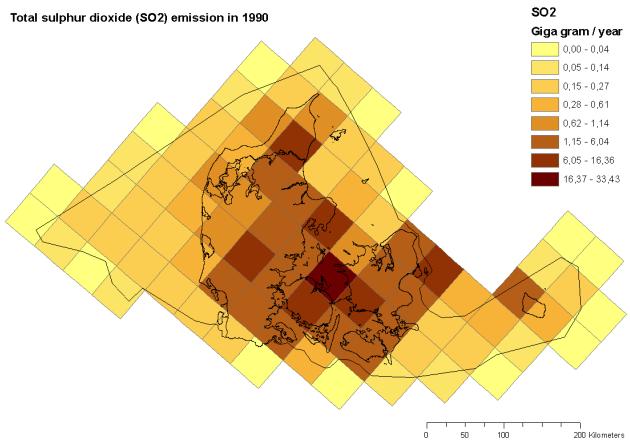

Figure 8.2 Spatial pattern of the total annual SO_2 emission in Denmark in 1990.

References

Jensen, M.T., Nielsen, O-K., Mikkelsen, M.H., Winther, M., Gyldenkærne, S., Viuf, P.Ø. & Illerup J.B., 2008: Rapportering af Luftemissioner på Grid – Metoder og Principper. Danmarks Miljøundersøgelser, Århus Universitet. 58 s. – Faglig rapport fra DMU nr. 654. (report in Danish). Available at:
http://www2.dmu.dk/Pub/FR654.pdf

Mikkelsen M.H., Gyldenkærne, S., Poulsen, H.D., Olesen, J.E. & Sommer, S.G., 2006: Emission of ammonia, nitrous oxide and methane from Danish Agriculture 1985 – 2002. Methodology and Estimates. National Environmental Research Institute, Denmark. 90 pp –Research Notes from NERI No. 231. Available at:
http://www2.dmu.dk/Pub/AR231.pdf

UN, 2003: Guidelines for Estimating and Reporting Emission Data under the Convention on Long-range Transboundary Air Pollution. Air Pollution Studies No. 15. Economic Commission for Europe. United Nations. Available at:
http://www.unece.org/env/documents/2003/eb/air/ece.eb.air.80.E.pdf (26-04-2008).

9 Recalculations and Improvements

In general, considerable work is being carried out to improve the inventories. Investigations and research carried out in Denmark and abroad produce new results and findings which are given consideration and, to the extent which is possible, are included as the basis for emission estimates and as data in the inventory databases. Furthermore, the updates of the EMEP/CORINAIR guidebook, and the work of the Task Force on Emission Inventories and its expert groups are followed closely in order to be able to incorporate the best scientific information as the basis for the inventories. The further important references in this regard are the IPCC guidelines and IPCC good practice guidance.

The implementation of new results in inventories is made in a way so that improvements, as far as possible, better reflect Danish conditions and circumstances. This is in accordance with good practice. Furthermore, efforts are made to involve as many experts as possible in the reasoning, justification and feasibility of implementation of improvements.

In improving the inventories, care is taken to consider implementation of improvements for the whole time-series of inventories to make it consistent. Such efforts lead to recalculation of previously submitted inventories. This submission includes recalculated inventories for the whole time-series. The reasoning for the recalculations performed is to be found in the sectoral chapters of this report. The text below focuses on improvements and recalculations, in general, and further serves as an overview and summary of the relevant text in the sectoral chapters.

9.1 Energy

Improvements and updates of the Danish energy statistics are made regularly by the producer of the statistics, the Danish Energy Agency. In close cooperation with the DEA, these improvements and updates are reflected in the emission inventory for the energy sector. The Danish energy statistics have, for the most part, been aggregated to the SNAP categorisation. This, however, does not include energy statistics for fuel consumption data for specific industries.

The inventories are still being improved through work to increase the number of large point sources, e.g. power plants, included in the databases as individual point sources. Such an inclusion makes it possible to use plant-specific data for emissions, etc, available e.g. in annual environmental reports from the plants in question.

9.1.1 Stationary Combustion

The national energy statistics has been updated for the years 1980-2006. This has primarily resulted in small differences. However, a larger recalculation of the residential wood consumption was made by the DEA resulting in higher emissions of a number of air pollutants in 2006.

The emission factor for straw in residential plants has been updated to reflect the value provided in the EMEP/Corinair Guidebook. The emission factor was reduced from 600 g pr GJ to 400 g pr GJ. This change was made for the whole time-series.

The emission factor for CO for residential wood combustion was updated based on the technology distribution of stoves and boilers together with default emission factors from the EMEP/Corinair Guidebook. This reduced the emissions factor from 6000 g pr GJ to 3441 g pr GJ in 2007. A time-series for the emission factor was elaborated and is included in annex 2A.

HCB emissions were estimated for the first time. Default emission factors from the EMEP/Corinair Guidebook were used in the calculations.

9.1.2 Mobile sources

Road transport

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

Recalculations have been made from 1985-2006 resulting in minor emission differences between 0 and -1 %, for all emission components other than the fuel related ones. For these latter components, the emissions remain the same.

National sea transport

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

This has caused the fuel consumption and emissions to change from 1996 onwards. Most significantly the emission changes for NO_x are between -3 and -20 %, whereas the emission changes for other components are between -3 and 3 %. The fuel consumption increases are between 0 and 2 % in the period.

Fishery

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

Fishery is a part of the CRF-NFR code 1A4c consisting of agriculture, forestry and fisheries activities, and hence the fuel consumption and emission impacts are somewhat smaller for the sector as a whole.

From 1996-2005 the fuel consumption and emission changes are between 0 and -2 %. For 2006 the emission changes are between -3 and -1

%. For SO_2 though the emission change is -7 %, due to the relatively high sulphur content in marine gas oil.

Military

Emission factors derived from the new road transport simulations have caused minor emission changes from 1985-2006. The emission differences are between -1 and 2 %, for all emission components other than the fuel related ones. For these latter components, the emissions remain the same.

Residential

No changes have been made.

Railways

No changes have been made.

Aviation

No changes have been made.

9.1.3 Industrial processes

No changes have been made.

9.1.4 Solvents

The main improvements in the 2009 submission include the following

- The following chemicals and groups have been removed, compared to the 2006 inventory, due to vapour pressures below 0.01kPa: aminooxygen groups, glycerol, toluendiisocyanate, dioctylphthalate, diethylenglycol.
- Emission factors (EFs) have been adjusted for all chemicals, with most predominant effect for the following chemicals: ethanol, formaldehyde, turpentine, xylene, toluene and ethylenglycol.
- A differentiation of EFs in four different categories has been implemented: 1) chemical industry (lowest EF), 2) other industry, 3) non-industrial activities, 4) domestic and other diffuse use (highest EF). In previous inventories there was only a differentiation in two categories.
- More detailed and reliable information on use amounts and emission factors has been obtained from importers and producers for the following chemicals: methanol, ethanol in windscreen washing agent, naphthalene, propane and butane.
- Acrylic acid has been included in the inventory.

9.1.5 Agriculture

Compared with the previous NH_3 and PM emissions inventory (submission 2007), some changes and updates have been made. These changes cause a decrease in the NH_3 emission (1985 – 2006) and an increase in the PM emission (2004 – 2006), please see chapter 6 on agriculture for more information.

There have been no changes in the methodology. Emission factors for synthetic fertilizers the have been changed to the values given by EMEP/EEA (2009) and recalculations is done for 1985-2006. This results

in a decrease in the ammonia emission from synthetic fertilizers of 10-26 %.

The emission factors for crops are lowered from 5 to 2 % for crops and from 3 to 0.5 % for grass based on a literary survey (Gyldenkærne and Albrektsen, 2009). Recalculations have been done for the years 1985-2006. This results in a decrease in the ammonia emission from crops of 62-64 %.

Updated data from The Danish Environmental Protection Agency for the use of sewage sludge as fertilizers for the years 2004-2006 have been received and therefore recalculations. This results in an increase in the emission from sewage sludge used as fertilizer of 11 – 25 %.

Emission factors for fur farming have been raised from 25 to 36 % in agreement with Poulsen, H. D (pers. comm. 2008) and recalculation is done for the years 1985-2006.

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

Calculations of nitrogen loss from livestock have partly been adjusted to TAN for the years 2003-2006. This together with the changes in time on pasture is the main cause to the additional decrease in the total NH_3 emission.

Annex 1

The complete NFR tables for Denmark can be found on Eionets Central Data Repository:
http://cdr.eionet.europa.eu/dk/Air_Emission_Inventories/Submission_EMEP_UNECE/envsywqrw

ANNEX 2A

Danish Emission Inventories for Stationary Combustion Plants

Inventories until year 2007

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Marlene Plejdrup
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Preface

The Danish National Environmental Research Institute at Aarhus University (NERI) prepares the Danish atmospheric emission inventories and reports the results on an annual basis to the Climate Convention and to the UNECE Convention on Long-Range Transboundary Air Pollution. This annex forms part of the documentation for the inventories and covers emissions from stationary combustion plants. The results of inventories up to 2007 are included. The annex extracts relevant data from an updated version of the sector report for stationary combustion plants that will be published later this year.

Sammendrag

Opgørelser over de samlede danske luftemissioner rapporteres årligt til UNECE Konventionen om langtransporteret grænseoverskridende luftforurening (*UNECE Convention on Long-Range Transboundary Air Pollution* der forkortes LRTAP Convention). De danske emissioner opgøres og rapporteres af Danmarks Miljøundersøgelser (DMU). Emissionsopgørelserne omfatter følgende stoffer af relevans for stationær forbrænding: SO_2, NO_x, NMVOC, CO, partikler, tungmetaller, dioxin, PAH og HCB. Foruden de årlige opgørelser over de samlede nationale emissioner rapporteres også sektoropdelt emission. Hvert femte år rapporteres endvidere geografisk fordeling af emissionerne, fremskrivning af emissionerne samt de aktivitetsdata – fx brændselsforbrug – der ligger til grund for opgørelserne.

Emissionsopgørelserne for stationære forbrændingsanlæg (ikke mobile kilder) er baseret på den danske energistatistik og på et sæt af emissionsfaktorer for forskellige sektorer, teknologier og brændsler. Anlægsspecifikke emissionsdata for store anlæg, som fx kraftværker, indarbejdes i opgørelserne. Denne rapport giver detaljeret baggrundsinformation om den anvendte metode samt referencer for de data der ligger til grund for opgørelsen – energistatistikken og emissionsfaktorerne.

Emissionsfaktorerne stammer enten fra danske referencer eller fra internationale guidebøger (EEA 2007 og IPCC 1997) udarbejdet til brug for denne type emissionsopgørelser. De danske referencer omfatter miljølovgivning, danske rapporter samt middelværdier baseret på anlægsspecifikke emissionsdata fra et betydeligt antal større værker. Anlægsspecifikke emissionsfaktorer oplyses af anlægsejere, bl.a. i grønne regnskaber.

I emissionsopgørelsen for 2007 er 71 stationære forbrændingsanlæg defineret som punktkilder. Punktkilderne omfatter: kraftværker, decentrale kraftvarmeværker, affaldsforbrændingsanlæg, industrielle forbrændingsanlæg samt raffinaderier. Brændselsforbruget for disse anlæg svarer til 60% af det samlede brændselsforbrug for alle stationære forbrændingsanlæg.

Variationen i årlig import/eksport af el medfører at det totale danske brændselsforbrug varierer. Siden 1990 er brændselsforbruget steget med 12%, men forbruget af fossile brændsler er faldet 2%. Forbruget af kul er faldet, mens forbruget af naturgas og af biobrændsler er steget.

For følgende stoffer udgør emissionen fra stationær forbrænding over 50% af den nationale emission: SO_2, tungmetaller (dog ikke Cu), partikler, dioxin, HCB og PAH. Endvidere udgør emissionen over 10% for NO_x, CO, NMVOC og Cu.

Indenfor de stationære forbrændingsanlæg er kraftværker og decentrale kraftvarmeværker den betydeligste emissionskilde for SO_2, NO_x, og tungmetaller.

Emissioner fra kedler, brændeovne mv. i forbindelse med beboelse er den betydeligste emissionskilde for CO, NMVOC, partikler, dioxin og PAH. Det er især forbrænding af træ, som bidrager til disse emissioner.

I rapporten vises tidsserier for emissioner fra stationær forbrænding.

SO_2-emissionen fra stationær forbrænding er faldet med 95% siden 1980 og 87% siden 1990. Den store reduktion skyldes primært, at emissionen fra el- og fjernvarmeproducerende anlæg er faldet, som følge af installering af afsvovlningsanlæg samt brug af brændsler med lavere svovlindhold.

NO_x-emissionen fra stationær forbrænding er faldet med 58% siden 1985 og 46% siden 1990. Reduktionen skyldes primært at emissionen fra el og fjernvarmeproducerende anlæg er faldet som følge af at der benyttes lav-NO_x-brændere på flere anlæg og at der er idriftsat NO_x-røggasrensning på flere store kraftværker. Variationen i NO_x-emissionen følger variationen i import/eksport af el.

Forbrænding af træ i villakedler og brændeovne var i 2007 4,1 gange så højt som i 1990. Denne stigning har medført en væsentlig stigning i emissionen af CO, NMVOC, partikler og PAH. Emissionen af dioxin er ligeledes stigende de senere år som følge heraf. Emissionen af disse stoffer stiger dog knap så meget som brændselsforbruget idet emissionsfaktorerne for forbrænding af træ i forbindelse med husholdninger er dog faldende. Dette skyldes at emissionen fra nyere brændeovne mv er lavere end for de ældre.

CO emissionen er steget 22 % siden 1990. Emissionen fra brændeovne er steget, men samtidig er emissionen fra halmfyrede gårdanlæg faldet.

Emissionen af NMVOC fra stationær forbrænding er øget med 104 % siden 1985 og 109 % siden 1990. Stigningen skyldes primært det øgede forbrug af træ i forbindelse med beboelse (brændeovne mv) og idriftsættelsen af gasmotorer på decentrale kraftvarmeværker i 1990-erne.

Emissionen af partikler er steget 68-71 % siden år 2000, igen på grund af den øgede brug af træ i brændeovne og små villakedler. Emissionen af de forskellige PAH'er er af samme grund steget 130-190 % siden 1990.

Tungmetalemissionerne er faldet betydeligt siden 1990. Emissionen af de enkelte tungmetaller er reduceret mellem 34 % og 82 %[1]. Faldet skyldes den forbedrede røggasrensing på affaldsforbrændingsanlæg og på kraftværker.

[1] For Zn er der beregnet en stigning på 15% siden 1990. Dette kan dog meget vel være et resultat af utilstrækkelig opdatering af emissionsfaktoren for affaldsforbrænding.

Summary

Danish emission inventories are prepared on an annual basis and are reported to the UNECE *Convention on Long-Range Transboundary Air Pollution* (LRTAP Convention). The annual Danish emission inventories are prepared by the Danish National Environmental Research Institute (NERI). The inventories include the following pollutants relevant to stationary combustion: SO_2, NO_x, NMVOC, CO, particulate matter, heavy metals, dioxins, PAH and HCB. In addition to annual national emissions, the report includes emission data for subsectors. Every five years the reporting includes data on the geographical distribution of the emissions, a projection of emissions data and details of the activity data – e.g. fuel consumption – on which the inventories are based.

The inventories for stationary combustion are based on the Danish energy statistics and on a set of emission factors for various sectors, technologies and fuels. Plant specific emissions for large combustion sources are incorporated into the inventories. This report provides detailed background information on the methodology and references for the input data in the inventory - energy statistics and emission factors.

The emission factors are based either on national references or on international guidebooks (EEA, 2007 and IPCC, 1997). The majority of the country-specific emission factors refer to: Danish legislation, Danish research reports or calculations based on plant-specific emissions from a considerable number of large point sources. The plant-specific emission factors are provided by plant operators, e.g. in annual environmental reports.

In the inventory for the year 2007, 71 stationary combustion plants are specified as large point sources. The point sources include large power plants, municipal waste incineration plants, industrial combustion plants and petroleum refining plants. The fuel consumption of these large point sources corresponds to 60% of the overall fuel consumption of stationary combustion.

Since 1990 fuel consumption has increased by 12% - fossil fuel consumption, however, decreased by 2%. The use of coal has decreased whereas the use of natural gas and renewable fuels has increased. The Danish fuel consumption fluctuates due to variation in the import/export of electricity from year to year.

Stationary combustion plants account for more than 50% of the national emission for the following pollutants: SO_2, heavy metals (except Cu), TSP, PM_{10}, $PM_{2.5}$, dioxin, HCB and PAH. Furthermore, the emission from stationary combustion plants accounts for more than 10% of the national emission for the following pollutants: NO_x, CO, NMVOC and Cu.

Public electricity and heat production are the most important stationary combustion emission source for SO_2, NO_x and heavy metals.

Residential plants represent the most important stationary combustion source for CO, NMVOC, particulate matter, PAH and dioxin. Wood combustion in residential plants is the predominant emission source.

SO_2 emission from stationary combustion plants has decreased by 95% from 1980 and by 87% from 1990. The considerable emission decrease is mainly a result of the reduced emission from electricity and heat production due to installation of desulphurisation technology and the use of fuels with lower sulphur content.

The NO_x emission from stationary combustion plants has decreased by 58% since 1985 and 46% 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.

Wood consumption in residential plants 2007 is 4.1 times the 1990 level. This has caused a considerable increase in the emission of CO, NMVOC, PM and PAH. The emission of dioxin also increased in resent years due to increased residential wood combustion. A change of technology (installation of modern stoves) has, however, caused decreasing emission factors for several pollutants.

The CO emission has increased by 22 % from 1990 to 2007. The increase in CO emission from residential plants is less than the increase in wood consumption, because the CO emission factor for wood combustion in residential plants decreased since 1990. Furthermore the emission from straw-fired farmhouse boilers has decreased considerably.

The NMVOC emission from stationary combustion plants has increased by 104 % from 1985 and 109 % from 1990. The increased NMVOC emission is mainly a result of the increasing wood combustion in residential plants and the increased use of lean-burn gas engines. The emission from straw-fired farmhouse boilers has decreased.

The emission of TSP, PM_{10} and $PM_{2.5}$ increased 68-71 % since 2000 due to the increase of wood combustion in residential plants. The emission of PAHs has increased 130-190 % since 1990, also a result of the increased combustion of wood in residential plants.

All the heavy metal emissions decreased considerably since 1990 – between 34 % and 82 %[2]. This is a result of the installation and improved performance of gas cleaning devices in municipal waste incineration plants and large power plants.

Dioxin emission decreased 55 % since 1990 mainly due to installation of dioxin filters in MSW incineration plants. However, the emission from residential plants is increasing due to the increasing wood combustion in the sector. This has caused a 23 % increase of dioxin emission from stationary combustion since 2004.

[2] The estimated Zn emission in 2007 is 15 % higher than in 1990. This is presumably due to insufficient emission factor update for resent years.

1 Fuel consumption data

In 2007 total fuel consumption for stationary combustion plants was 559 PJ of which 446 PJ was fossil fuels and 114 PJ was biomass. The fuel consumption rates are shown in Appendix 2A-3.

Fuel consumption distributed according to the stationary combustion subsectors is shown in Figure 2A-1. The majority – 59 % - of all fuels is combusted in the sector, *Public electricity and heat production.* Other sectors with high fuel consumption are *Residential* and *Industry*. The energy consumption in *Other energy industries* is mainly natural gas used in gas turbines in the off-shore industry.

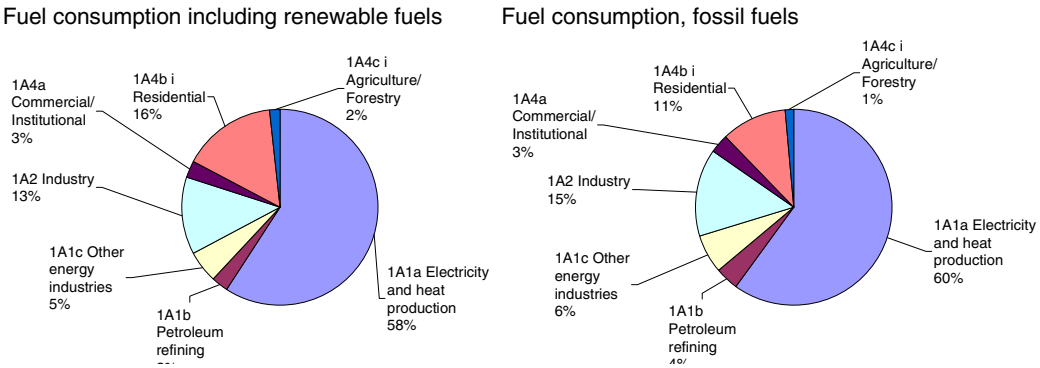


Figure 2A-1 Fuel consumption rate of stationary combustion, 2007 (based on DEA (2008a)).

Coal and natural gas are the most utilised fuels for stationary combustion plants. Coal is mainly used in power plants and natural gas is used in power plants and decentralised CHP plants, as well as in industry, district heating and residential plants (see Figure 2A-2).

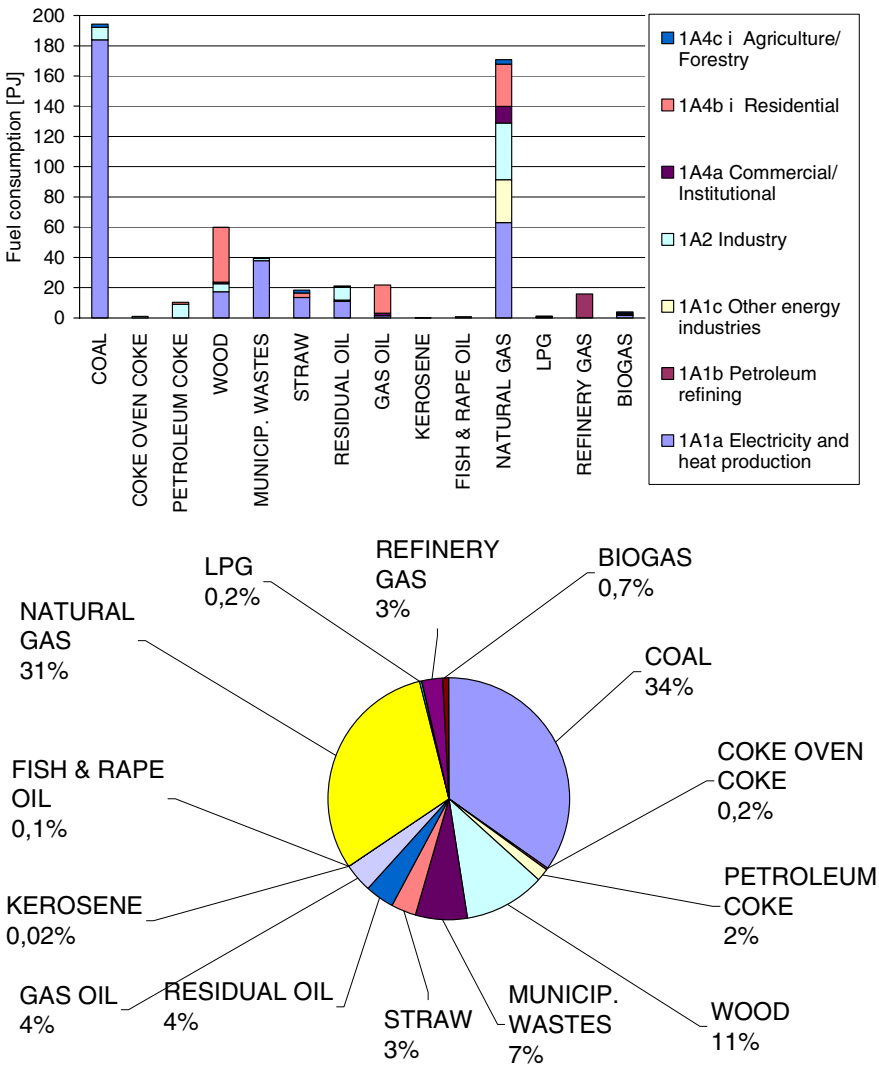


Figure 2A-2 Fuel consumption of stationary combustion plants 2007 (based on DEA (2008a)).

Fuel consumption time-series for stationary combustion plants are presented in Figure 2A-3[3]. The total fuel consumption has increased by 12 % from 1990 to 2007, while the fossil fuel consumption has decreased by 2 % and the biomass fuel consumption increased by 163 %.

The consumption of natural gas and renewable fuels has increased since 1990 whereas coal consumption has decreased.

[3] Time series 1980 onwards are included in Appendix 2A-12

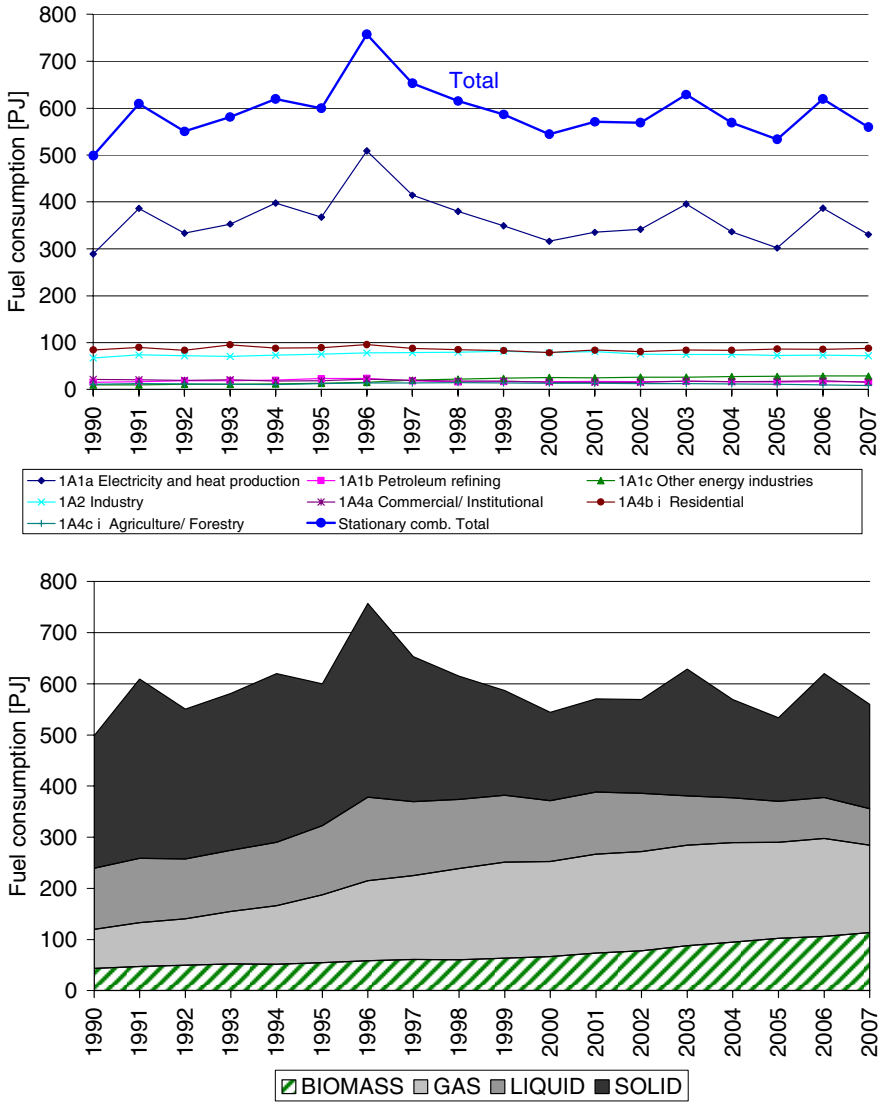


Figure 2A-3 Fuel consumption time-series, stationary combustion (based on DEA (2008a)).

The fluctuations in the time-series for fuel consumption are mainly a result of electricity import/export, but also of outdoor temperature variations from year to year. This, in turn, leads to fluctuations in emission levels. The fluctuations in electricity trade, fuel consumption and NO_x emission are illustrated and compared in Figure 2A-4. In 1990 the Danish electricity import was large causing relatively low fuel consumption, whereas the fuel consumption was high in 1996 due to a large electricity export. In 2007 the net electricity export was 3420 TJ which is a lower export rate than in 2006. The large electricity export that occurs some years is a result of low rainfall in Norway and Sweden causing insufficient hydropower production in both countries.

To be able to follow the national energy consumption as well as for statistical and reporting purposes, the Danish Energy Authority produces a correction of the actual fuel consumption without random variations in electricity imports/exports and in ambient temperature. This fuel consumption trend is also illustrated in Figure 2A-4. The corrections are included here to explain the fluctuations in the emission time-series.

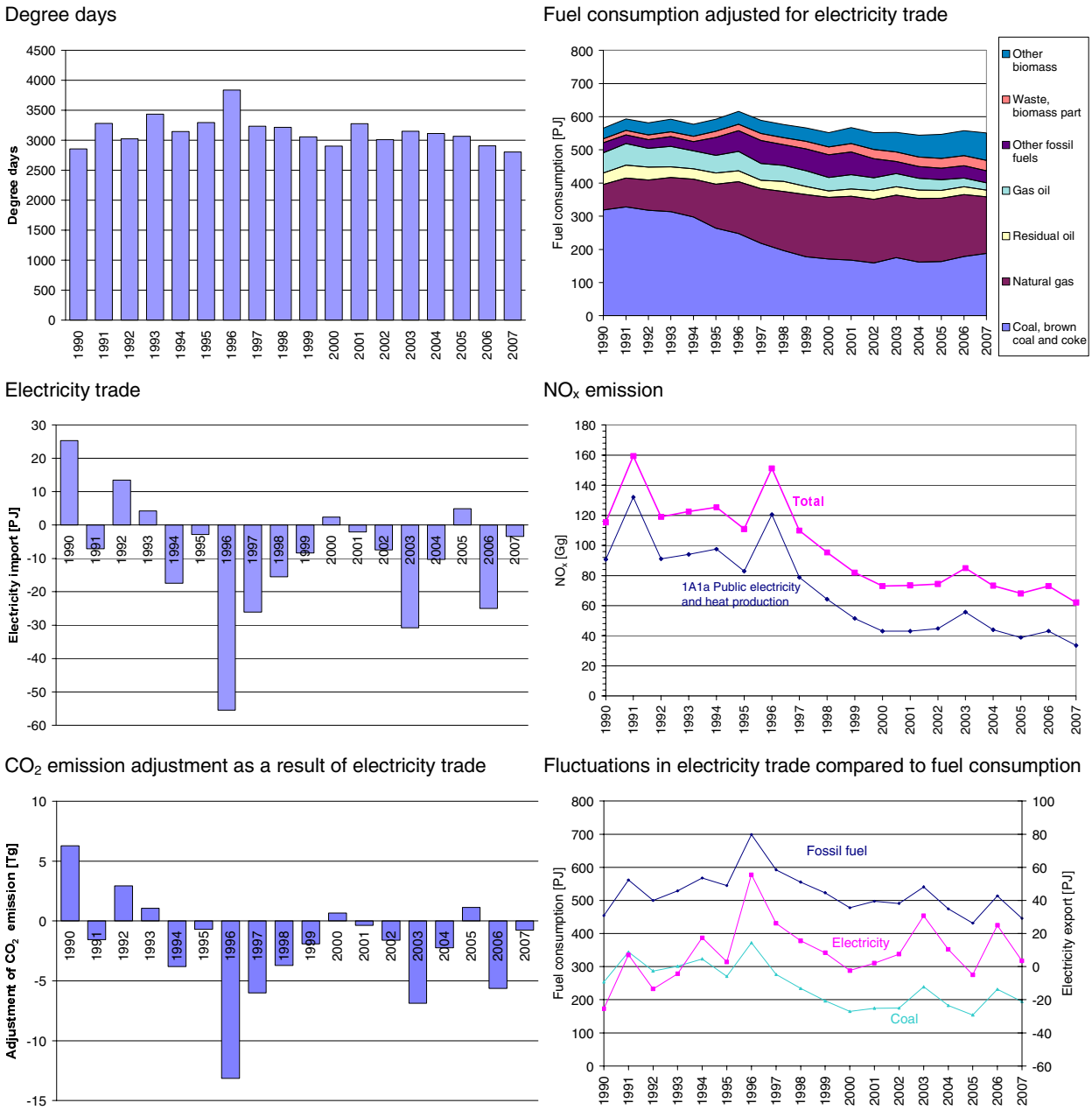


Figure 2A-4 Comparison of time-series fluctuations for electricity trade, fuel consumption and NO_x emission (DEA, 2008b).

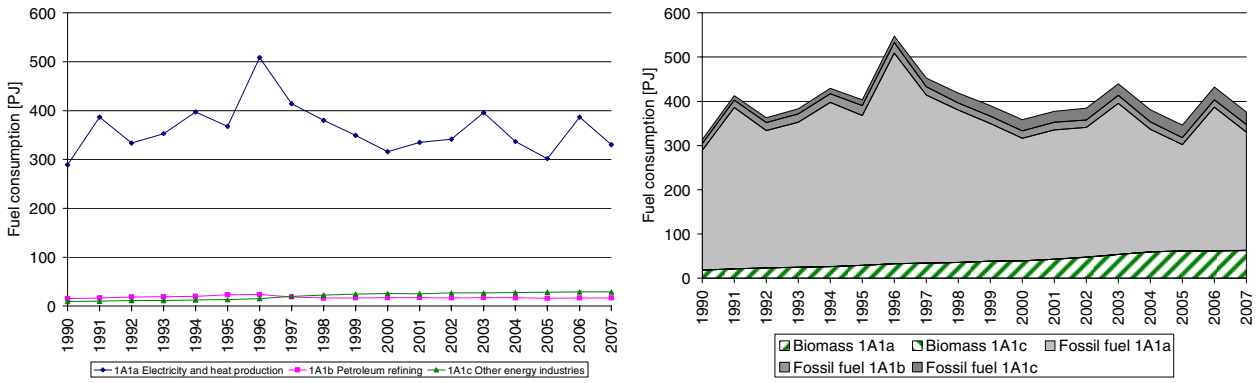
Fuel consumption time-series for the subsectors to stationary combustion is shown in Figure 2A-5.

Fuel consumption for the <u>*1A1 Energy Sector*</u> is fluctuating due to electricity trade as discussed above. The fluctuation in electricity production is based on fossil fuel consumption in *1A1a Electricity and Heat Production*. Time-series for fossil fuel consumption in other sectors are more stable. The biomass fuel consumption in *1A1 Energy Sector* 2007 added up to 63 PJ which is 3.4 times the level in 1990.

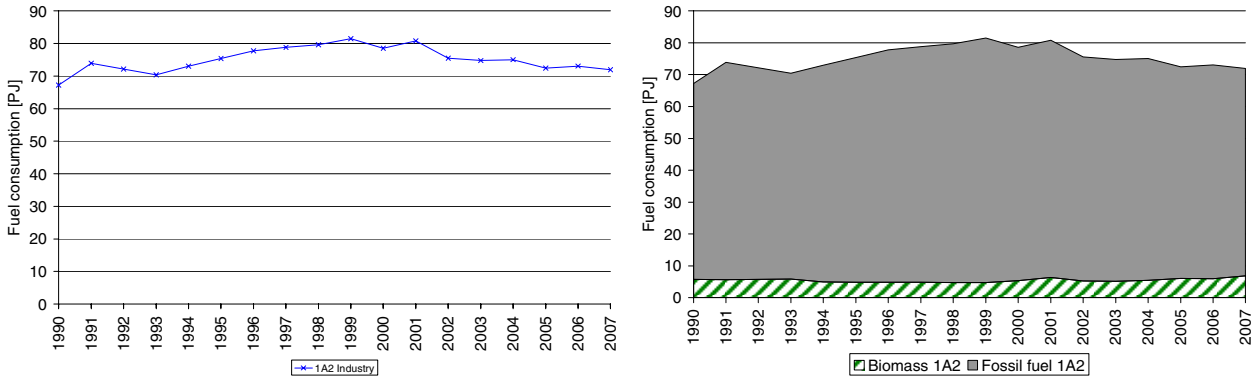
The fuel consumption in <u>*1A2 Industry*</u> increased 7 % since 1990 (Figure 2A-5). However, in resent years the fuel consumption seems to be slowly decreasing. The biomass fuel consumption in *1A2 Industry* 2007 added up to 7 PJ which is a 19 % increase since 1990.

The total fuel consumption in *1A4 Other Sectors* decreased 5 % since 1990 (Figure 2A-5). The biomass part of the fuel consumption, however, has increased; the biomass part of the fuel consumption increased from 16 % in 1990 to 39 % in 2007. Wood consumption in residential plants in 2007 is 2.5 times the consumption in year 2000.

1A1 Energy Sector



1A2 Industry



1A4 Other Sectors

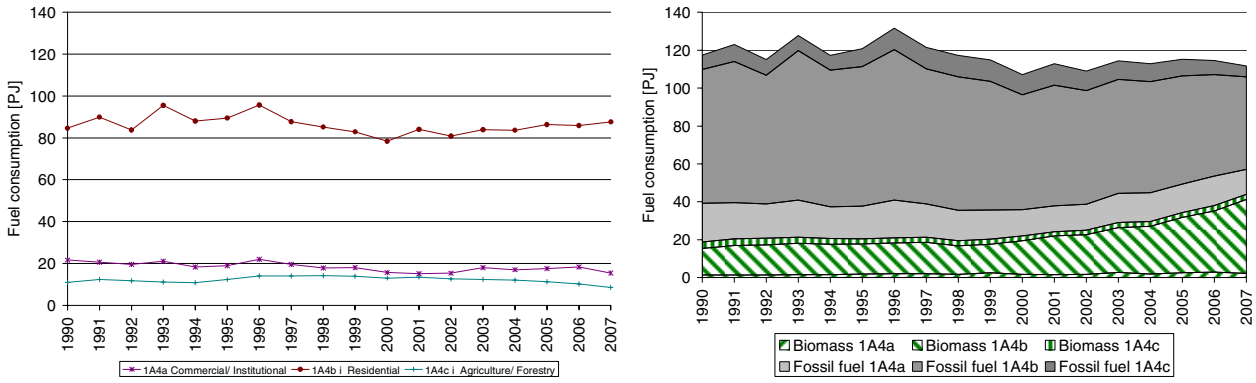


Figure 2A-5 Fuel consumption time-series for subsectors.

2 SO_2, NO_x, NMVOC and CO

The emissions of sulphur dioxide (SO_2), nitrogen oxides (NO_x), non volatile organic compounds (NMVOC) and carbon monoxide (CO) from Danish stationary combustion plants 2007 are presented in Table 2A-1. The emission of these pollutants is also included in the report to the Climate Convention.

SO_2 from stationary combustion plants accounts for 88 % of the national emission. NO_x, CO and NMVOC account for 37 %, 38 % and 25% of national emissions, respectively.

Table 2A-1 SO_2, NO_x, NMVOC and CO emission from stationary combustion 2007 [1].

Pollutant	NO_x Gg	CO Gg	NMVOC Gg	SO_2 Gg
1A1 Fuel consumption, Energy industries	42,5	9,3	2,7	9,1
1A2 Fuel consumption, Manufacturing Industries and Construction (Stationary combustion)	11,1	13,6	0,6	7,2
1A4 Fuel consumption, Other sectors (Stationary combustion)	8,5	147,6	23,1	4,4
Emission from stationary combustion plants	62,1	170,5	26,4	20,6
National emission	166,7	448,1	104,4	23,3
		%		
Emission share for stationary combustion	37	38	25	88

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

2.1 SO_2

Stationary combustion is the most important emission source for SO_2 accounting for 88 % of the national emission. Table 2A-2 present the SO_2 emission inventory for the stationary combustion subsectors.

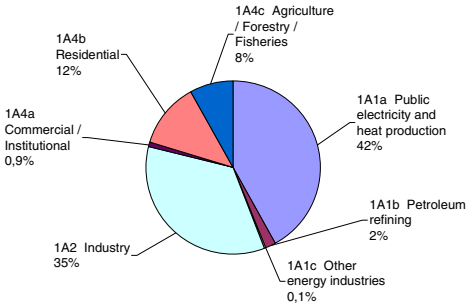
Electricity and heat production is the largest emission source accounting for 42 % of the emission. However, the SO_2 emission share is lower than the fuel consumption share for this sector, which is 59 %. This is a result of effective flue gas desulphurisation equipment installed in power plants combusting coal. In the Danish inventory the sector *1A1a Electricity and heat production* is further disaggregated. Figure 2A-6 shows the SO_2 emission from *Electricity and heat production* on a disaggregated level. Power plants >300MW_{th} are the main emission source, accounting for 79 % of the emission.

The SO_2 emission from industrial plants is 35 %, a remarkably high emission share compared with fuel consumption. The main emission sources in the industrial sector are combustion of coal and residual oil, but emissions from the cement industry is also a considerable emission source. Some years ago, SO_2 emission from the industrial sector only accounted for a small portion of the emission from stationary combustion, but as a result of reduced emissions from power plants the share has now increased.

Time-series for SO_2 emission from stationary combustion are shown in Figure 2A-7. The SO_2 emission from stationary combustion plants has decreased by 95 % from 1980 and 87 % from 1990. The large emission decrease is mainly a result of the reduced emission from *Electricity and heat production*, made possible due to installation of desulphurisation plants and due to the use of fuels with lower sulphur content. Despite the considerable reduction in emission from electricity and heat production plants, these still account for 42 % of the emission from stationary combustion, as mentioned above. The emission from other sectors also decreased considerably since 1980.

Table 2A-2 SO_2 emission from stationary combustion plants 2007 [1)].

SO_2		2007	
1A1a	Public electricity and heat production	8641	Mg
1A1b	Petroleum refining	423	Mg
1A1c	Other energy industries	10	Mg
1A2	Industry	7157	Mg
1A4a	Commercial / Institutional	183	Mg
1A4b	Residential	2509	Mg
1A4c	Agriculture / Forestry / Fisheries	1680	Mg
Total		20604	Mg



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

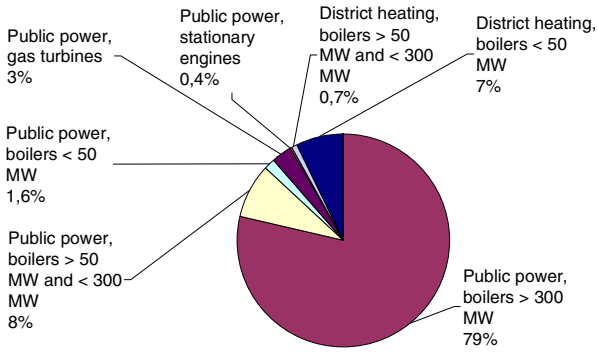


Figure 2A-6 Disaggregated SO_2 emissions from *1A1a Energy and heat production.*

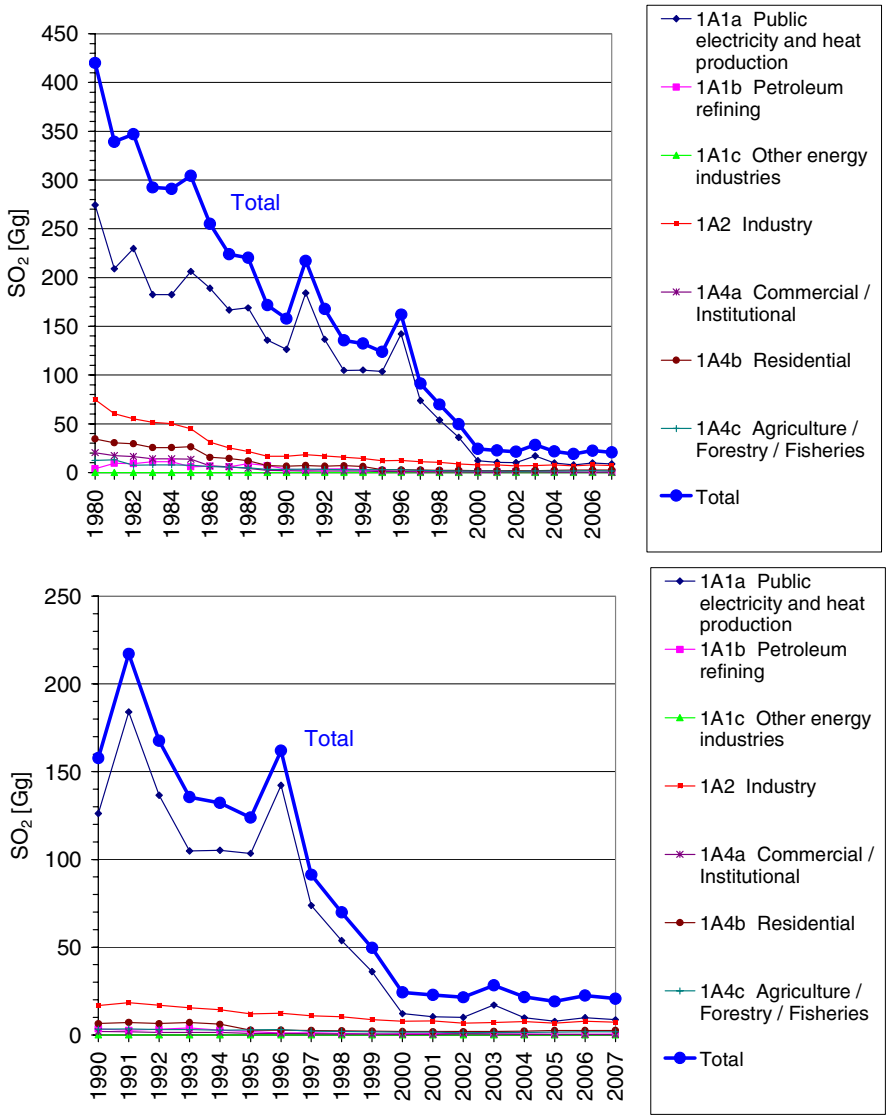


Figure 2A-7 SO_2 emission time-series for stationary combustion.

2.2 NO_x

Stationary combustion accounts for 37 % of the national NO_x emission. Table 2A-3 shows the NO_x emission inventory for stationary combustion subsectors.

Electricity and heat production is the largest emission source accounting for 54 % of the emission from stationary combustion plants.

Industrial combustion plants are also an important emission source accounting for 18 % of the emission. The main industrial emission source is cement production, accounting for 64 % of the emission.

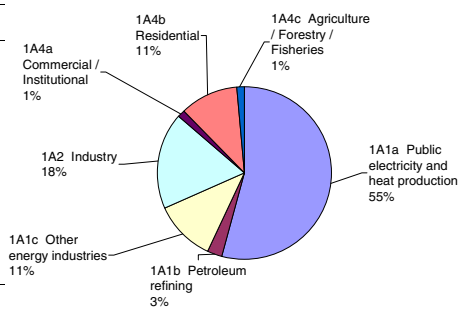
Residential plants accounts for 11 % of the NO_x emission. The fuel origin of this emission is mainly wood, gas oil and natural gas accounting for 65 %, 15 % and 15 % of the residential plant emission, respectively.

Time-series for NO_x emission from stationary combustion are shown in Figure 2A-8. NO_x emission from stationary combustion plants has decreased by 58 % from 1985 and 46 % 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 2A-3 NO_x emission from stationary combustion plants 2007 [1].

		2007	
1A1a	Public electricity and heat production	33608	Mg
1A1b	Petroleum refining	1754	Mg
1A1c	Other energy industries	7120	Mg
1A2	Industry	11136	Mg
1A4a	Commercial / Institutional	919	Mg
1A4b	Residential	6653	Mg
1A4c	Agriculture / Forestry / Fisheries	909	Mg
Total		62100	Mg



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

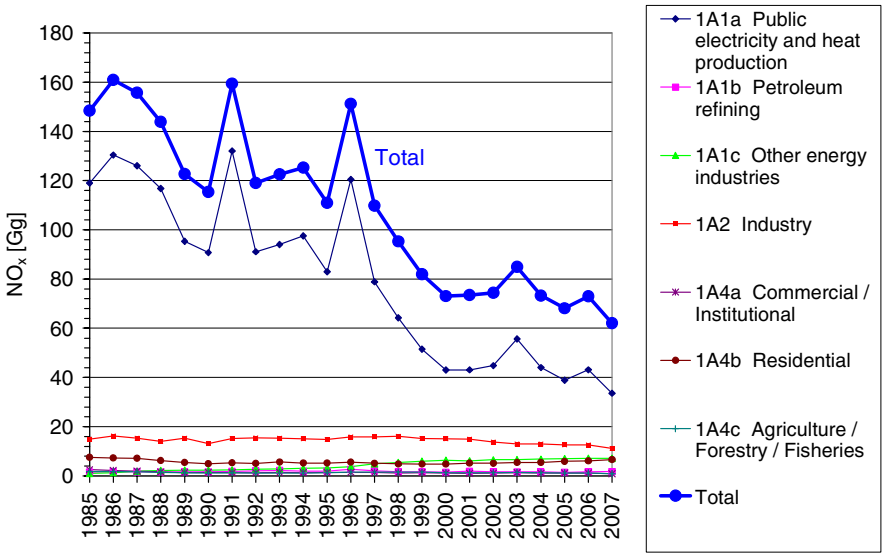


Figure 2A-8 NO_x emission time-series for stationary combustion.

2.3 NMVOC

Stationary combustion plants account for 25 % of the national NMVOC emission. Table 2A-4 presents the NMVOC emission inventory for the stationary combustion subsectors.

Residential plants are the largest emission source accounting for 79 % of the emission from stationary combustion plants. For residential plants NMVOC is mainly emitted from wood and straw combustion, see Figure 2A-9.

Electricity and heat production is also a considerable emission source, accounting for 10 % of the emission. Lean-burn gas engines have a relatively high NMVOC emission factor and are the most important emission source in this subsector (see Figure 2A-9). The gas engines are either natural gas or biogas fuelled.

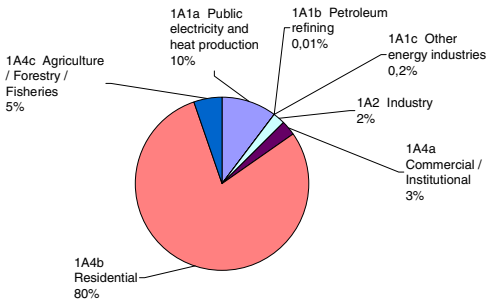
Time-series for NMVOC emission from stationary combustion are shown in Figure 2A-10. The emission has increased by 104 % from 1985 and 109 % from 1990. The increased emission is mainly a result of the increasing wood consumption in residential plants and of the increased use of lean-burn gas engines in CHP plants.

The emission from residential plants in 2007 is 2.1 times the 1990 level. The NMVOC emission from wood combustion in 2007 is 3.1 times the 1990 level due to increased wood consumption. However, the emission factor has decreased since 1990. Further the emission from straw combustion in farmhouse boilers has decreased (43 %) over this period.

The use of wood in residential boilers and stoves is relatively low in 1998-99 resulting in a lower emission level these years.

Table 2A-4 NMVOC emission from stationary combustion plants 2007 [1].

	2007	
1A1a Public electricity and heat production	2698	Mg
1A1b Petroleum refining	3	Mg
1A1c Other energy industries	42	Mg
1A2 Industry	571	Mg
1A4a Commercial / Institutional	732	Mg
1A4b Residential	20957	Mg
1A4c Agriculture / Forestry / Fisheries	1379	Mg
Total	26382	Mg



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

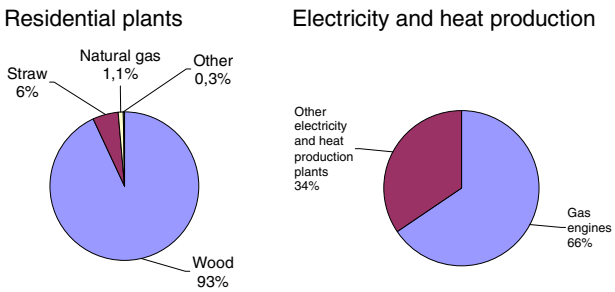


Figure 2A-9 NMVOC emission from residential plants and from electricity and heat production, 2007.

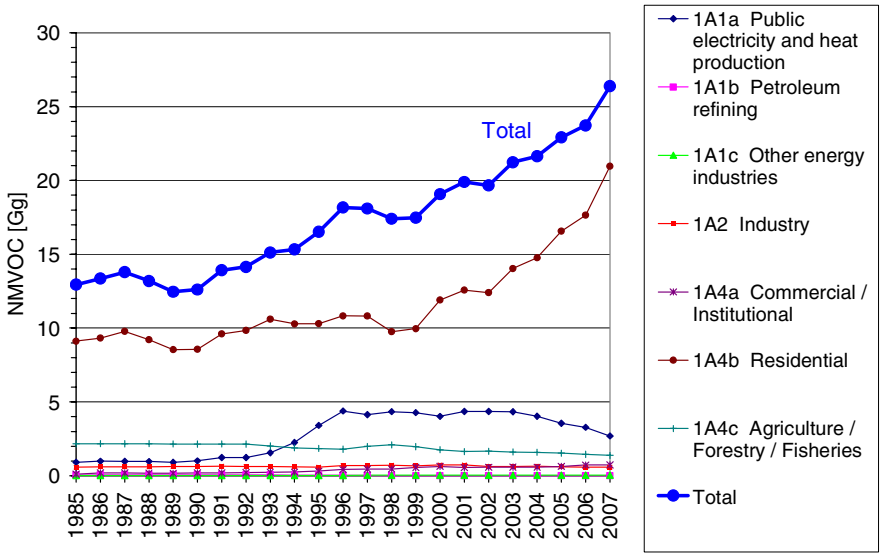


Figure 2A-10 NMVOC emission time-series for stationary combustion.

2.4 CO

Stationary combustion accounts for 38 % of the national CO emission. Table 2A-5 presents the CO emission inventory for stationary combustion subsectors.

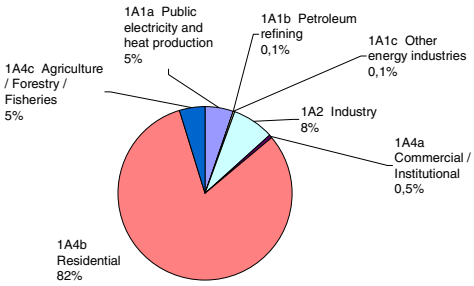
Residential plants are the largest emission source, accounting for 81 % of the emission. Wood combustion accounts for 90 % of the emission from residential plants, see Figure 2A-11. This is in spite of the fact that the fuel consumption share is only 41 %. Combustion of straw is also a considerable emission source whereas the emission from other fuels used in residential plants is almost negligible.

Time-series for CO emission from stationary combustion are shown in Figure 2A-12. The emission has increased by 27 % from 1985 and increased 22 % from 1990. The time-series for CO from stationary combustion plants follows the time-series for CO emission from residential plants.

The consumption of wood in residential plants 2007 is 4.1 times the 1990 level. However, the CO emission factor for wood decreased since 1990 causing the CO emission from wood combustion in residential plants 2007 to be only 3.2 times the 1990 level. Both straw consumption and CO emission factor for residential plants have decreased since 1990.

Table 2A-5 CO emission from stationary combustion plants 2007 [1].

		2007	
1A1a	Public electricity and heat production	8854	Mg
1A1b	Petroleum refining	225	Mg
1A1c	Other energy industries	211	Mg
1A2	Industry	13574	Mg
1A4a	Commercial / Institutional	846	Mg
1A4b	Residential	138661	Mg
1A4c	Agriculture / Forestry / Fisheries	8096	Mg
Total		170467	Mg



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

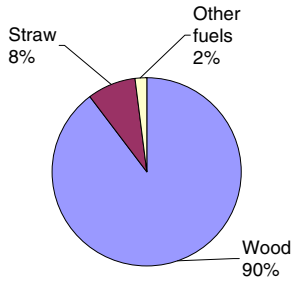


Figure 2A-11 CO emission sources, residential plants, 2007.

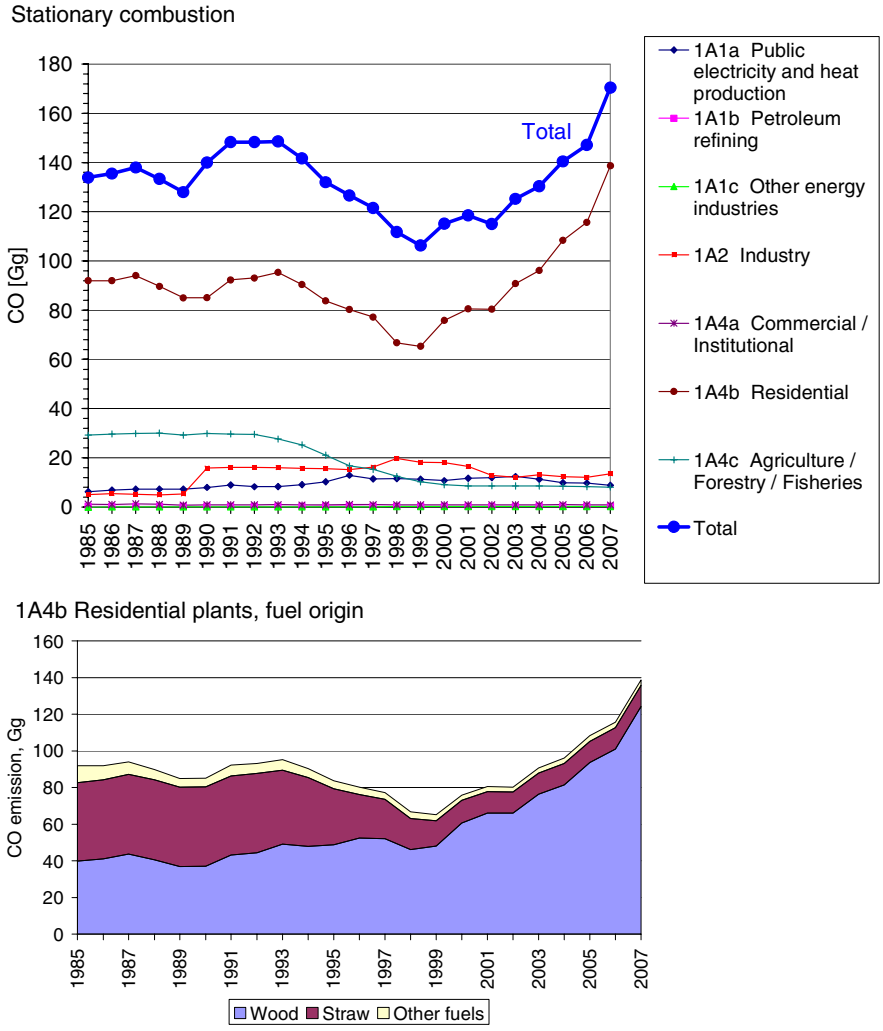


Figure 2A-12 CO emission time-series for stationary combustion.

3 Particulate matter (PM)

The emission of total suspended particulates (TSP), particulate matter < 10 µm (PM_{10}) and particulate matter < 2.5 µm ($PM_{2.5}$) from Danish stationary combustion plants 2007 is presented in Table 2A-6. The particulate matter (PM) emission is reported to the LRTAP Convention.

To date, PM emissions from stationary combustion, transport, agriculture and the industrial sector have been included in the Danish inventory. TSP from stationary combustion accounts for 54 % of the national emission. The emission shares for PM_{10} and $PM_{2.5}$ are 61 % and 75 %, respectively.

Table 2A-6 Danish PM emissions 2007 [1].

Pollutant	TSP	PM_{10}	$PM_{2.5}$
	Mg	Mg	Mg
1A1 Fuel combustion, Energy industries	1124	894	742
1A2 Fuel combustion, Manufacturing Industries and Construction (Stationary combustion)[1]	917	629	361
1A4 Fuel combustion, Other sectors (Stationary combustion)[1]	26278	24887	23544
Emission from stationary combustion plants	28319	26410	24648
National emission (gross)	52299	43431	32746
Emission share for stationary combustion (%)	54	61	75

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

Table 2A-7 and Figure 2A-13 show the PM emission inventory for the stationary combustion subsectors. Residential plants are the largest emission source accounting for 93 % of the $PM_{2.5}$ emission from stationary combustion plants.

The primary sources of PM emissions are:

- Residential boilers, stoves and fireplaces combusting wood
- Farmhouse boilers combusting straw
- Power plants primarily combusting coal
- Coal and residual oil combusted in industrial boilers and processes

Furthermore, there are considerable emissions from:

- Residential boilers using gas oil
- Refineries

The PM emission from wood combusted in residential plants is the predominant source. Thus 90 % of the $PM_{2.5}$ emission from stationary combustion is emitted from residential wood combustion. This corresponds to 68 % of the national emission. A literature review (Nielsen et al. 2003) and a Nordic Project (Sternhufvud et al. 2007) has demonstrated that the emission factor uncertainty for residential combustion of wood in stoves and boilers is extremely high.

In Figure 2A-14 the fuel consumption and the $PM_{2.5}$ emission of residential plants is shown. Wood combustion accounts for 97 % of the $PM_{2.5}$ emission from residential plants in spite of the limited wood consumption share.

Emission inventories for PM have only been reported for the years 2000-2007. Time-series for PM emission from stationary combustion are shown in Figure 2A-15. The emission of TSP, PM_{10} and $PM_{2.5}$ increased 68 %, 69 % and 71 % since year 2000. The time-series for PM emission from residential plants follows the time-series for PM emission from residential plants.

Table 2A-7 PM emission from stationary combustion plants, 2007 [1)].

		TSP	PM_{10}	$PM_{2.5}$	
1A1a	Public electricity and heat production	1000	779	632	Mg
1A1b	Petroleum refining	121	113	108	Mg
1A1c	Other energy industries	3	2	1	Mg
1A2	Industry	917	629	361	Mg
1A4a	Commercial/Institutional	162	160	150	Mg
1A4b	Residential	25604	24253	22954	Mg
1A4c	Agriculture/Forestry/Fisheries	512	475	440	Mg
Total		28319	26410	24648	Mg

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

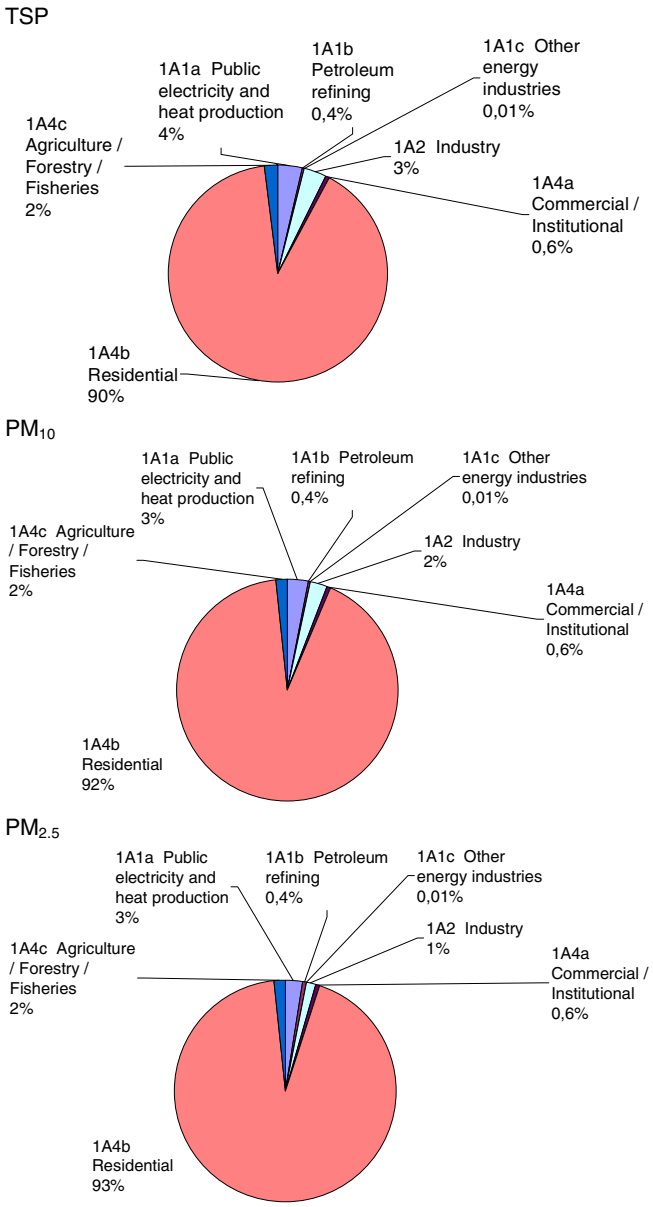


Figure 2A-13 PM emission sources, stationary combustion plants, 2007.

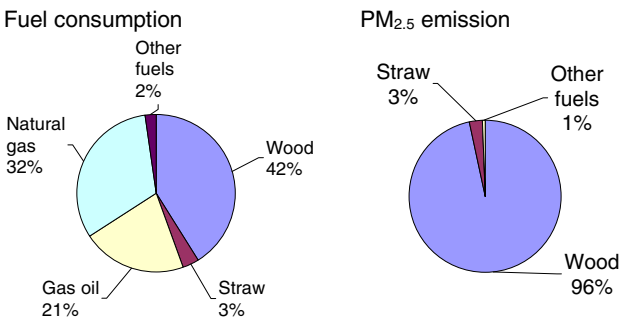


Figure 2A-14 Fuel consumption and $PM_{2.5}$ emission from residential plants.

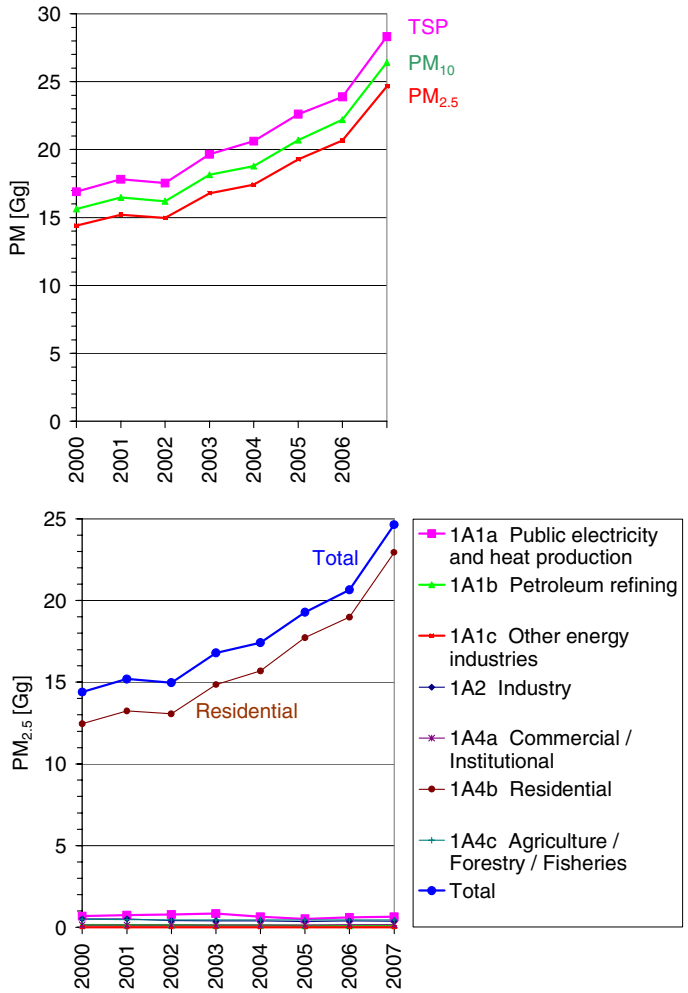


Figure 2A-15 PM emission time-series for stationary combustion.

4 Heavy metals

Emission inventories for nine heavy metals (HM) are reported to the LRTAP Convention. Three of the metals are considered priority metals: Pb, Cd and Hg. The 2007 emissions are presented in Table 2A-8.

Stationary combustion plants are the most important emission sources for heavy metals. For Cu the emission share from stationary combustion plants is 12 %, but for all other heavy metals the emission share is more than 75 %, see Table 2A-8.

Table 2A-8 The emission of heavy metals in 2007.

Pollutant	Pb Mg	Cd Mg	Hg Mg	As Mg	Cr Mg	Cu Mg	Ni Mg	Se Mg	Zn Mg
1A1 Fuel combustion, Energy industries	3,57	0,25	0,49	0,36	0,66	0,73	2,33	1,24	15,55
1A2 Fuel combustion, Manufacturing Industries and Construction (Stationary combustion)	0,81	0,17	0,25	0,20	0,37	0,18	4,95	0,54	1,35
1A4 Fuel combustion, Other sectors (Stationary combustion)	0,23	0,27	0,32	0,05	0,06	0,30	0,62	0,11	5,39
Emission from stationary combustion plants	4,61	0,69	1,06	0,61	1,09	1,22	7,90	1,89	22,29
National emission	6,17	0,75	1,12	0,63	1,36	9,99	8,72	1,99	28,18
Emission share for stationary combustion	75%	92%	95%	97%	80%	12%	91%	95%	79%

Table 2A-9 and Figure 2A-16 present the heavy metal emission inventory for the stationary combustion subsectors. The sectors *Electricity and heat production* and *Industry* have the highest emission shares. *Electricity and heat production* accounts for 77 %, 34 % and 45 % of the emission of the priority metals Pb, Cd and Hg, respectively. Residential plants accounts for 37 % of the Cd emission. More than 97 % of the emission from residential plants originates from wood combustion[4].

Table 2A-10 presents the emission share for municipal waste incineration plants.

[4] The applied emission factor for Cd is 6.8 mg pr GJ. This is a considerably higher emission factor than suggested in the 2007 EEA Emission inventory Guidebook (1.4 mg pr GJ). HM emission factors from the Guidebook (EEA, 2007) might be applied for residential wood combustion in future inventoies.

Table 2A-9 Heavy metal emission from stationary combustion plants, 2007 [1].

		As kg	Cd kg	Cr kg	Cu kg	Hg kg	Ni kg	Pb kg	Se kg	Zn kg
1A1a	Public electricity and heat production	348	236	633	723	482	1802	3546	1232	15547
1A1b	Petroleum refining	12	11	27	11	4	528	19	10	2
1A1c	Other energy industries	0	0	0	0	0	0	0	0	0
1A2	Industry	202	169	371	180	254	4951	812	538	1351
1A4a	Commercial / Institutional	6	11	10	13	12	152	14	11	176
1A4b	Residential	26	252	23	275	289	27	184	88	5167
1A4c	Agriculture / Forestry / Fisheries	16	11	28	18	20	442	35	9	51
Total		610	689	1092	1218	1061	7902	4609	1888	22294

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

Table 2A-10 Heavy metal emission share for municipal waste incineration plants, 2007.

Pollutant	Municipal waste incineration, CHP and district heating
As	30%
Cd	25%
Cr	37%
Cu	44%
Hg	21%
Ni	9%
Pb	70%
Se	1%
Zn	61%

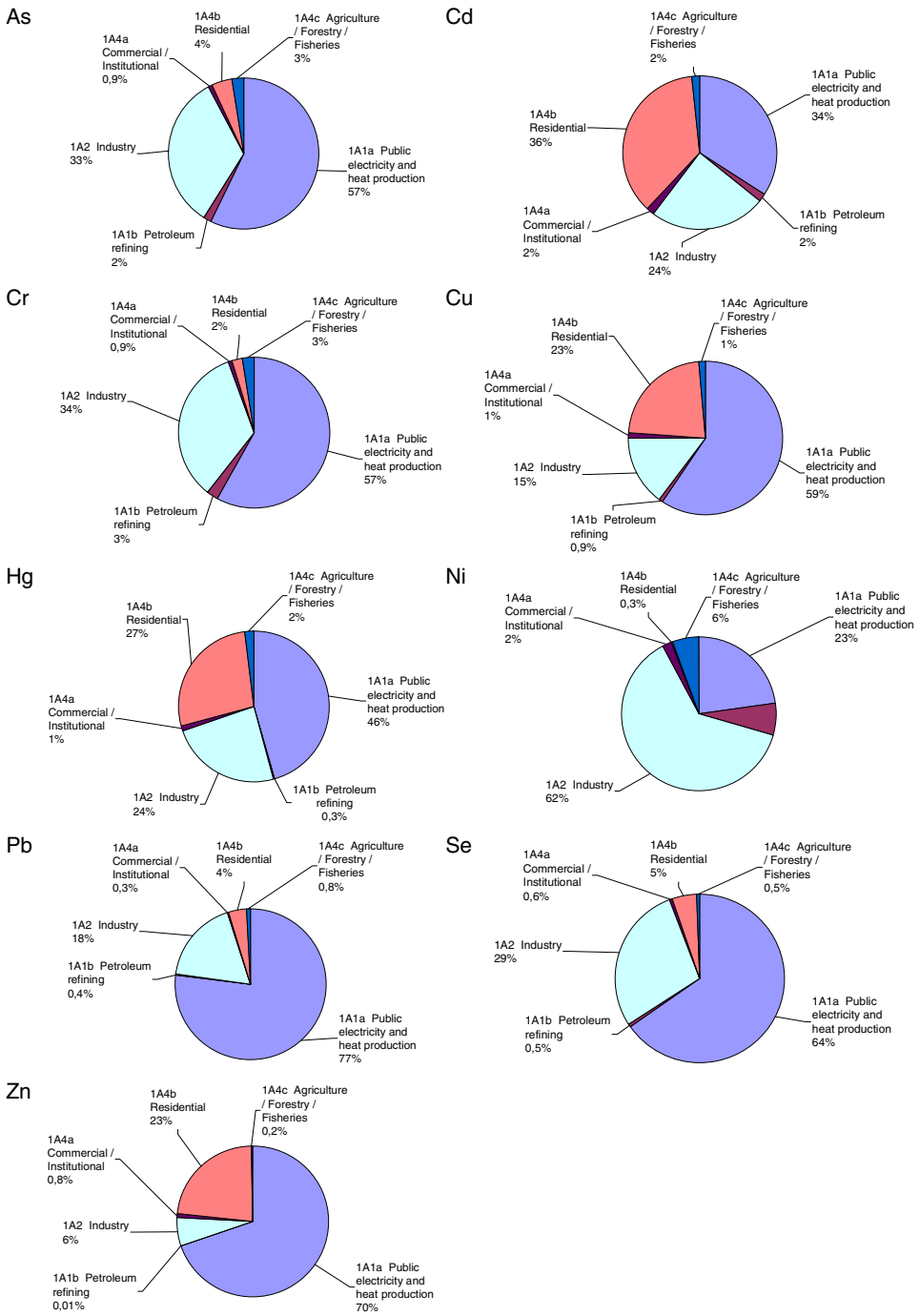


Figure 2A-16 Heavy metal emission sources, stationary combustion plants, 2007.

Time-series for heavy metal emissions are provided in Figure 2A-17. Emissions of all heavy metals, except Zn, have decreased considerably since 1990, see Table 2A-11. Emissions have decreased despite increased incineration of municipal waste. This has been made possible due to installation and improved performance of gas cleaning devices in waste incineration plants and also in large power plants, the latter a further important emission source.

The increasing Zn emission estimated in resent years might be a result of insufficient data for resent years. Emission from MSW incineration plants is the most important source of emission. For Se and Zn the same emission factor has been applied since 1995 whereas a time-series have been estimated for all other heavy metal emission factors (Nielsen & Illerup 2003). As a part of ongoing work that will update, several emission factors for CHP plants, time-series for Se and Zn emission from MSW incineration plants will be estimated. These time-series will be included in future inventories.

The estimated As emission level decreased remarkably from 1994 to 1995. Plant-specific emission data for power plants are available for all power plants from 1995 onwards and the general point source emission factor for power plants has potentially been overestimated.

Table 2A-11 Decrease in heavy metal emission 1990-2007.

Pollutant	Decrease since 1990
As	58%
Cd	34%
Cr	82%
Cu	66%
Hg	65%
Ni	63%
Pb	70%
Se	56%
Zn	-15%

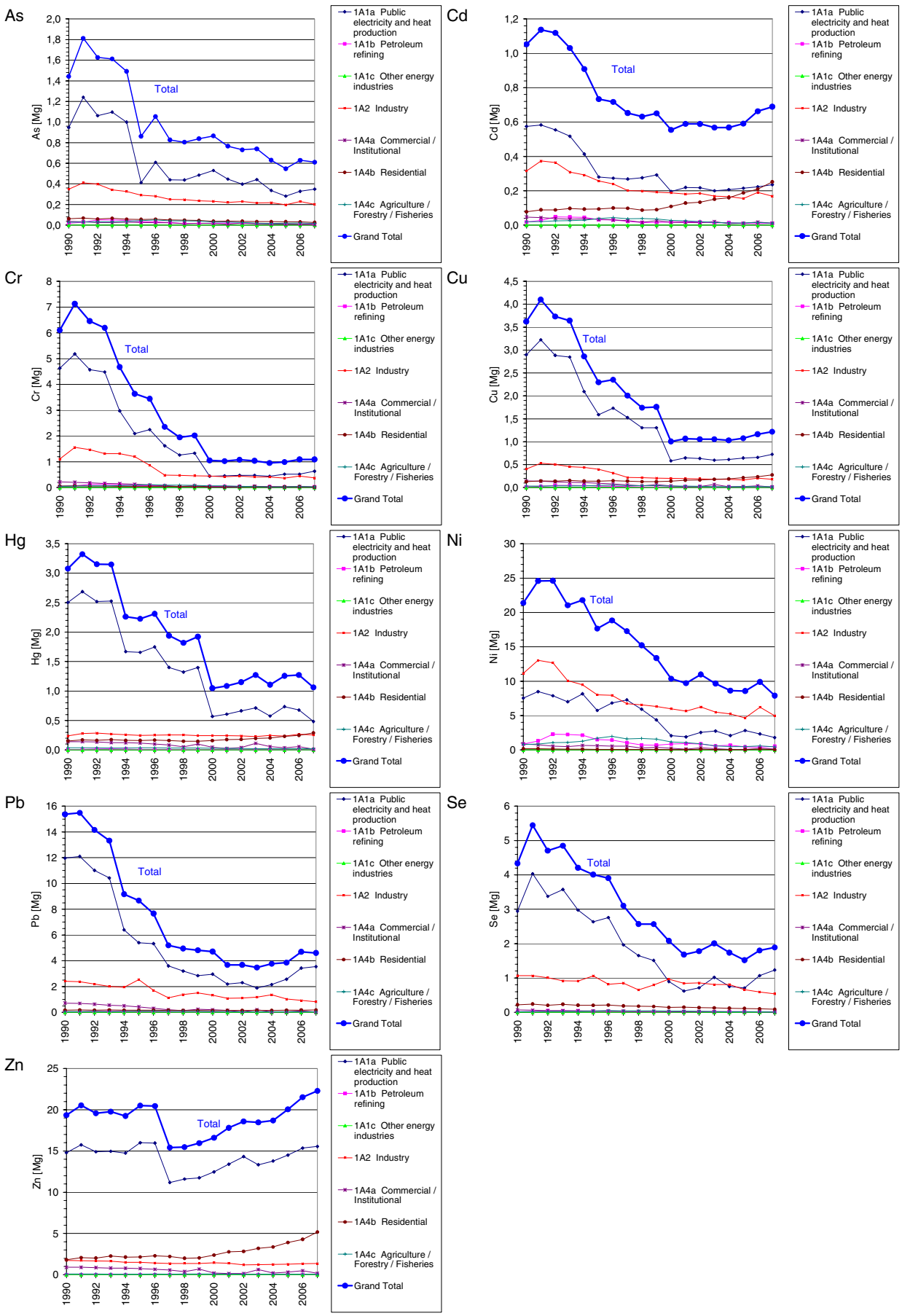


Figure 2A-17 Heavy metal emission time-series, stationary combustion plants.

5 PAH

Emission inventories for four polycyclic aromatic hydrocarbons (PAH) are reported to the LRTAP Convention. The emission inventories for PAH are presented in Table 2A-12. Stationary combustion plants account for more than 96 % of the PAH emission in 2007.

Table 2A-12 PAH emission for the year 2007

Pollutant	Benzo(a)-pyrene Mg	Benzo(b)fluo-ranthene Mg	Benzo(k)fluo-ranthene Mg	Indeno(1,2,3-c,d)pyrene Mg
1A1 Fuel combustion, Energy industries	0,01	0,03	0,01	0,01
1A2 Fuel combustion, Manufacturing Industries and Construction (Stationary combustion)	0,03	0,10	0,02	0,01
1A4 Fuel combustion, Other sectors (Stationary combustion)	4,96	5,19	2,87	3,52
Emission from stationary combustion plants	4,99	5,32	2,90	3,54
National emission	5,06	5,42	3,01	3,62
Emission share for stationary combustion	99%	98%	97%	98%

Table 2A-13 and Figure 2A-18 present the PAH emission inventories for the stationary combustion subsectors. Residential combustion is the largest emission source accounting for more than 90 % of the emission. Combustion of wood is the predominant source, accounting for more than 98 % of the PAH emission in residential plants. See Figure 2A-19.

Time-series for PAH emission are presented in Figure 2A-20. The increasing (130 %-190 %) emission trend for PAH is a result of the increased combustion of wood in residential plants. The time-series for wood combustion in residential plants is also provided in Figure 2A-20.

Table 2A-13 PAH emission from stationary combustion plants, 2007 [1].

	Benzo(a)-pyrene Mg	Benzo(b)-fluoranthene Mg	Benzo(k)-fluoranthene Mg	Indeno(1,2,3-c,d)pyrene Mg
1A1a Public electricity and heat production	7	28	14	6
1A1b Petroleum refining	0	0	0	0
1A1c Other energy industries	0	0	0	0
1A2 Industry	30	104	16	8
1A4a Commercial / Institutional	171	225	75	122
1A4b Residential	4623	4787	2772	3139
1A4c Agriculture / Forestry / Fisheries	162	174	24	263
Total	4994	5319	2902	3538

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

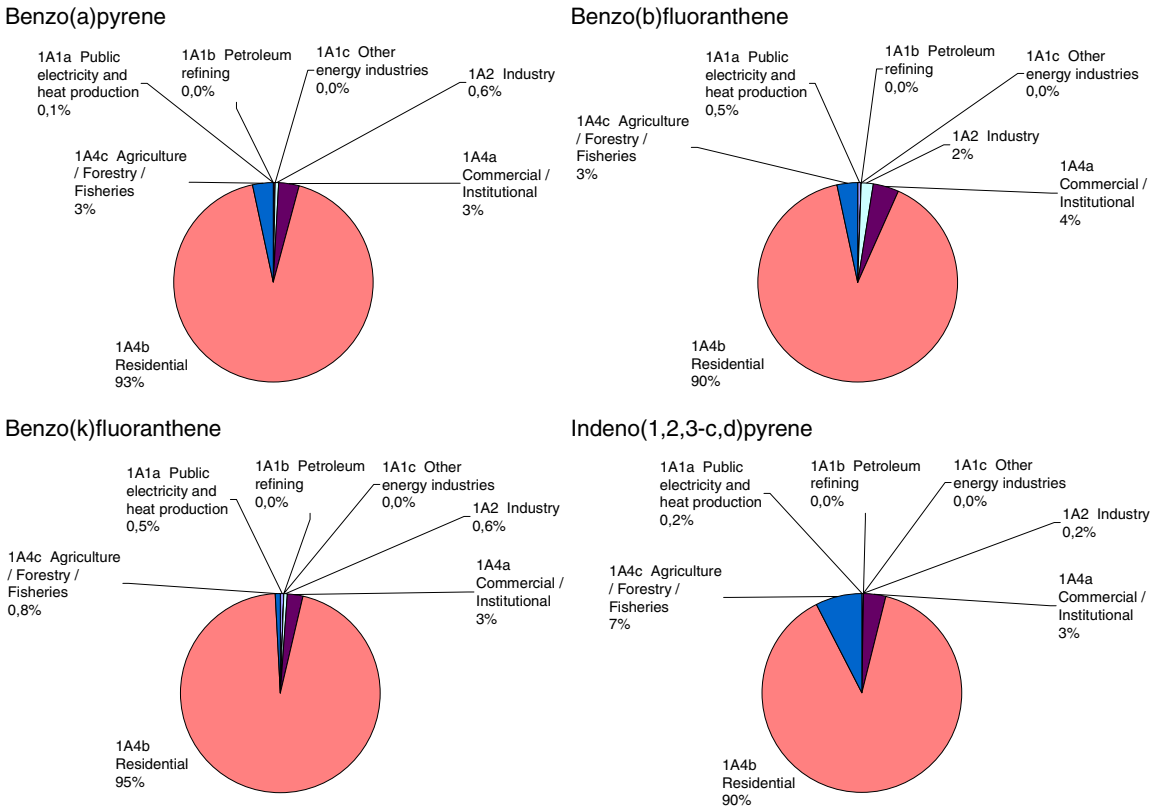


Figure 2A-18 PAH emission sources, stationary combustion plants, 2007.

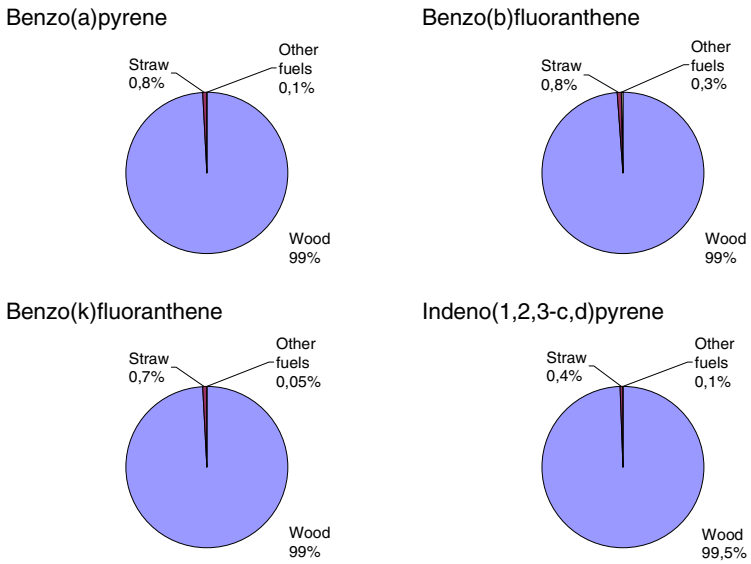


Figure 2A-19 PAH emission from residential combustion plants (stationary), fuel origin.

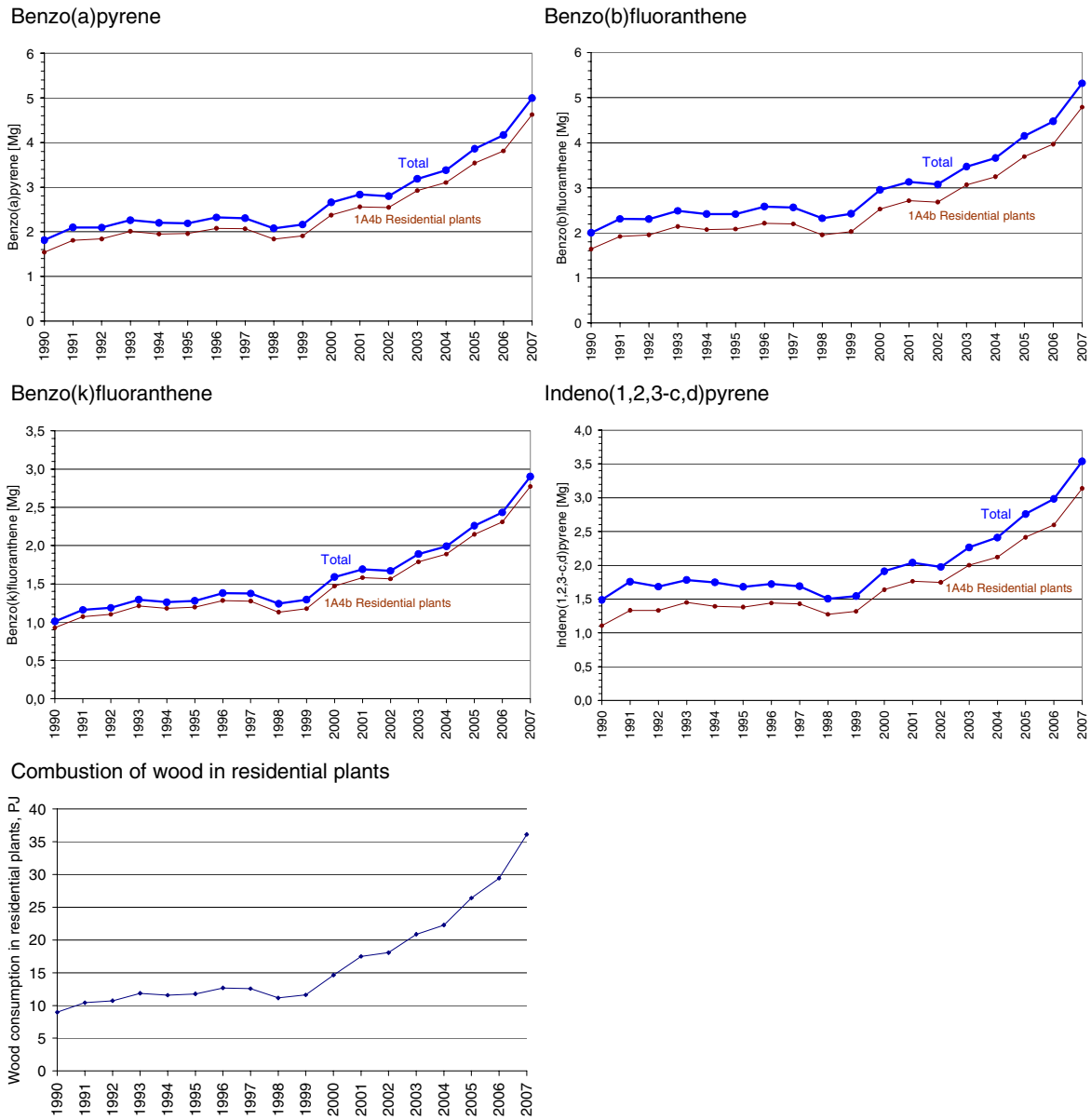


Figure 2A-20 PAH emission time-series, stationary combustion plants. Comparison with wood consumption in residential plants.

6 Dioxin

Emission inventories for dioxin are reported to the LRTAP Convention. The emission inventory for dioxin is presented in Table 2A-14. Stationary combustion plants account for 77 % of the dioxin emission.

Table 2A-14 Dioxin emission for the year 2007.

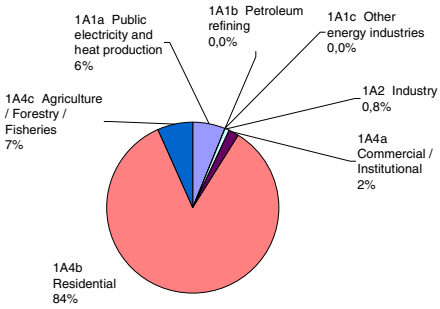
Pollutant	Dioxin g I-teq
1A1 Fuel combustion, Energy industries	1,28
Fuel combustion, Manufacturing Industries and Construction (Stationary combustion)	0,18
Fuel combustion, Other sectors (Stationary combustion)	19,87
Emission from stationary combustion plants	21,32
National emission	27,83
Emission share for stationary combustion	77%

Table 2A-15 present the dioxin emission inventories for the stationary combustion subsectors. In 2007 the emission from residential plants accounts for 84 % of the emission. Combustion of wood is the predominant source accounting for 85 % of the emission from residential plants.

Time-series for dioxin emission are presented in Figure 2A-22. Dioxin emission decreased 55 % since 1990 mainly due to installation of dioxin filters in MSW incineration plants. The emission from residential plants is increasing due to increased wood consumption in this sector.

Table 2A-15 Dioxin emission from stationary combustion plants, 2007 [1].

		Dioxin g I-teq
1A1a	Public electricity and heat production	1,28
1A1b	Petroleum refining	0,00
1A1c	Other energy industries	0,00
1A2	Industry	0,18
1A4a	Commercial / Institutional	0,45
1A4b	Residential	17,97
1A4c	Agriculture / Forestry / Fisheries	1,44
Total		21,32



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

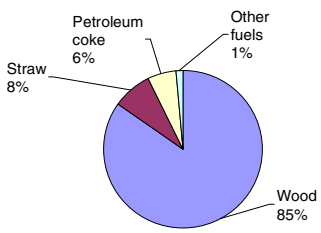


Figure 2A-21 Dioxin emission from residential plants, fuel origin.

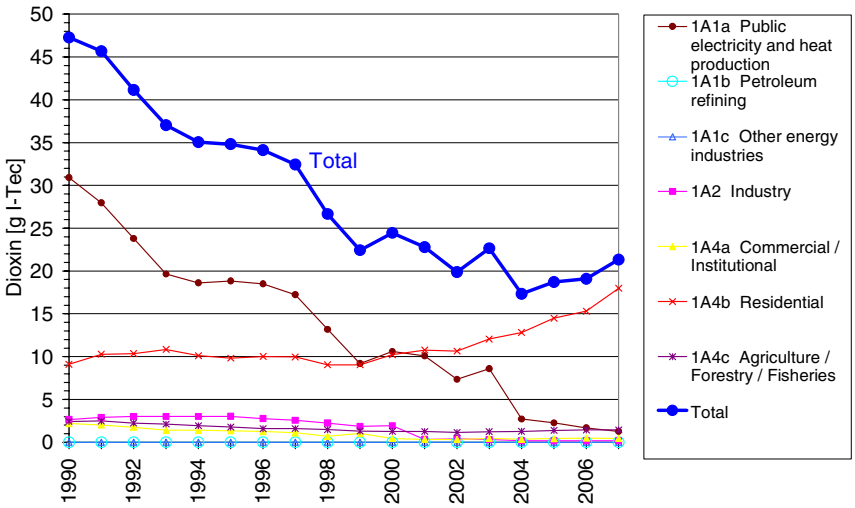


Figure 2A-22 Dioxin emission time-series, stationary combustion plants.

7 HCB

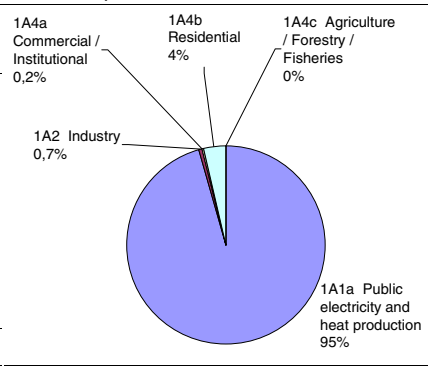
Emission inventories for hexachlorobenzene (HCB) are reported to the LRTAP Convention. In this first inventory for HCB the emission have been estimated only for stationary combustion plants and for cremation. Stationary plants account for more than 99 % of the estimated HCB emission in 2007.

Table 2A-16 shows the HCB emission inventory for the stationary combustion subsectors. Public electricity and heat production account for more than 95 % of the emission. The main source is MSW incineration plants.

The increasing emission trend follows the increasing combustion of municipal waste in Denmark. The installation of improved flue gas cleaning devices have not been taken into account in this first inventory for HCB and thus the apparent 132 % increase since 1990 might be misleading. Future inventories will take emission factor time series for incineration of municipal waste into account.

Table 2A-16 HCB emission from stationary combustion plants, 2007 [1)]

	HCB kg
1A1a Public electricity and heat production	3,79
1A1b Petroleum refining	-
1A1c Other energy industries	-
1A2 Industry	0,03
1A4a Commercial / Institutional	0,01
1A4b Residential	0,14
1A4c Agriculture / Forestry / Fisheries	0,00
Total	3,97



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

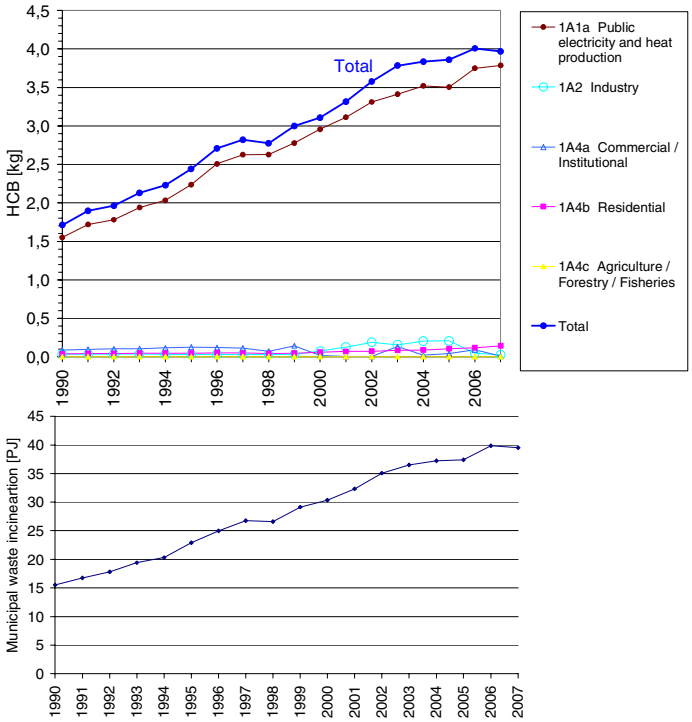


Figure 2A-23 HCB emission time-series, stationary combustion plants. Compared to municipal waste incineration

8 Geographical distribution of the emissions

Geographical distribution of emissions has been reported to the LRTAP Convention for the years 1990, 1995, 2000 and 2005 (Jensen et al., 2008). The emissions are disaggregated to a grid of 50x50 km². Gridded data are reported for SO_2, NO_x, NMVOC, CO, PM, heavy metals, dioxin and PAH. The assumptions and methodology will not be discussed here, but gridded emission data for SO_2 are illustrated in Figure 2A-24. The gridded emission data are available on the EU EIONET (European Environment Information and Observation Network) homepage, which can be linked from the NERI home page, www.dmu.dk.

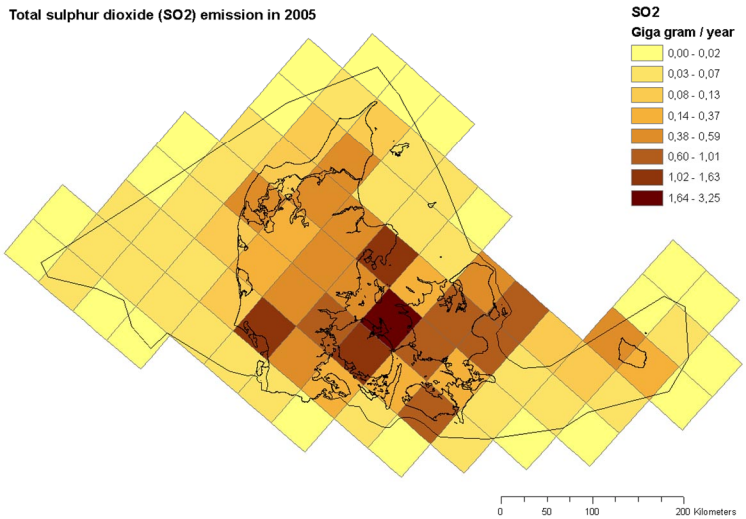


Figure 2A-24 Gridded SO_2 emission from stationary combustion, 2005 (Jensen et al., 2008).

9 Methodological issues

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

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

9.1 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 LRTAP Convention is based on a correspondence list between SNAP and IPCC sectors enclosed in Appendix 2A-2.

The sector codes applied in the reporting activity will be referred to as IPCC sectors. The IPCC sectors define six main source categories, listed in Table 2A-17, and a number of subcategories. Stationary combustion is part of the IPCC sector 1, *Energy*. Table 2A-18 presents subsectors in the IPCC energy sector. The table also presents the sector in which the NERI documentation is included. Though industrial combustion is part of the stationary combustion detailed documentation for some of the specific industries is discussed in the industry chapters/reports. Stationary combustion is defined as combustion activities in the SNAP sectors 01-03.

Table 2A-17 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 2A-18 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 emission 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 tables and figures in this report only include emissions originating from stationary combustion plants of a given IPCC sector. The IPCC sector codes have been applied unchanged, but some sector names have been changed to reflect the stationary combustion element of the source.

The CO_2 from calcination is not part of the energy sector. This emission is included in the IPCC sector 2 Industrial processes.

9.2 Large point sources

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

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

- Power plants and decentralised CHP plants (combined heat and power plants)
- Municipal waste incineration plants
- Large industrial combustion plants
- Petroleum refining plants

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

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

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

A list of the large point sources for 2007 and the fuel consumption rates is provided in Appendix 2A-7. The number of large point sources registered in the databases increased from 1990 to 2007.

The emissions from a point source are based either on plant specific emission data or, if plant specific data are not available, on fuel consumption data and the general Danish emission factors. Appendix 2A-7 shows which of the emission data for large point sources are plant-specific and which are based on emission factors.

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

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

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

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

9.3 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.

9.4 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, 2008a). Some fuel types in the official Danish energy statistics are added to obtain a less detailed fuel aggregation level see Appendix 2A-4. The calorific values on which the energy statistics are based are also

enclosed in Appendix 2A-4. The correspondence list between the energy statistics and SNAP sectors are enclosed in Appendix 2A-10.

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.

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

Petroleum coke purchased abroad and combusted in Danish residential plants (border trade of 251 TJ) is added to the apparent consumption of petroleum coke and the emissions are included in the inventory.

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

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

The Danish national energy statistics includes three fuels used for non-energy purposes, bitumen, white spirit and lubricants. The total consumption for non-energy purposes is relatively low, e.g. 13.2 PJ in 2007. The use of white spirit is included in the inventory for solvent use. The emissions associated with the use of bitumen and lubricants are included under industrial processes IPCC sectors 2A and 2G respectively.

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

Fuel consumption data are presented in Chapter 1.

9.5 Town gas

The consumption of town gas in Denmark is very low, e.g. 0.4 PJ in 2007. In 1990 the town gas consumption was 1.5 PJ and the consumption has been steadily decreasing though the time-series. Until now the emission factors for town gas has been assumed equal to those for natural gas. In Denmark town gas is produced based on natural gas, the use of coal for town gas production ceased in the early 1980'es.

An indicative composition of town gas according to the largest supplier of town gas in Denmark is shown in the Table 2A-19 below (KE, 2009).

Table 2A-19 Composition of town gas currently used (KE, 2009).

Component	Town gas, % (mol.)
Methane	43.9
Ethane	2.9
Propane	1.1
Butane	0.5
Carbon dioxide	0.4
Nitrogen	40.5
Oxygen	10.7

The lower heating value is listed as 19.3 MJ pr. Nm^3. In earlier years the composition of natural gas was somewhat different. The table below is constructed with the input of KE and DGC (Jeppesen, 2008 and Kristensen, 2007). The data are from three measurements performed several years apart the first in 2000 and the latest in 2005.

Table 2A-20 Composition of town gas, information from the period 2000-2005

Component	Town gas, % (mol.)
Methane	22.3-27.8
Ethane	1.2-1.8
Propane	0.5-0.9
Butane	0.13-0.2
Higher hydrocarbons	0-0.6
Carbon dioxide	8-11.6
Nitrogen	15.6-20.9
Oxygen	2.3-3.2
Hydrogen	35.4-40.5
Carbon monoxide	2.6-2.8

The lower calorific value has been between 15.6 and 17.8 MJ pr Nm^3.

Due to the scarce data available and the very low consumption of town gas compared to both the natural gas use and the overall fuel use, it is not thought to be reasonable to expend more resources on this issue.

9.6 Emission factors

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

A complete list of emission factors including time-series and references is provided in Appendix 2A-5.

A considerable part of the emission data for municipal waste incineration plants and large power plants are plant-specific. The area source emission factors do not, therefore, necessarily represent average values for these plant categories. To attain a set of emission factors that expresses the average emission for power plants combusting coal and for

municipal waste incineration plants, implied emission factors have been calculated for these two plant categories. The implied emission factors are presented in Appendix 2A-6. The implied emission factors are calculated as total emission divided by total fuel consumption.

9.6.1 SO_2, NO_x, NMVOC and CO

Emission factors for SO_2, NO_x, NMVOC and CO are listed in Appendix 2A-5. The Appendix includes references and time-series.

The emission factors refer to:

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

Emission factor time-series have been estimated for a considerable number of the emission factors. These are provided in Appendix 2A-5.

9.6.2 Particulate matter (PM)

Emission factors for PM and references for the emission factors are listed in Appendix 2A-5. The emission factors are based on:

- The TNO/CEPMEIP emission factor database (CEPMEIP, 2001)

and a considerable number of country-specific factors (Nielsen et al. 2003) referring to:

- Danish legislation:

- Luftvejledningen, 2001 (legislation from Danish Environmental Protection Agency).
- Bek. 689, 1990 (legislation from Danish Environmental Protection Agency).

- Calculations based on plant-specific emission data from a considerable number of municipal waste incineration plants.
- Danish research reports including:
  - Danish research regarding wood combustion in residential plants (Henriksen et al. 2007)
  - An emission measurement program for decentralised CHP plants (Nielsen & Illerup, 2003).
  - An emission measurement program for large power plants (Livbjerg et al. 2001).
- Additional personal communication concerning wood and straw combustion in residential plants.

Emission factor time-series have been estimated for residential wood combustion. All other emission factors are considered constant in 2000-2003.

9.6.3 Heavy metals

Emission factors for 2007 for heavy metals (HM) are presented in Appendix 2A-5. The Appendix includes references and time-series. The emission factors refer to:

- Research concerning heavy metal emission factors representative for Denmark (Illerup et al. 1999).
- Emission measurement program carried out on Danish decentralised CHP plants (Nielsen & Illerup, 2003).

Time-series have been estimated for municipal waste incineration. For all other sources the same emission factors have been applied for 1990-2007.

The HM emission factors listed in Appendix 2A-5 are only given for the categories where activity data are available. Missing emission factors for some categories and some years reflect that the aggregation level is different for different years.

9.6.4 PAH

Emission factors 2007 for PAHs are shown in Appendix 2A-5. The Appendix includes references. The PAH emission factors refer to:

- Research carried out by TNO (Berdowski et al. 1995).
- Research carried out by Statistics Norway (Finstad et al. 2001).
- An emission measurement program performed on biomass fuelled plants. The project was carried out for the Danish Environmental Protection Agency (Jensen & Nielsen, 1996).
- An emission measurement program carried out on Danish decentralised CHP plants (Nielsen & Illerup, 2003).
- Additional information from the gas sector and the electricity production sector (Sander, 2003 and Jensen, 2001).

- For residential wood combustion country specific emission factors have been aggregated based on technology distribution in the sector (Illerup et al. 2007) and guidebook emission factors (EEA, 2007)

Emission factor time-series have been estimated for residential wood combustion. All other emission factors are considered constant in 1990-2007. In general, emission factors for PAH are uncertain.

9.6.5 Dioxin

Emission factors 2007 for dioxin is shown in Appendix 2A-5.

All dioxin emission factors, except for residential wood combustion, refer to research regarding dioxin emission carried out by NERI to prepare a new dioxin emission inventory (Henriksen et al. 2006).

- Henriksen, T.C., Illerup, J.B., Nielsen, O., 2006. Dioxin Air Emission Inventory 1990-2004. NERI Technical Report No. 206.

The emission factor for residential wood combustion refers to technology specific emission factors from Henriksen et al. (2006) and to updated technology distribution data (Illerup et al., 2007).

Time-series for residential wood combustion and for combustion of municipal waste have been estimated. For all other sources the same emission factors have been applied for 1990-2007.

9.6.6 HCB

Emission factors 2007 for HCB are shown in Appendix 2A-5. The HCB emission factors all refer to the EMEP/Corinair Guidebook (EEA, 2007). Time series have not yet been estimated for HCB emission factors.

10 Uncertainty

10.1 Methodology

Uncertainty estimates include uncertainty with regard to the total emission inventory as well as uncertainty with regard to trends.

The IPCC methodologies for uncertainty estimates have been adopted for the LRTAP Convention reporting activities (Pulles & Aardenne, 2004). The Danish uncertainty estimates are based on the simple tier 1 approach. Uncertainty estimates have not yet been performed for dioxin and HCB.

The uncertainty estimates are based on emission data for the base year and year 2007 as well as on uncertainties for fuel consumption and emission factors for each of the main SNAP sectors. For particulate matter 2000 is considered to be the base year, but for all other pollutants the base year is 1990. The applied uncertainties for activity rates and emission factors are default values referring to Pulles & Aardenne (2003). The uncertainty for PM is, however, estimated by NERI. 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 2A-21. The uncertainty for fuel consumption in stationary combustion plants was assumed to be 2 %.

Table 2A-21 Uncertainty rates for emission factors, %.

SNAP sector	SO_2	NO_x	NMVOC	CO	PM	HM	PAH
01	10	20	50	20	50	100	100
02	20	50	50	50	500	1000	1000
03	10	20	50	20	50	100	100

10.2 Results

The uncertainty estimates for stationary combustion emission inventories are shown in Table 2A-22. Detailed calculation sheets are provided in Appendix 2A-8.

The total emission uncertainty is 7 % for SO_2, 16 % for NO_x, 44 % for NMVOC and 43 % for CO. For PM, most heavy metals and PAH the uncertainty estimate is greater than 100 %.

Table 2A-22 Danish uncertainty estimates, 2007.

Pollutant	Uncertainty Total emission, %	Trend 1990-2007, %	Uncertainty Trend, %-age points
SO_2	7,1	-87	±0,7
NO_x	16	-46	±3
NMVOC	44	+109	±6
CO	43	+22	±4
TSP [1)]	464	+61	±48
PM_{10} [1)]	471	+69	±48
$PM_{2.5}$ [1)]	478	+71	±40
As	104	-58	±7
Cd	400	-34	±171
Cr	89	-82	±4
Cu	258	-66	±57
Hg	307	-65	±69
Ni	105	-63	±6
Pb	94	-70	±3
Se	101	-58	±5
Zn	252	+15	±112
Benzo(b)fluoranthene	975	+166	±40
Benzo(k)fluoranthene	989	+187	±64
Benzo(a)pyrene	993	+176	±11
Indeno(1,2,3-c,d)	996	+138	±23

[1)] The base year for PM is year 2000.

11 QA/QC and verification

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

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

The work on expanding the QC will be ongoing in future years.

Data storage level 1

Table 2A-23 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 10.

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 10.

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 2A-23 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 statis-

tics. Thus, for example, estimation of the annual consumption of non-traded wood is included. Petroleum coke, purchased abroad and combusted in Danish residential plants (border trade), is added to the apparent consumption of petroleum coke and the emissions are included in the inventory.

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

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

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

Emission factors from a wide range of sources

For specific references, see the chapter regarding emission factors.

Data for emission of heavy metals and particles from central power plants, DONG Energy and Vattenfall

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 2A-23.

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 2A-23 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 2A-23.

Data Processing Level 1

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

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

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

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

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

The methodological approach is consistent with international guidelines.

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

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

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

The calculations follow the principle in international guidelines.

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

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

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

There is no missing accessibility to critical data sources.

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

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

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

During data processing it is checked that calculations are done correctly. However, documentation for this needs to be elaborated.

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

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

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

The IPCC reference approach validates the fuel consumption rates and CO_2 emissions of fuel combustion. Fuel consumption rates and CO_2 emissions differ by less than 1.7% (1990-2007). The reference approach is further discussed below.

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

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

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

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

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

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

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

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

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

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

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

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

Other QC procedures

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

Some automated checks have been prepared for the emission databases:

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

Suggested QA/QC plan for stationary combustion

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

Data storage level 1

A fully comprehensive list of references for emission factors and activity data.

A comparison with external data from other countries in order to evaluate discrepancies.

Data processing level 1

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

11.1 External review

The 2005 and 2007 updates of the sector report for stationary combustion were reviewed by Jan Erik Johnsson from the Technical University of Denmark and Bo Sander from Elsam Engineering. This annex extract data from an updated version of the report that will be published later in 2009. This version (March 2009) have not yet been reviewed.

11.2 Key source analysis

A first attempt key source analysis for SO_2, NO_x, NMVOC, CO and PM has been performed for stationary combustion this year. The key source analysis has been based on the EMEP/Corinair Guidebook 2008 (EEA, 2008). Disaggregation to fuel types has not been estimated. For these pollutants emission sources that adds up to 80 % of total emission is considered key sources. Trend key sources have been estimated with 1990 as a base year. Trend key sources have not been estimated for PM. Detailed calculation sheets are shown in Appendix 2A-11.

Table 2A-24 shows key sources for each pollutant.

Table 2A-24 Key source analysis, other pollutants.

	SO_2	NO_x	NMVOC	CO	TSP	PM_{10}	$PM_{2,5}$
1A1a Public electricity and heat production	L, T	L, T	L				
1A1b Petroleum refining							
1A1c Other energy industries		L, T					
1A2 Industry	L, T	L, T	T				
1A4a Commercial/Institutional							
1A4b Residential	L		L, T	L, T	L	L	L
1A4c Agriculture/Forestry/Fisheries			T	T			

12 Recalculations since reporting in 2008

Improvements and recalculations since the 2008 emission inventory submission include:

- The national energy statistics has been updated for the years 1980-2006. This has primarily resulted in small differences, however a larger recalculation of the residential wood consumption was made by the DEA resulting in higher emissions of a number of air pollutants in 2006.
- The NMVOC emission factor for straw in residential plants has been updated to reflect the value provided in the EMEP/Corinair Guidebook (EEA, 2007). The emission factor was reduced from 600 g pr GJ to 400 g pr GJ. This change was made for the whole time-series.
- The emission factor for CO for residential wood combustion was updated based on the technology distribution of stoves and boilers together with default emission factors from the EMEP/Corinair Guidebook (EEA, 2007). This reduced the emissions factor from 6000 g pr GJ to 3441 g pr GJ in 2007. A time-series for the emission factor was elaborated.
- HCB emissions were estimated for the first time. Default emission factors from the EMEP/Corinair Guidebook (EEA, 2007) were used in the calculations.
- An improved documentation for the use of town gas has been included.
- An improved documentation concerning emissions from non-energy use of fuels has been incorporated.

13 Planned improvements

Some planned improvements to the emission inventories are discussed below.

1) Improved documentation for emission factors

The reporting of, and references for, the applied emission factors will be further developed in future inventories. This will include further QA/QC checks on plant specific emission factors.

2) Uncertainty estimates

Uncertainty estimates are based mainly on default uncertainty levels for activity rates and emission factors. Default uncertainty levels will be updated according to the updated EEA Guidebook (EEA 2008).

3) Emission factors for CHP plants

Updated emission factors for CHP plants will be estimated this year and will be applied in the next inventory.

14 Conclusion

The annual Danish emission inventories are prepared and reported by NERI. The inventories are based on the Danish energy statistics and on a set of emission factors for various sectors, technologies and fuels. Plant-specific emissions for large combustion sources are incorporated in the inventories.

Since 1990 fuel consumption has increased by 12 % - fossil fuel consumption, however, decreased by 2 %. The use of coal has decreased whereas the use of natural gas and renewable fuels has increased. The Danish fuel consumption fluctuates due to variation in the import/export of electricity from year to year.

Stationary combustion plants account for more than 50% of the national emission for the following pollutants: SO_2, heavy metals (except Cu), TSP, PM_{10}, $PM_{2.5}$, dioxin, HCB and PAH. Furthermore, the emission from stationary combustion plants accounts for more than 10% of the national emission for the following pollutants: NO_x, CO, NMVOC and Cu.

Public electricity and heat production are the most important stationary combustion emission source for SO_2, NO_x and heavy metals.

Residential plants represent the most important stationary combustion source for CO, NMVOC, particulate matter, PAH and dioxin. Wood combustion in residential plants is the predominant emission source.

SO_2 emission from stationary combustion plants has decreased by 95 % from 1980 and by 87 % from 1990. The considerable emission decrease is mainly a result of the reduced emission from electricity and heat production due to installation of desulphurisation technology and the use of fuels with lower sulphur content.

The NO_x emission from stationary combustion plants has decreased by 58 % since 1985 and 46 % 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.

Wood consumption in residential plants 2007 is 4.1 times the 1990 level. This has caused a considerable increase in the emission of CO, NMVOC, PM and PAH. The emission of dioxin also increased in resent years due to increased residential wood combustion. A change of technology (installation of modern stoves) has, however, caused decreasing emission factors for several pollutants.

The CO emission has increased by 22 % from 1990 to 2007. The increase in CO emission from residential plants is less than the increase in wood consumption, because the CO emission factor for wood combustion in residential plants decreased since 1990. Furthermore the emission from straw-fired farmhouse boilers has decreased considerably.

The NMVOC emission from stationary combustion plants has increased by 104 % from 1985 and 109 % from 1990. The increased NMVOC emission is mainly a result of the increasing wood combustion in residential plants and the increased use of lean-burn gas engines. The emission from straw-fired farmhouse boilers has decreased.

The emission of TSP, PM_{10} and $PM_{2.5}$ increased 68-71 % since 2000 due to the increase of wood combustion in residential plants. The emission of PAHs has increased 130-190 % since 1990, also a result of the increased combustion of wood in residential plants.

All the heavy metal emissions decreased considerably since 1990 – between 34 % and 82 %[5]. This is a result of the installation and improved performance of gas cleaning devices in municipal waste incineration plants and large power plants.

Dioxin emission decreased 55 % since 1990 mainly due to installation of dioxin filters in MSW incineration plants. However, the emission from residential plants is increasing due to the increasing wood combustion in the sector. This has caused an 23 % increase of dioxin emission from stationary combustion since 2004.

[5] The estimated Zn emission in 2007 is 15 % higher than in 1990. This is presumably due to insufficient emission factor update for resent years.

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Appendix 2A - overview

Appendix 2A-1: Emission inventory for the year 2007 reported to the LRTAP Convention in 2009-

Appendix 2A-2: IPCC/SNAP source correspondence list

Appendix 2A-3: Fuel rate

Appendix 2A-4: Lower Calorific Value (LCV) of fuels

Appendix 2A-5: Emission factors

Appendix 2A-6: Implied emission factors for power plants and municipal waste incineration plants

Appendix 2A-7: Large point sources

Appendix 2A-8: Uncertainty estimates

Appendix 2A-9: Emission inventory 2007 based on SNAP sectors

Appendix 2A-10: Description of the Danish energy statistics

Appendix 2A-11: Key source analysis

Appendix 2A-12: Fuel consumption time-series 1980-2007

Appendix 2A-1 Emission inventory for the year 2007 reported to the LRTAP Convention in 2009

Table 2A-25 Emission inventory for the year 2007 reported to the LRTAP in 2009 (a) (Nielsen et al. 2009b).

	NO_x Gg NO_2	CO Gg	NMVOC Gg	SOx Gg SO_2	TSP Mg	PM_{10} Mg	$PM_{2.5}$ Mg
1 A 1 a Public Electricity and Heat Production	33,61	8,85	2,70	8,64	1000,32	779,31	632,50
1 A 1 b Petroleum refining	1,75	0,23	0,00	0,42	120,72	112,50	108,39
1 A 1 c Manufacture of Solid Fuels and Other Energy Industries	7,12	0,21	0,04	0,01	3,11	1,80	1,49
1 A 2 Manufacturing Industries and Construction	0,00	0,00	0,00	0,00	0,00	0,00	0,00
1 A 2 a Iron and Steel	IE	IE	IE	IE	148,26	44,48	6,67
1 A 2 b Non-ferrous Metals	IE	IE	IE	IE	38,91	34,97	16,14
1 A 2 c Chemicals	IE	IE	IE	IE	IE	IE	IE
1 A 2 d Pulp, Paper and Print	IE	IE	IE	IE	IE	IE	IE
1 A 2 e Food Processing, Beverages and Tobacco	IE	IE	IE	IE	IE	IE	IE
1 A 2 f Other (Please specify in a covering note)	21,79	20,95	2,07	7,19	1667,42	1487,01	1275,93
1 A 3 a ii Civil Aviation (Domestic, LTO)	0,21	0,75	0,13	0,01	1,48	1,48	1,48
1 A 3 a ii Civil Aviation (Domestic, Cruise)	0,29	0,12	0,02	0,02	1,11	1,11	1,11
1 A 3 b Road Transportation	0,00	0,00	0,00	0,00	0,00	0,00	0,00
1 A 3 b i R.T., Passenger cars	19,25	116,62	10,41	0,04	786,15	786,15	786,15
1 A 3 b ii R.T., Light duty vehicles	10,80	11,52	1,67	0,02	1224,06	1224,06	1224,06
1 A 3 b iii R.T., Heavy duty vehicles	34,21	7,69	1,52	0,02	885,26	885,26	885,26
1 A 3 b iv R.T., Mopeds & Motorcycles	0,23	19,25	3,37	0,00	61,89	61,89	61,89
1 A 3 b v R.T., Gasoline evaporation	NA	NA	3,41	NA	NA	NA	NA
1 A 3 b vi R.T., Automobile tyre and brake wear	NA	NA	NA	NA	1660,88	1245,08	677,95
1 A 3 b vii R.T., Automobile road abrasion	NA	NA	NA	NA	1144,26	572,13	308,95
1 A 3 c Railways	3,56	0,63	0,23	0,00	119,99	119,99	119,99
1 A 3 d ii National Navigation	5,93	6,57	1,09	0,84	257,22	255,95	255,32
1 A 3 e Other (Please specify in a covering note)	0,00	0,00	0,00	0,00	0,00	0,00	0,00
1 A 3 e i Pipeline compressors	IE	IE	IE	IE	IE	IE	IE
1 A 3 e ii Other mobile sources and machinery	NO	NO	NO	NO	NO	NO	NO
1 A 4 a Commercial / Institutional	0,92	0,85	0,73	0,18	162,36	159,52	149,98
1 A 4 b Residential	0,00	0,00	0,00	0,00	0,00	0,00	0,00
1 A 4 b i Residential plants	6,65	138,66	20,96	2,51	25603,69	24252,61	22954,13
1 A 4 b ii Household and gardening (mobile)	0,29	89,40	8,10	0,00	79,60	79,60	79,60
1 A 4 c Agriculture / Forestry / Fishing	0,00	0,00	0,00	0,00	0,00	0,00	0,00
1 A 4 c i Stationary	0,91	8,10	1,38	1,68	511,97	474,67	439,95
1 A 4 c ii Off-road Vehicles and Other Machinery	11,15	15,71	2,11	0,04	895,33	895,33	895,33
1A 4 c iii National Fishing	7,03	0,97	0,30	0,48	119,41	118,21	117,62
1 A 5 a Other, Stationary (including Military)	NO	NO	NO	NO	NO	NO	NO
1 A 5 b Other, Mobile (Including military)	0,77	0,55	0,07	0,04	20,24	20,24	20,24
1B1 Fugitive Emissions from Solid Fuels	0,00	0,00	0,00	0,00	0,00	0,00	0,00
1 B 1 a Coal Mining and Handling	NA	NA	NA	NA	1218,48	487,39	48,74
1 B 1 b Solid fuel transformation	NO	NO	NO	NO	NO	NO	NO
1 B 1 c Other (Please specify in a covering note)	NO	NO	NO	NO	NO	NO	NO
1 B 2 Oil and natural gas	0,00	0,00	0,00	0,00	0,00	0,00	0,00
1 B 2 a Oil	0,00	0,00	0,00	0,00	0,00	0,00	0,00
1 B 2 a i Exploration Production, Transport	NA	NA	8,42	IE	NA	NA	NA
1 B 2 a iv Refining / Storage	NA	NA	3,77	0,61	NA	NA	NA
1 B 2 a v Distribution of oil products	NA	NA	0,97	NA	NA	NA	NA
1 B 2 a vi Other	NO	NO	NO	NO	NO	NO	NO
1 B 2 b Natural gas	NA	NA	0,05	NA	NA	NA	NA

1 B 2 c Venting and flaring	0,22	0,16	0,05	0,53	2,33	2,33	2,33
2 A MINERAL PRODUCTS (b)	0,00	0,00	0,00	0,00	0,00	0,00	0,00
2 A 1 Cement Production	IE	IE	IE	IE	IE	IE	IE
2 A 2 Lime Production	IE	IE	IE	IE	IE	IE	IE
2 A 3 Limestone and Dolomite Use	IE	IE	IE	IE	IE	IE	IE
2 A 4 Soda Ash Production and use	IE	IE	IE	IE	IE	IE	IE
2 A 5 Asphalt Roofing	NE	0,00	0,00	NE	NE	NE	NE
2 A 6 Road Paving with Asphalt	NE	0,35	0,57	NE	NE	NE	NE
2 A 7 Other including Non Fuel Mining & Construction (Please specify in a covering note)	NE	NE	0,02	NE	NE	NE	NE
2 B CHEMICAL INDUSTRY	0,00	0,00	0,00	0,00	0,00	0,00	0,00
2 B 1 Ammonia Production	NO	NO	NO	NO	NO	NO	NO
2 B 2 Nitric Acid Production	0,00	NA	NA	NA	0,00	0,00	0,00
2 B 3 Adipic Acid Production	NO	NO	NO	NO	NO	NO	NO
2 B 4 Carbide Production	NO	NO	NO	NO	NO	NO	NO
2 B 5 Other (Please specify in a covering note)	0,02	NE	0,02	0,04	NE	NE	NE
2 C METAL PRODUCTION	NA	NE	NE	NA	NE	NE	NE
2 D OTHER PRODUCTION (b)	0,00	0,00	0,00	0,00	0,00	0,00	0,00
2 D 1 Pulp and Paper	NE	NE	NE	NE	NE	NE	NE
2 D 2 Food and Drink	NE	NE	0,50	NE	NE	NE	NE
2 G OTHER (Please specify in a covering note)	NO	NO	NO	NO	NO	NO	NO
3 A PAINT APPLICATION	NA	NA	11,40	NA	NA	NA	NA
3 B DEGREASING AND DRY CLEANING	NA	NA	4,84	NA	NA	NA	NA
3 C CHEMICAL PRODUCTS, MANUFACTURE AND PROCESSING	NA	NA	2,18	NA	NA	NA	NA
3 D OTHER including products containing HMs and POPs (Please specify in a covering note)	NA	NA	9,52	NA	NA	NA	NA
4 B MANURE MANAGEMENT (c)	0,00	0,00	0,00	0,00	0,00	0,00	0,00
4 B 1 Cattle	0,00	0,00	0,00	0,00	0,00	0,00	0,00
4 B 1 a Dairy	NA	NA	NA	NA	727,91	334,84	215,14
4 B 1 b Non-Dairy	NA	NA	NA	NA	449,41	206,73	133,52
4 B 2 Buffalo	NO	NO	NO	NO	NO	NO	NO
4 B 3 Sheep	NA	NA	NA	NA	NE	NE	NE
4 B 4 Goats	NA	NA	NA	NA	NE	NE	NE
4 B 5 Camels and Llamas	NO	NO	NO	NO	NO	NO	NO
4 B 6 Horses	NA	NA	NA	NA	33,85	15,57	10,38
4 B 7 Mules and Asses	NO	NO	NO	NO	NO	NO	NO
4 B 8 Swine	NA	NA	NA	NA	8331,05	3748,97	611,91
4 B 9 Poultry	NA	NA	NA	NA	5020,04	5020,04	702,28
4 B 13 Other	NA	NA	NA	NA	NE	NE	NE
4 C RICE CULTIVATION	NO	NO	NO	NO	NO	NO	NO
4 D AGRICULTURAL SOILS	0,00	0,00	0,00	0,00	0,00	0,00	0,00
4 D 1 Direct Soil Emission	NA	NA	1,78	NA	NE	NE	NE
4 F FIELD BURNING OF AGRICULTURAL WASTES	NO	NO	NO	NO	NO	NO	NO
4 G OTHER (d)	NO	NO	NO	NO	NO	NO	NO
5 B FOREST AND GRASSLAND CONVERSION	NO	NO	NO	NO	NO	NO	NO
6 A SOLID WASTE DISPOSAL ON LAND	NA	NA	NE	NA	NA	NA	NA
6 B WASTE-WATER HANDLING	NA	NA	NE	NA	NA	NA	NA
6 C WASTE INCINERATION (e)	0,01	0,00	0,00	0,00	1,82	1,64	1,64
6 D OTHER WASTE (f)	NO	NO	NO	NO	NO	NO	NO
7 OTHER	NA	NA	NA	NA	NA	NA	NA
National Total	**166,71**	**448,14**	**104,39**	**23,33**	**52298,52**	**43430,85**	**32746,05**
Memo Items							
International Aviation (LTO)	1,04	0,70	0,14	0,07	3,58	3,58	3,58

International Aviation (Cruise)	10,56	1,26	0,38	0,79	39,95	39,95	39,95
International Navigation	89,72	9,13	2,77	26,88	2503,86	2478,82	2466,30
5 E Other	NO	NO	NO	NO	NO	NO	NO
X (11 08 Volcanoes)	NO	NO	NO	NO	NO	NO	NO

Table 2A-26 Emission inventory for the year 2007 reported to the LRTAP in 2009 (b) (Nielsen et al. 2009b).

	Pb Mg	Cd Mg	Hg Mg	As Mg	Cr Mg	Cu Mg	Ni Mg	Se Mg	Zn Mg
1 A 1 a Public Electricity and Heat Production	3,55	0,24	0,48	0,35	0,63	0,72	1,80	1,23	15,55
1 A 1 b Petroleum refining	0,02	0,01	0,00	0,01	0,03	0,01	0,53	0,01	0,00
1 A 1 c Manufacture of Solid Fuels and Other Energy Industries	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
1 A 2 Manufacturing Industries and Construction	-	-	-	-	-	-	-	-	-
1 A 2 a Iron and Steel	0,53	0,01	IE	0,02	0,08	IE	0,10	0,37	0,37
1 A 2 b Non-ferrous Metals	0,01	0,00	IE	IE	IE	0,00	IE	IE	-
1 A 2 c Chemicals	IE	IE	IE	IE	IE	IE	IE	IE	IE
1 A 2 d Pulp, Paper and Print	IE	IE	IE	IE	IE	IE	IE	IE	IE
1 A 2 e Food Processing, Beverages and Tobacco	IE	IE	IE	IE	IE	IE	IE	IE	IE
1 A 2 f Other (Please specify in a covering note)	0,27	0,16	0,25	0,18	0,31	0,73	4,88	0,17	1,30
1 A 3 a ii Civil Aviation (Domestic, LTO)	1,33	0,00	NE	NE	0,00	0,02	0,00	0,00	0,01
1 A 3 a ii Civil Aviation (Domestic, Cruise)	-	0,00	-	-	0,00	0,04	0,00	0,00	0,02
1 A 3 b Road Transportation	-	-	-	-	-	-	-	-	-
1 A 3 b i R.T., Passenger cars	0,05	0,02	NE	NE	0,11	3,67	0,15	0,02	2,16
1 A 3 b ii R.T., Light duty vehicles	0,00	0,01	NE	NE	0,04	1,49	0,06	0,01	0,88
1 A 3 b iii R.T., Heavy duty vehicles	0,00	0,01	NE	NE	0,05	1,85	0,08	0,01	1,09
1 A 3 b iv R.T., Mopeds & Motorcycles	0,00	0,00	NE	NE	0,00	0,06	0,00	0,00	0,03
1 A 3 b v R.T., Gasoline evaporation	NA	NA	NA	NA	NA	NA	NA	NA	NA
1 A 3 b vi R.T., Automobile tyre and brake wear	NA	NA	NA	NA	NA	NA	NA	NA	NA
1 A 3 b vii R.T., Automobile road abrasion	NA	NA	NA	NA	NA	NA	NA	NA	NA
1 A 3 c Railways	NA	0,00	NA	NA	0,00	0,12	0,01	0,00	0,07
1 A 3 d ii National Navigation	0,01	0,00	0,01	0,01	0,01	0,07	0,46	0,03	0,09
1 A 3 e Other (Please specify in a covering note)	-	-	-	-	-	-	-	-	-
1 A 3 e i Pipeline compressors	IE	IE	IE	IE	IE	IE	IE	IE	IE
1 A 3 e ii Other mobile sources and machinery	NO	NO	NO	NO	NO	NO	NO	NO	NO
1 A 4 a Commercial / Institutional	0,01	0,01	0,01	0,01	0,01	0,01	0,15	0,01	0,18
1 A 4 b Residential	-	-	-	-	-	-	-	-	-
1 A 4 b i Residential plants	0,18	0,25	0,29	0,03	0,02	0,27	0,03	0,09	5,17
1 A 4 b ii Household and gardening (mobile)	0,00	0,00	NE	NE	0,00	0,12	0,01	0,00	0,07
1 A 4 c Agriculture / Forestry / Fishing	-	-	-	-	-	-	-	-	-
1 A 4 c i Stationary	0,03	0,01	0,02	0,02	0,03	0,02	0,44	0,01	0,05
1 A 4 c ii Off-road Vehicles and Other Machinery	0,00	0,00	NA	NA	0,02	0,64	0,03	0,00	0,37
1A 4 c iii National Fishing	0,01	0,00	0,01	0,01	0,00	0,01	0,01	0,02	0,06
1 A 5 a Other, Stationary (including Military)	NO	NO	NO	NO	NO	NO	NO	NO	NO
1 A 5 b Other, Mobile (Including military)	0,08	0,00	-	-	0,00	0,09	0,00	0,00	0,06
1B1 Fugitive Emissions from Solid Fuels	-	-	-	-	-	-	-	-	-
1 B 1 a Coal Mining and Handling	NA	NA	NA	NA	NA	NA	NA	NA	NA
1 B 1 b Solid fuel transformation	NO	NO	NO	NO	NO	NO	NO	NO	NO
1 B 1 c Other (Please specify in a covering note)	NO	NO	NO	NO	NO	NO	NO	NO	NO
1 B 2 Oil and natural gas	-	-	-	-	-	-	-	-	-
1 B 2 a Oil	-	-	-	-	-	-	-	-	-
1 B 2 a i Exploration Production, Transport	NA	NA	NA	NA	NA	NA	NA	NA	NA
1 B 2 a iv Refining / Storage	NA	NA	NA	NA	NA	NA	NA	NA	NA
1 B 2 a v Distribution of oil products	NA	NA	NA	NA	NA	NA	NA	NA	NA
1 B 2 a vi Other	NO	NO	NO	NO	NO	NO	NO	NO	NO
1 B 2 b Natural gas	NA	NA	NA	NA	NA	NA	NA	NA	NA
1 B 2 c Venting and flaring	NA	NA	NA	NA	NA	NA	NA	NA	NA
2 A MINERAL PRODUCTS (b)	-	-	-	-	-	-	-	-	-
2 A 1 Cement Production	IE	IE	IE	IE	IE	IE	IE	IE	IE
2 A 2 Lime Production	IE	IE	IE	IE	IE	IE	IE	IE	IE
2 A 3 Limestone and Dolomite Use	IE	IE	IE	IE	IE	IE	IE	IE	IE
2 A 4 Soda Ash Production and use	IE	IE	IE	IE	IE	IE	IE	IE	IE
2 A 5 Asphalt Roofing	NE	NE	NE	NE	NE	NE	NE	NE	NE
2 A 6 Road Paving with Asphalt	NE	NE	NE	NE	NE	NE	NE	NE	NE
2 A 7 Other including Non Fuel Mining & Construction (Please specify in a covering note)	NE	NE	NE	NE	NE	NE	NE	NE	NE
2 B CHEMICAL INDUSTRY	-	-	-	-	-	-	-	-	-
2 B 1 Ammonia Production	NO	NO	NO	NO	NO	NO	NO	NO	NO
2 B 2 Nitric Acid Production	NA	NA	NA	NA	NA	NA	NA	NA	NA
2 B 3 Adipic Acid Production	NO	NO	NO	NO	NO	NO	NO	NO	NO
2 B 4 Carbide Production	NO	NO	NO	NO	NO	NO	NO	NO	NO
2 B 5 Other (Please specify in a covering note)	NE	NE	NE	NE	NE	NE	NE	NE	NE
2 C METAL PRODUCTION	0,07	0,00	-	NE	-	0,05	-	NE	0,63
2 D OTHER PRODUCTION (b)	-	-	-	-	-	-	-	-	-
2 D 1 Pulp and Paper	NA	NA	NA	NA	NA	NA	NA	NA	NA
2 D 2 Food and Drink	NA	NA	NA	NA	NA	NA	NA	NA	NA
2 G OTHER (Please specify in a covering note)	NO	NO	NO	NO	NO	NO	NO	NO	NO
3 A PAINT APPLICATION	NA	NA	NA	NA	NA	NA	NA	NA	NA
3 B DEGREASING AND DRY CLEANING	NA	NA	NA	NA	NA	NA	NA	NA	NA

3 C CHEMICAL PRODUCTS, MANUFACTURE AND PROCESSING	NA	NA	NA	NA	NA	NA	NA	NA	NA
3 D OTHER including products containing HMs and POPs (Please specify in a covering note)	NA	NA	NA	NA	NA	NA	NA	NA	NA
4 B MANURE MANAGEMENT (c)	-	-	-	-	-	-	-	-	-
4 B 1 Cattle	-	-	-	-	-	-	-	-	-
4 B 1 a Dairy	NA	NA	NA	NA	NA	NA	NA	NA	NA
4 B 1 b Non-Dairy	NA	NA	NA	NA	NA	NA	NA	NA	NA
4 B 2 Buffalo	NO	NO	NO	NO	NO	NO	NO	NO	NO
4 B 3 Sheep	NA	NA	NA	NA	NA	NA	NA	NA	NA
4 B 4 Goats	NA	NA	NA	NA	NA	NA	NA	NA	NA
4 B 5 Camels and Llamas	NO	NO	NO	NO	NO	NO	NO	NO	NO
4 B 6 Horses	NA	NA	NA	NA	NA	NA	NA	NA	NA
4 B 7 Mules and Asses	NO	NO	NO	NO	NO	NO	NO	NO	NO
4 B 8 Swine	NA	NA	NA	NA	NA	NA	NA	NA	NA
4 B 9 Poultry	NA	NA	NA	NA	NA	NA	NA	NA	NA
4 B 13 Other	NA	NA	NA	NA	NA	NA	NA	NA	NA
4 C RICE CULTIVATION	NO	NO	NO	NO	NO	NO	NO	NO	NO
4 D AGRICULTURAL SOILS	-	-	-	-	-	-	-	-	-
4 D 1 Direct Soil Emission	NA	NA	NA	NA	NA	NA	NA	NA	NA
4 F FIELD BURNING OF AGRICULTURAL WASTES	NO	NO	NO	NO	NO	NO	NO	NO	NO
4 G OTHER (d)	NO	NO	NO	NO	NO	NO	NO	NO	NO
5 B FOREST AND GRASSLAND CONVERSION	NO	NO	NO	NO	NO	NO	NO	NO	NO
6 A SOLID WASTE DISPOSAL ON LAND	NA	NA	NA	NA	NA	NA	NA	NA	NA
6 B WASTE-WATER HANDLING	NA	NA	NA	NA	NA	NA	NA	NA	NA
6 C WASTE INCINERATION (e)	0,00	0,00	0,05	0,00	0,00	0,00	0,00	0,00	0,01
6 D OTHER WASTE (f)	NO	NO	NO	NO	NO	NO	NO	NO	NO
7 OTHER	NA	NA	NA	NA	NA	NA	NA	NA	NA
National Total	**6,17**	**0,75**	**1,12**	**0,63**	**1,36**	**9,99**	**8,72**	**1,99**	**28,18**
Memo Items									
International Aviation (LTO)	0,01	0,00	-	-	0,00	0,12	0,00	0,00	0,07
International Aviation (Cruise)	-	0,01	-	-	0,04	1,34	0,06	0,01	0,79
International Navigation	0,20	0,03	0,03	0,44	0,18	0,44	25,87	0,40	0,90
5 E Other	NO	NO	NO	NO	NO	NO	NO	NO	NO
X (11 08 Volcanoes)	NO	NO	NO	NO	NO	NO	NO	NO	NO

Table 2A-27 Emission inventory for the year 2007 reported to the LRTAP in 2009 (c) (Nielsen et al. 2009b).

	Dioxin g I-TEQ	Benzo(a)-pyrene Mg	Benzo(b)-fluoranthene Mg	Benzo(k)-fluoranthene Mg	Indeno(1,3,3-c,d)pyrene Mg
1 A 1 a Public Electricity and Heat Production	1,278	0,007	0,028	0,014	0,006
1 A 1 b Petroleum refining	0,001	0,000	0,000	0,000	0,000
1 A 1 c Manufacture of Solid fuels and Other ENRrgy Industries	0,001	0,000	0,000	0,000	0,000
1 A 2 Manufacturing Industries and Construction	-	-	-	-	-
1 A 2 a Iron and Steel	NA	NA	NA	NA	NA
1 A 2 b NAn-ferrous Metals	0,036	NA	NA	NA	NA
1 A 2 c Chemicals	NA	NA	NA	NA	NA
1 A 2 d Pulp, Paper and Print	NA	NA	NA	NA	NA
1 A 2 e Food Processing, Beverages & Tobacco	NA	NA	NA	NA	NA
1 A 2 f Other (Please specify in a covering NAte)	0,151	0,034	0,111	0,023	0,012
1 A 3 a ii Civil Aviation (Domestic, LTO)	0,001	0,000	0,000	0,000	0,000
1 A 3 a ii Civil Aviation (Domestic, Cruise)	-	-	-	-	-
1 A 3 b Road Transportation	-	-	-	-	-
1 A 3 b i R.T., Passenger cars	0,084	0,033	0,031	0,032	0,037
1 A 3 b ii R.T., Light duty vehicles	0,020	0,020	0,019	0,017	0,019
1 A 3 b iii R.T., Heavy duty vehicles	0,046	0,004	0,023	0,034	0,006
1 A 3 b iv R.T., Mopeds & Motorcycles	0,030	0,001	0,001	0,001	0,001
1 A 3 b v R.T., GasoliNR evaporation	NA	NA	NA	NA	NA
1 A 3 b vi R.T., Automobile tyre and brake wear	NA	NA	NA	NA	NA
1 A 3 b vii R.T., Automobile road abrasion	NA	NA	NA	NA	NA
1 A 3 c Railways	0,002	0,000	0,001	0,001	0,000
1 A 3 d ii National Navigation	0,060	0,001	0,003	0,002	0,005
1 A 3 e Other (Please specify in a covering NAte)	-	-	-	-	-
1 A 3 e i PipeliNR compressors	NA	NA	NA	NA	NA
1 A 3 e ii Other mobile sources and machiNRry	NO	NO	NO	NO	NO
1 A 4 a Commercial / Institutional	0,454	0,171	0,225	0,075	0,122
1 A 4 b Residential	-	-	-	-	-
1 A 4 b i Residential plants	17,974	4,623	4,787	2,772	3,139
1 A 4 b ii Household and gardening (mobile)	0,016	0,000	0,001	0,000	0,001
1 A 4 c Agriculture / Forestry / Fishing	-	-	-	-	-
1 A 4 c i Stationary	1,441	0,162	0,174	0,024	0,263
1 A 4 c ii Off-road Vehicles and Other MachiNRry	0,013	0,004	0,008	0,008	0,004
1A 4 c iii National Fishing	0,062	0,001	0,003	0,002	0,006
1 A 5 a Other, Stationary (including Military)	NO	NO	NO	NO	NO
1 A 5 b Other, Mobile (Including military)	0,001	0,000	0,000	0,000	0,000
1B1 Fugitive Emissions from Solid Fuels	-	-	-	-	-
1 B 1 a Coal Mining and Handling	NA	NA	NA	NA	NA
1 B 1 b Solid fuel transformation	NO	NO	NO	NO	NO
1 B 1 c Other (Please specify in a covering NAte)	NO	NO	NO	NO	NO
1 B 2 Oil and natural gas	-	-	-	-	-
1 B 2 a Oil	-	-	-	-	-
1 B 2 a i Exploration Production, Transport	NA	NA	NA	NA	NA
1 B 2 a iv Refining / Storage	NA	NA	NA	NA	NA
1 B 2 a v Distribution of oil products	NA	NA	NA	NA	NA
1 B 2 a vi Other	NA	NA	NA	NA	NA
1 B 2 b Natural gas	NA	NA	NA	NA	NA
1 B 2 c Venting and flaring	0,000	-	-	-	-
2 A MINRRAL PRODUCTS (a)	-	-	-	-	-
2 A 1 Cement Production	NA	NA	NA	NA	NA
2 A 2 Lime Production	0,017	NA	NA	NA	NA
2 A 3 LimestoNR and Dolomite Use	NA	NA	NA	NA	NA
2 A 4 Soda Ash Production and use	NA	NA	NA	NA	NA
2 A 5 Asphalt Roofing	NA	NA	NA	NA	NA
2 A 6 Road Paving with Asphalt	NA	NA	NA	NA	NA
2 A 7 Other including NAn Fuel Mining & Construction (Please specify in a covering NAte)	NA	NA	NA	NA	NA
2 B CHEMICAL INDUSTRY	-	-	-	-	-
2 B 1 Ammonia Production	NO	NO	NO	NO	NO
2 B 2 Nitric Acid Production	NA	NA	NA	NA	NA
2 B 3 Adipic Acid Production	NO	NO	NO	NO	NO
2 B 4 Carbide Production	NO	NO	NO	NO	NO

2 B 5 Other (Please specify in a covering NAte)	NA	NA	NA	NA	NA
2 C METAL PRODUCTION	-	NA	NA	NA	NA
2 D OTHER PRODUCTION (a)	NA	NA	NA	NA	NA
2 D 1 Pulp and Paper	NA	NA	NA	NA	NA
2 D 2 Food and Drink	NA	NA	NA	NA	NA
2 G OTHER (Please specify in a covering NAte)	NO	NO	NO	NO	NO
3 A PAINT APPLICATION	NA	NA	NA	NA	NA
3 B DEGREASING AND DRY CLEANING	NA	NA	NA	NA	NA
3 C CHEMICAL PRODUCTS, MANUFACTURE AND PROCESSING	NA	NA	NA	NA	NA
3 D OTHER including products containing HMs and POPs (Please specify in a covering NAte)	NA	NA	NA	NA	NA
4 B MANURE MANAGEMENT (b)	-	-	-	-	-
4 B 1 Cattle	NA	NA	NA	NA	NA
4 B 1 a Dairy	NA	NA	NA	NA	NA
4 B 1 b NAn-Dairy	NA	NA	NA	NA	NA
4 B 2 Buffalo	NO	NO	NO	NO	NO
4 B 3 Sheep	NA	NA	NA	NA	NA
4 B 4 Goats	NA	NA	NA	NA	NA
4 B 5 Camels and Llamas	NO	NO	NO	NO	NO
4 B 6 Horses	NA	NA	NA	NA	NA
4 B 7 Mules and Asses	NO	NO	NO	NO	NO
4 B 8 SwiNR	NA	NA	NA	NA	NA
4 B 9 Poultry	NA	NA	NA	NA	NA
4 B 13 Other	NA	NA	NA	NA	NA
4 C RICE CULTIVATION	NO	NO	NO	NO	NO
4 D AGRICULTURAL SOILS	NA	NA	NA	NA	NA
4 D 1 Direct Soil Emission	NA	NA	NA	NA	NA
4 F FIELD BURNING OF AGRICULTURAL WASTES	NO	NO	NO	NO	NO
4 G OTHER (c)	NO	NO	NO	NO	NO
5 B FOREST AND GRASSLAND CONVER-SION	NO	NO	NO	NO	NO
6 A SOLID WASTE DISPOSAL ON LAND	NA	NA	NA	NA	NA
6 B WASTEWATER HANDLING	NA	NA	NA	NA	NA
6 C WASTE INCINRRATION (d)	0,040	0,000	0,000	0,000	0,000
6 D OTHER WASTE (e)	NA	NA	NA	NA	NA
7 OTHER	6,100	NA	NA	NA	NA
National Total	**27,826**	**5,062**	**5,417**	**3,005**	**3,621**
International Aviation (LTO)	0,000	0,000	0,000	0,000	0,000
International Aviation (Cruise)	-	-	-	-	-
International MariNR (b)	0,604	0,004	0,014	0,006	0,020
5 E Other	NO	NO	NO	NO	NO
X (11 08 VolcaNAes)	NO	NO	NO	NO	NO

Appendix 2A-2 IPCC/SNAP source correspondence list

Table 2A-28 Correspondence list for IPCC source categories 1A1, 1A2 and 1A4 and SNAP (EEA, 2007).

SNAP_id	SNAP_name	IPCC source
01	Combustion in energy and transformation industries	
010100	Public power	1A1a
010101	Combustion plants >= 300 MW (boilers)	1A1a
010102	Combustion plants >= 50 and < 300 MW (boilers)	1A1a
010103	Combustion plants < 50 MW (boilers)	1A1a
010104	Gas turbines	1A1a
010105	Stationary engines	1A1a
010200	District heating plants	1A1a
010201	Combustion plants >= 300 MW (boilers)	1A1a
010202	Combustion plants >= 50 and < 300 MW (boilers)	1A1a
010203	Combustion plants < 50 MW (boilers)	1A1a
010204	Gas turbines	1A1a
010205	Stationary engines	1A1a
010300	Petroleum refining plants	1A1b
010301	Combustion plants >= 300 MW (boilers)	1A1b
010302	Combustion plants >= 50 and < 300 MW (boilers)	1A1b
010303	Combustion plants < 50 MW (boilers)	1A1b
010304	Gas turbines	1A1b
010305	Stationary engines	1A1b
010306	Process furnaces	1A1b
010400	Solid fuel transformation plants	1A1c
010401	Combustion plants >= 300 MW (boilers)	1A1c
010402	Combustion plants >= 50 and < 300 MW (boilers)	1A1c
010403	Combustion plants < 50 MW (boilers)	1A1c
010404	Gas turbines	1A1c
010405	Stationary engines	1A1c
010406	Coke oven furnaces	1A1c
010407	Other (coal gasification, liquefaction, ...)	1A1c
010500	Coal mining, oil/gas extraction, pipeline compressors	
010501	Combustion plants >= 300 MW (boilers)	1A1c
010502	Combustion plants >= 50 and < 300 MW (boilers)	1A1c
010503	Combustion plants < 50 MW (boilers)	1A1c
010504	Gas turbines	1A1c
010505	Stationary engines	1A1c
02	Non-industrial combustion plants	
020100	Commercial and institutional plants (t)	1A4a
020101	Combustion plants >= 300 MW (boilers)	1A4a
020102	Combustion plants >= 50 and < 300 MW (boilers)	1A4a
020103	Combustion plants < 50 MW (boilers)	1A4a
020104	Stationary gas turbines	1A4a
020105	Stationary engines	1A4a
020106	Other stationary equipments (n)	1A4a
020200	Residential plants	1A4b
020201	Combustion plants >= 50 MW (boilers)	1A4b
020202	Combustion plants < 50 MW (boilers)	1A4b
020203	Gas turbines	1A4b
020204	Stationary engines	1A4b
020205 [2)]	Other equipments (stoves, fireplaces, cooking,...) [2)]	1A4b
020300	Plants in agriculture, forestry and aquaculture	1A4c
020301	Combustion plants >= 50 MW (boilers)	1A4c
020302	Combustion plants < 50 MW (boilers)	1A4c
020303	Stationary gas turbines	1A4c
020304	Stationary engines	1A4c
020305	Other stationary equipments (n)	1A4c
03	Combustion in manufacturing industry	
030100	Comb. in boilers, gas turbines and stationary	1A2
030101	Combustion plants >= 300 MW (boilers)	1A2
030102	Combustion plants >= 50 and < 300 MW (boilers)	1A2
030103	Combustion plants < 50 MW (boilers)	1A2
030104	Gas turbines	1A2
030105	Stationary engines	1A2
030106	Other stationary equipments (n)	1A2
030200	Process furnaces without contact	
030203	Blast furnace cowpers	1A2a
030204	Plaster furnaces	1A2f
030205	Other furnaces	1A2f
0303	Processes with contact	

030301	Sinter and pelletizing plants	1A2a
030302	Reheating furnaces steel and iron	1A2a
030303	Gray iron foundries	1A2a
030304	Primary lead production	1A2b
030305	Primary zinc production	1A2b
030306	Primary copper production	1A2b
030307	Secondary lead production	1A2b
030308	Secondary zinc production	1A2b
030309	Secondary copper production	1A2b
030310	Secondary aluminium production	1A2b
030311	Cement (f)	1A2f
030312	Lime (includ. iron and steel and paper pulp industr.)(f)	1A2f
030313	Asphalt concrete plants	1A2f
030314	Flat glass (f)	1A2f
030315	Container glass (f)	1A2f
030316	Glass wool (except binding) (f)	1A2f
030317	Other glass (f)	1A2f
030318	Mineral wool (except binding)	1A2f
030319	Bricks and tiles	1A2f
030320	Fine ceramic materials	1A2f
030321	Paper-mill industry (drying processes)	1A2d
030322	Alumina production	1A2b
030323	Magnesium production (dolomite treatment)	1A2b
030324	Nickel production (thermal process)	1A2b
030325	Enamel production	1A2f
030326	Other	1A2f
08 [1)]	Other mobile sources and machinery	
0804 [1)]	Maritime activities	
080403 [1)]	National fishing	1A4c
0806 [1)]	Agriculture	1A4c
0807 [1)]	Forestry	1A4c
0808 [1)]	Industry	1A2f
0809 [1)]	Household and gardening	1A4b

[1)] Not stationary combustion. Included in a IPCC sector that also includes stationary combustion plants

[2)] Stoves, fireplaces and cooking is included in the sector 0202 or 020202 in the Danish inventory. It is not possible based on the Danish energy statistics to split the residential fuel consumption between stoves/fireplaces/cooking and residential boilers.

Appendix 2A-3 Fuel rate

Table 2A-29 Fuel consumption rate of stationary combustion plants 2007, GJ.

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
BIOGAS	184000	194000	204000	206000	206000	294000	345000	342000	354000	636024
BROWN COAL BRI.	383652	496548	816696	705377	705377	813099	458600	346801	196980	129096
COAL	245685136	195559902	238414633	232978427	232978427	301615024	305999044	300365510	280931543	231283239
COKE OVEN COKE	3539672	2815351	2948292	2540081	2540081	1960469	1586536	1521648	1254520	1029996
FISH & RAPE OIL	0	0	0	0	0	0	0	1972000	1860000	1302000
GAS OIL	147197854	121178671	107794483	99564640	99564760	109917912	102702376	101129151	83419659	71248190
KEROSENE	3925475	3570724	3610152	3554263	3554263	4611382	3886360	3004737	1946503	1765091
LPG	6380545	5590787	5601509	5638966	5638966	5026008	4868737	4382052	3569668	2938175
MUNICIP. WASTES (Biomass part)	7594876	8037744	8483273	8975864	8975864	9875897	10255844	10243613	10326833	10798089
NAPHTA	0	0	0	0	0	0	102000	0	0	0
NATURAL GAS	5041410	5500530	5664046	6280155	6280155	30402888	48497000	62192141	67423123	71714632
ORIMULSION	0	0	0	0	0	0	0	0	0	0
PETROLEUM COKE	1142772	2626233	6100737	7229662	7229662	8626648	9746749	8198313	5900762	4550111
PLASTIC WASTE	3043695	3221178	3399726	3597135	3597135	3957829	4110095	4105193	4138545	4327403
REFINERY GAS	11029056	11672336	10580745	11858275	11858275	11520000	13168000	13253000	13619000	14632000
RESIDUAL OIL	177766285	138192247	117465966	96628813	95487233	84783983	74195436	55385455	44542849	38303077
SEWAGE SLUDGE	0	0	0	0	0	0	0	0	0	0
STRAW	4840100	6646800	7419890	8318650	8318650	9892190	10273990	10830790	11258300	11658740
WOOD	11331423	13996790	14975670	14998693	14998693	15008206	17025334	17967540	17629153	17595257
Grand Total	629085951	519299841	533479818	503075001	501933541	598305535	607221101	595239944	548371438	483911120

Continued	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
BIOGAS	752001	910000	898999	1077001	1279488	1753645	1985110	2390005	2635029	2612573
BROWN COAL BRI.	115931	166823	95324	128246	91500	74609	56053	54331	47745	37607
COAL	253443653	344299909	286838436	300798816	323397473	270346013	371908020	276277338	234284903	196471581
COKE OVEN COKE	1275912	1449734	1181054	1154538	1226146	1272909	1226000	1253015	1346306	1422574
FISH & RAPE OIL	744000	744000	744000	800000	245419	250912	60409	13751	13619	27148
GAS OIL	61449256	64998154	56102476	62025402	53930105	53698269	58018611	51071033	48425146	47555370
KEROSENE	5086021	943393	783765	771272	649577	580777	539748	436636	417009	255606
LPG	2596144	2548699	2315050	2370506	2398317	2638278	2869571	2362592	2412781	2176932
MUNICIP. WASTES (Biomass part)	11064760	11953565	13158042	14565777	15242992	17532500	19377316	20788826	20649637	22627957
NAPHTA	0	0	0	0	0	0	0	0	0	0
NATURAL GAS	76092457	86106669	90466659	102475053	114585627	132698559	156276599	164489313	178706886	187876815
ORIMULSION	0	0	0	0	0	19913113	36766527	40488416	32580001	34190632
PETROLEUM COKE	4459523	4403568	4814028	6179382	4308897	4849824	6381422	6523131	5797915	7283513
PLASTIC WASTE	4434273	4790468	4639209	4844130	5069352	5373824	5575124	5981235	5941188	6510378
REFINERY GAS	14169000	14537000	14865000	15405000	16359999	20837864	21476000	16945381	15225340	15723812
RESIDUAL OIL	32118474	38252201	38505343	32823098	46228742	33008720	37766205	26579997	29985354	23696332
SEWAGE SLUDGE	0	0	0	0	0	0	0	0	0	0
STRAW	12481150	13306150	13880150	13366000	12662374	13053145	13545634	13911770	13903701	13668183
WOOD	18246813	20042437	21030660	22220198	21939961	21844810	23389205	23459225	22937838	24402569
Grand Total	498529367	609452770	550318195	581004419	619615969	599727770	757217553	653025995	615310399	586539582

Continued	2000	2001	2002	2003	2004	2005	2006	2007
BIOGAS	2870670	3020152	3331898	3545061	3451790	3930140	3978152	3914004
BROWN COAL BRI.	25748	32903	18922	3056	0	0	0	0
COAL	164707937	174308632	174654028	238978034	182496587	154007923	231965884	194145940
COKE OVEN COKE	1187177	1109591	1068454	995409	1143051	979704	1010558	1122307
FISH & RAPE OIL	49046	191475	126772	258882	650447	731501	970010	835389
GAS OIL	41260017	43667641	38673521	38955371	35918638	31852171	26797658	21809088
KEROSENE	169963	286786	256128	338430	214577	280244	221223	118877
LPG	1885313	1609877	1477458	1554215	1668540	1671309	1719997	1387805
MUNICIP. WASTES (Biomass part)	23570138	25102244	27224180	28339868	28910923	29057059	30961566	30669611
NAPHTA	0	0	0	0	0	0	0	0
NATURAL GAS	186121970	193826826	193608713	196322338	194677694	187700819	191122163	170874742
ORIMULSION	34148181	30243677	23846404	1921399	18719	0	0	0
PETROLEUM COKE	7291583	8313464	8281655	8716515	9380530	9340778	9719587	10415098
PLASTIC WASTE	6781457	7222265	7832775	8153774	8318075	8360120	8908073	8824074
REFINERY GAS	15556268	15755428	15197000	16554512	15890576	15347072	16115632	15916264
RESIDUAL OIL	18835569	21090663	26160841	28430623	24499899	21939523	26094472	21185578
SEWAGE SLUDGE	40162	375148	64508	55369	58266	58000	0	0
STRAW	12219993	13698193	15651212	16718510	17938819	18483159	18624816	18330862
WOOD	27521693	30866936	31630227	39002025	43649055	49797489	51475513	59935629
Grand Total	544242885	570721900	569104696	628843391	568886186	533537010	619685304	559485267

Table 2A-30 Detailed fuel consumption data for stationary combustion plants, GJ.

fuel_type	fuel_gr_abbr	NFR	nfr_name	snap_id	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
BIOMASS	BIOGAS	1A1	Electricity and heat production	010100	54000	54000	54000	56000	56000	94000	100000	97000	115000	164000
				010200						10000	40000	40000	34000	30000
		1A2	Industry	030100	7450	7450	7450	7450	7450	24016	24016	24016	33016	281024
		1A4	Commercial/ Institutional	020100	122550	132550	142550	142550	142550	165984	180984	180984	171984	161000
	FISH & RAPE OIL	1A1	Electricity and heat production	010200								1972000	1860000	1302000
	STRAW	1A1	Electricity and heat production	010100						73000	87000	58000		58000
				010200	290000	290000	304000	551000	551000	1436000	1740000	2262000	2683000	3074000
		1A4	Residential	020200	2730060	3814080	4269534	4660590	4660590	5029914	5068194	5106474	5145180	5116044
			Agriculture/ Forestry	020300	1820040	2542720	2846356	3107060	3107060	3353276	3378796	3404316	3430120	3410696
	WOOD	1A1	Electricity and heat production	010200							1290000	1702000	2031000	2762000
		1A2	Industry	030100	3709983	4250630	4423950	4780933	4780933	5279585	5555307	5480090	5580343	5695287
		1A4	Commercial/ Institutional	020100							164500	164500	164500	163660
			Residential	020200	7621440	9746160	10551720	10217760	10217760	9626280	9921760	10550320	9782680	8887160
			Agriculture/ Forestry	020300						102341	93767	70630	70630	87150
GAS	NATURAL GAS	1A1	Electricity and heat production	010100						3176000	5562000	3510000	5959000	6510000
				010200				296000	296000	6082000	12317000	15041000	13816000	11291000
			Other energy industries	010504	16770	813809	1265871	1572063	1572063	4150764	5210296	7390844	8805412	9131489
		1A2	Industry	030100	414300	429624	391352	351783	351783	5035350	8977161	14819847	17190071	21887005
				030106						150079	1873	344246	267688	224467
		1A4	Commercial/ Institutional	020100	368827	340568	319207	340958	340958	3287471	3667103	5022400	5338558	5256417
			Residential	020200	4241513	3916529	3687616	3719351	3719351	8273262	11809577	14758786	14548404	15519244
			Agriculture/ Forestry	020300						247962	951990	1305018	1497990	1895010
LIQUID	GAS OIL	1A1	Electricity and heat production	010100	249000	345000	297000	382000	382000	117000	231000	416000	400000	317000
				010200	287000	295000	389000	330000	330000	886000	732000	739000	707000	2952000
			Petroleum refining	010306							4376	1291		
		1A2	Industry	030100	6106649	2874404	1070466	780127	780199	3571846	2875401	2196046	860461	882118
				030106							1578	1722	1148	6062
		1A4	Commercial/ Institutional	020100	24694233	21725557	18298990	17880378	17880378	18637788	17960927	18062384	13819090	12177486
			Residential	020200	113249342	94406114	87068425	79681730	79681730	84840836	79360398	78460412	67097827	54285165
			Agriculture/ Forestry	020300	2611630	1532596	670602	510405	510453	1864442	1536696	1252296	534133	628359
	KEROSENE	1A2	Industry	030100	167388	183779	166135	178524	178524	435905	269735	190391	102834	61109
		1A4	Commercial/ Institutional	020100	1145042	1008749	996521	977758	977758	1440849	987734	686497	592512	464477
			Residential	020200	2343867	2042724	2029444	2083633	2083633	2487618	2454195	1978348	1184828	1207419
			Agriculture/ Forestry	020300	269178	335472	418052	314348	314348	247010	174696	149501	66329	32086
	LPG	1A1	Electricity and heat production	010200	2000	2000	153000	141000	141000	63000	23000	12000	10000	10000
		1A2	Industry	030100	3657492	2962409	2723401	2774825	2774825	1972661	1986874	2122492	1942927	1694084
		1A4	Commercial/ Institutional	020100	941705	854373	935095	903310	903310	1160205	1006688	214281	166954	119794
			Residential	020200	1162932	1186199	1336178	1421242	1421242	1774281	1800370	1791181	1240784	839996
			Agriculture/ Forestry	020300	616416	585806	453835	398589	398589	55861	51805	242098	209003	274301
	NAPHTA	1A1	Electricity and heat production	010100							102000			
	PETROLEUM COKE	1A1	Electricity and heat production	010200								165000	63000	
		1A2	Industry	030100	1142772	2626233	5661137	6988667	6988667	419787	1501743	450651	50303	
				030311						6765224,2	6818598	5458138	3921232	3820223
		1A4	Commercial/ Institutional	020100			104185	55404	55404	176296	35840	296153	273456	54969
			Residential	020200			335415	178369	178369	826871	698983	1111949	889851	674919
			Agriculture/ Forestry	020300				7222	7222	438470	691585	716422	702920	
	REFINERY GAS	1A1	Petroleum refining	010300							68000	137000	205000	332000
				010306	10925750	11561850	10468246	11728803	11728803	11390365	12959444	12952720	13224720	14092052
		1A2	Industry	030100	103306	110486	112499	129472	129472	129635	140556	163280	189280	207948
	RESIDUAL OIL	1A1	Electricity and heat production	010100	47677000	24956000	18017000	8518000	8518000	13348000	14292000	10464000	12960000	10783000
				010200	48997000	43678000	40823000	34724000	34724000	25102000	15665000	11530000	5426000	3035000
			Petroleum refining	010306	3301237	3591874	2527344	2501548	2501548	2824864	2740332	2179863	1606062	1653370
		1A2	Industry	030100	50678043	40700051	35663413	33703630	32562050	29888272	29389732	21333832	17169929	16598817
				030311						376030,5	1330136	2122576	2652323,3	2627054

fuel_type	fuel_gr_abbr	NFR	nfr_name	snap_id	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
		1A4	Commercial/ Institutional	020100	12482064	10468810	10333734	8304005	8304005	7737174	5611058	4214252	2574042	1534841
			Residential	020200	4847152	4675534	4888421	3527418	3527418	2960584	2541824	1296954	461006	366761
			Agriculture/ Forestry	020300	9783789	10121978	5213054	5350212	5350212	2547058	2625354	2243978	1693487	1704234
OTHER 1	MUNICIP. WASTES	1A1	Electricity and heat production	010100									138496,6	187755,7
				010200	7126863,7	7545209,1	7950704,3	8415453,2	8415453,2	9272133,2	9631224,9	9631224,9	9574112,9	9973183
		1A2	Industry	030100	38958,2369	38494,9158	53541,7861	53541,7861	53541,7861	45493,9914	44932,1521	32700,9034	33109,2542	26765,5388
		1A4	Commercial/ Institutional	020100	429053,9	454040,4	479026,9	506869	506869	558269,8	579686,8	579686,8	581114,6	610384,5
SOLID	BROWN COAL BRI.	1A2	Industry	030100	1800	17712	7704	29138	29138	76706	42282	37092	5270	
		1A4	Commercial/ Institutional	020100									640	378
			Residential	020200	381852	478836	808992	664882	664882	604240	276459	246519	149401	93348
			Agriculture/ Forestry	020300				11357	11357	132153	139859	63190	41669	35370
	COAL	1A1	Electricity and heat production	010100	226186000	177693000	221810000	216542000	216542000	271286000	276468000	272137000	253755000	206802000
				010200	102000	1704000	2583000	5222000	5222000	12092000	11344000	9343000	8486000	6800000
		1A2	Industry	030100	17652466	13258986	11441768	8011574	8011574	9837282	8966069	10254124	10359675	9108605
				030106	367632	412336	456783	374368	374368					
				030311						2757638	3790266	4158286	4185618,7	5476723
		1A4	Commercial/ Institutional	020100							10030	34348	169951	15332
			Residential	020200	1115764	1484028	927394	991143	991143	1001884	900472	306671	301556	435641
			Agriculture/ Forestry	020300	261274	1007552	1195688	1837342	1837342	4640220	4520207	4132081	3673742	2644938
	COKE OVEN COKE	1A2	Industry	030100	2470372	1529561	1344284	1493325	1493325	1307228	1120620	1089014	1055919	906593
		1A4	Residential	020200	1069300	1285790	1604008	1046756	1046756	653241	465916	432634	198601	123403
	PLASTIC WASTE	1A1	Electricity and heat production	010100									55503,4	75244,3
				010200	2856136,3	3023790,9	3186295,7	3372546,8	3372546,8	3715866,8	3859775,1	3859775,1	3836887,1	3996817
		1A2	Industry	030100	15612,7631	15427,0842	21457,2139	21457,2139	21457,2139	18232,0086	18006,8479	13105,0966	13268,7458	10726,4612
		1A4	Commercial/ Institutional	020100	171946,1	181959,6	191973,1	203131	203131	223730,2	232313,2	232313,2	232885,4	244615,5

fuel_type	fuel_gr_abbr	NFR	nfr_name	snap_id	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
BIOMASS	BIOGAS	1A1	Electricity and heat production	010100	141178	218984	29049	41826						
				010101					16910	419	24075	19550		
				010102					9835		94326	40561	50269	29597
				010103					54324	118012	79237	111449	86924	103711
				010104			78865	89233	199961	169040	6536			
				010105	94822	175016	251085	405941	415191	599387	826301	1229745	1548936	1500477
				010200	30000	30000	53000	53000						
				010203					45538	43775	54145	33623	31287	25003
				010205					40607					
			Other energy industries	010505	6803	6803	6803	6803	5946	51779	60257	57462	31144	29028
		1A2	Industry	030100					13014	126131	96199	117439	73558	32726
				030102					6534	16370	16478	19080	16361	16116
				030104						1052	1265	1137		
				030105									381	269
		1A4	Commercial/ Institutional	020100	199072	179112	83895	64492	112893	169712	173026	271951	225094	292653
				020103							14474	39396	71226	74379
				020104						27092				
				020105	270479	290438	386655	406059	349088	410626	389678	404594	439292	436918
			Agriculture/ Forestry	020300					2750	4455	132108	26121	34614	30392
				020304	9647	9647	9647	9647	6897	15795	17005	17897	25943	41304
	FISH & RAPE OIL	1A1	Electricity and heat production	010103					33707	24000	21799	188	5212	6974
				010200	744000	744000	744000	800000						
				010203					211712	226912	38610	13563	8407	20174
	STRAW	1A1	Electricity and heat production	010100	479000	985000	1487000	1643000						
				010101					100254	82215	610290	740153	1013770	1339800
				010102					621557	1286955,5	1704388	1845052	1751934,5	1819429
				010103					1126908	1297258	1361686	1174181	1180826	1058038
				010200	3524000	3843000	3915000	3806000						
				010201					22040					

fuel_type	fuel_gr_abbr	NFR	nfr_name	snap_id	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
				010202					57304	179930	114376	95990	136488	141564
				010203					3378461	3409001	3699694	3564019	3525786	3565456
		1A2	Industry	030100									446	446
				030103						3085				
		1A4	Residential	020200	5086890	5086890	5086890	4750200	4413510	4076820	3633120	3891945	3773190	3442590
			Agriculture/ Forestry	020300	3391260	3391260	3391260	3166800	2942340	2717880	2422080	2594630	2515460	2295060
				020302								5800	5800	5800
	WOOD	1A1	Electricity and heat production	010100			172000	515000						
				010101					42966				263719	
				010102					1053223	865377	861821,3	1001257	1371873	2377322
				010103					623575	671570	578451	644712	575350	732058
				010104					78890	4410				
				010105										1674
				010200	3217000	3648000	4096000	3751000						
				010201					8537					
				010202					44	43575	164768	190941	207278	193907
				010203					3337730	3490933	3857403	3795439	3971995	3928219
		1A2	Industry	030100	5783743	5690367	5750550	5821715	4464819	4254327	4097885	4166034	4273637	4250138
				030102									1776	1496
				030103					481414	412555	623748	523545	412235	413749
		1A4	Commercial/ Institutional	020100	204488	204488	204488	204488	216160	273035	449435	471415	492803	642041
				020105									2096	2057
			Residential	020200	8954432	10412432	10720472	11859632	11564240	11760665	12668890	12569082	11134265	11615182
			Agriculture/ Forestry	020300	87150	87150	87150	68363	68363	68363	86804	96800	230244	230875
				020304									567	13851
GAS	NATURAL GAS	1A1	Electricity and heat production	010100								5511	21264	16787
				010101	4005027,63	4394781	3279455	4422200	8437973,09	10453815,72	12217008	14600070	20808855	21307826
				010102					295111	299964	1346036	5620044	5987198	2416146
				010103					2487008	1775265	1558418	1138214	958646	716525
				010104	1859206	2396900	4806049	7327221	7776734	8547638,05	14500108,5	12220262	13002948	21614378
				010105	677767	1291319	2199496	4168579	8358415	16419956	22162423	24109208	26700713	26833951
				010200	11033000	13655000	12350000	11420000						
				010202					1072469	1017168	844253	660506	539227	282207
				010203					6160497	5525191	3803076	2420020	1988837	1873511
				010205					131795	338556	377124	230400	235829	226189
			Other energy industries	010502						399247,39	390587,25	417415	413342	409043
				010504	9482284	9703068	11118697	11235480	12267791	12506433	14849859	19454575	21636547	23561526
				010505	1760	3520	3520	3520	2570	4494	7551	4939	15340	13883
		1A2	Industry	030100	22280195	23780869	23887554	25535326	29248293	30317635	29252137	29423362	29114015	31167462
				030102					862925	2661778,52	2464664,75	2971625	2961903	3100115
				030103					300216	64308	146812	169825	131608	126872
				030104	506337	608907	664092	729919	761202	909952	2562511	3366152	5106083	6501018
				030105	187	187	187	187	11210	172920	873431	960232	1157405	1160055
				030106	136059	24239	37695	70154	53489	24415	15283	5288	31735	38608
				030315								924066	903336	1005440
				030318						624960	590400	620640	671040	686880
		1A4	Commercial/ Institutional	020100	6376293	6934201	7382035	8908566	7343015	8436587	11247402	9106736	8661696	7525335
				020103					2177			2434	49460	10801
				020104					11946	25798	31397	25514	22995	30739
				020105	45985	88875	278287	350372	473892	609395	681480	866185	959184	985839
			Residential	020200	17362132	20432645	21439693	24903983	24736624	26947401	30412122	28361811	29137977	28981613
				020202							25676	24503	18059	31289
				020204		7932	499046	776351	1022812	1094868	1448246	1488432	1575546	1554382
			Agriculture/ Forestry	020300	2222000	2680002	2385006	2462538	2485322	2559680	2666407	2644836	2476128	2241939
				020303							5959	26127	65805	77171
				020304	104224	104224	135847	160657	282141	961133	1796227	2620381	3354165	3379285
LIQUID	GAS OIL	1A1	Electricity and heat production	010100	239170	416396	641323	245263						
				010101					12386	51300	41614	194854	108730	258004

fuel_type	fuel_gr_abbr	NFR	nfr_name	snap_id	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
				010102					42898	30019	153012	113506	82184,29	158532
				010103					59149	40405	78104	41727	44468	61232
				010104	43987	43987	43987	43987	43987	75632	81094	54042	146795	60385
				010105	16843	32617	34690	34750	116493	136913	99083	100449	133710	108002
				010200	1941000	813000	744000	947000						
				010201					27268	7000				
				010202					174046	360676	799818,1	514978	418139	257831
				010203					843648	444369	554844	509625	652349	296296
				010205					717					1055
			Petroleum refining	010306		40029	44476	29125	49319	33321	21879	87482		
		1A2	Industry	030100	537931	1369948	1430556	951740	812691	1460371	2251856	1895198	1799389	2477807
				030102						3438			440	1327
				030103					1678	1453	11390	1015	1623	64
				030104								244	377	6787
				030105			1447	1578	1578					
				030106	6098	6636	8644	2762	9433	7030	6743	8178	15603	70265
				030315								1040	603	4950
		1A4	Commercial/ Institutional	020100	11794783	10622868	9062255	9007046	7156617	6556065	6619841	6093376	5442142	5781168
				020102					190782		215		75	
				020103					72		57796	58202	53618	39101
				020105			1361	1485	733	20330	1754	294	21	66
			Residential	020200	46463224	50638393	42913606	49967084	43678618	43287857	45295557	39595464	37849748	35675468
			Agriculture/ Forestry	020300	406220	1014280	1176131	793582	707992	1182090	1940156	1799028	1675132	2297030
				020302								7		
				020304							3855	2324		
	KEROSENE	1A2	Industry	030100	69635	45692	38315	35461	30485	24464	30937	27840	16078	8909
		1A4	Commercial/ Institutional	020100	569083	209843	206978	188910	154647	124344	103314	96459	127964	117233
			Residential	020200	4404777	659635	512024	520836	437788	410845	382564	287211	251843	118954
			Agriculture/ Forestry	020300	42526	28223	26448	26065	26657	21124	22933	25126	21124	10510
	LPG	1A1	Electricity and heat production	010100		1000	1000	3000						
				010103						736				
				010200	9000	13000	10000							
				010203					2732					9
			Petroleum refining	010306			4600		8004	15042	20654	18492		
		1A2	Industry	030100	1576175	1689355	1588914	1450676	1557782	1737694	1920315	1596586	1623548	1355035
		1A4	Commercial/ Institutional	020100	82757	77097	76519	122201	125183	131001	137989	128417	116413	109573
				020103									9	
				020105									803	771
			Residential	020200	669665	521639	442269	672725	588599	628367	653211	510109	545681	624403
			Agriculture/ Forestry	020300	258547	246608	191748	121904	116017	125438	137402	108988	126327	87141
	ORIMULSION	1A1	Electricity and heat production	010101						19913113	36766527	40488416	32580001	34190632
	PETROLEUM COKE	1A1	Electricity and heat production	010100				1239000						
		1A2	Industry	030100	300247		56107	122868		98156	110026	33598	25842	38999
				030311	2499251,6	2991306	3234048	3230651,8	3469025	3707398	4966161,2	5229890	4774684	6398880
		1A4	Commercial/ Institutional	020100	62023	104190	90150	96354	91988	70415	90528	97770	70544	50434
			Residential	020200	760877	697484	961122	990337	747884	734273	928841	839269	725791	705961
			Agriculture/ Forestry	020300	837124	610588	472601	500171		239582	285866	322604	201054	89239
	REFINERY GAS	1A1	Electricity and heat production	010101							35204	40077		
			Petroleum refining	010300	458000	926000	1526000	15917						
				010304				2067083	2355000	2289700	5069590	4081532	2996106	4172606
				010306	13520108	13485940	13236820	13213580	14004999,1	18548163,6	16336521,6	12771044	12202506	11551206
		1A2	Industry	030100	190892	125060	102180	108420			34684	52728	26728	
	RESIDUAL OIL	1A1	Electricity and heat production	010100	774830	364138	1742448	741228						
				010101	7171572,6	10052580	8691120	8420050	22142391,6	11174240,6	16072213,3	7736420	11557361	7213503
				010102	42264,6	16950	27100	24390	180489,8	253891,4	443478,7	420683	510374,3	762923
				010103					252297	173028	201180	159318	115535	101551
				010104					320163	347198	237194	302167	355440	118177

fuel_type	fuel_gr_abbr	NFR	nfr_name	snap_id	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
				010105	9332	9332	9332	9332	11554	4323	4888	2415	5984	4136
				010200	2006000	2236000	1141000	879000						
				010202					134116	172981	171394,6	140565	102376	135957
				010203					858909	938696	1201058	874538	779146	961623
			Petroleum refining	010306	1309202	2038140	3568653	3490237	3336716,8	2333786,8	2244019,4	1622382	1106086	1089501
		1A2	Industry	030100	16531282	19002497	18556701	14527324	12587628	10217307	10610245	9222966	9120750	8682720
				030102					741775	911132,6	788577,5	789663	663124	695536
				030103					200248	207326	165590	122783	121633	135661
				030104								54439		
				030311	1762853,4	2152997	2366678	2397243,2	2618777	2840310,6	1771379	1863965	2538540	885967
		1A4	Commercial/ Institutional	020100	1070494	865011	600545	517393	718786	677072	717757	729305	383913	450237
				020103					87533	78081				
			Residential	020200	216927	218605	167748	129878	95249	62794	66254	45933	43266	50365
			Agriculture/ Forestry	020300	1223716	1295951	1634018	1687023	1942109	2616552	3070976	2492455	2563430	2396266
				020302									9051	1105
				020304									9345	11104
OTHER 1	MUNICIP. WASTES	1A1	Electricity and heat production	010100	706761	2543625,7	4123982,74	6328376,19						
				010101									1000233,809	992599,3489
				010102					3834791,854	4995772,689	5554763,664	8411444,358	9097580,918	13153371,81
				010103					2183493,152	2874282,127	3884839,572	2387482,925	1519788,648	3136573,219
				010104					1249719,595	1551907,436	2478786,59	2349269,469	2179406,43	1904687,803
				010200	9685481,3	8668173,8	8214695,63	7383480,77						
				010201					5238,0014					
				010202					2605709,084	2834480,562	3607994,153	3610340,715	3585970,395	
				010203					4434077,748	4255021,63	2872498,261	3089448,622	2685493,992	2264006,742
		1A2	Industry	030100	20012,7587	20012,7587	27540,78183	29196,98001	19763,32448	21826,1464	21698,91894	18526,63049	22407,15078	27402,82559
		1A4	Commercial/ Institutional	020100	652504,6	721752,9	791822,43	824722,57	887273,9122	975541,3354	949283,8274	916117,2993	551310,3401	1143611,928
				020103					22925,6365	23668,4642	7451,18915	6196,25203	7445,75316	5703,13008
SOLID	BROWN COAL BRI.	1A2	Industry	030100	4374	6680	3806	17714	2745	2031	1464	1025		
		1A4	Commercial/ Institutional	020100	1025	1720		8217	769	622	421	309		
			Residential	020200	50600	66685	39107	80209	75963	62403	47324	48550	43847	37607
			Agriculture/ Forestry	020300	59932	91738	52411	22106	12023	9553	6844	4447	3898	
	COAL	1A1	Electricity and heat production	010100	8523090	12892052	10175750	8221270						
				010101	219780959	303105248	252745120	269458670	295430107,5	244510483	347251766	252648133	211429498	176640613
				010102	2118950,9	2653700	2250130	2269060	8604698,5	8380812,5	9032904,5	8671429	9022776	8238010
				010103					837469	526213	149470	38928	24300	33747
				010104					272428	269521	301136	74422		
				010105					20360					
				010200	6017000	6635000	5173000	3581000						
				010201					153003	20286				
				010202					1112251	789684	199724	64713	17914	371
				010203					377837	316754	228340	48919	48071	6562
		1A2	Industry	030100	8850301	8977254	6751419	7698631	5866929	4832666	4460978	4494493	4676030	3714901
				030102					614624	1051344	1449890	1466575	1405667	1411682
				030103					190179	182609	192925	192444		
				030311	5018873,4	6048697	6577274	6602369	6913652	7224933,5	7067608,6	7209034	6627624	5638061
		1A4	Commercial/ Institutional	020100	87539	9010	95877	75870	90286	66064	41260	43062	2306	
			Residential	020200	589051	1125243	866285	785646	618696	376644	85595	86470	127147	79262
			Agriculture/ Forestry	020300	2457889	2853705	2203581	2106300	2294953	1797999	1446423	1238716	903570	708372
	COKE OVEN COKE	1A2	Industry	030100	1169318	1351052	1077654	1073318	1163151	286685	303658	295421	319382	380768
				030318						937440	885600	930960	1006560	1030320
		1A4	Residential	020200	106594	98682	103400	81220	62995	48784	36742	26634	20364	11486
	PLASTIC WASTE	1A1	Electricity and heat production	010100	283239	1019374,3	1454017,26	2104623,81						
				010101									287781,1915	285584,6511
				010102					1275334,146	1531236,311	1598182,836	2420089,642	2617500,682	3784408,185
				010103					726162,8479	880985,8728	1117722,428	686912,0749	437264,3518	902435,7809
				010104					415618,4047	475669,5642	713181,4102	675917,5314	627045,5704	548005,197

fuel_type	fuel_gr_abbr	NFR	nfr_name	snap_id	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
				010200	3881518,7	3473826,2	2896304,37	2455519,23						
				010201					1741,9986					
				010202					866578,9162	868786,4382	1038070,147	1038745,285	1031733,605	
				010203					1474638,252	1304191,37	826457,7391	888877,3782	772654,0076	651386,258
		1A2	Industry	030100	8020,2413	8020,2413	9710,21817	9710,01999	6572,67552	6689,8536	6243,08106	5330,36951	6446,84922	7884,17441
		1A4	Commercial/ Institutional	020100	261495,4	289247,1	279177,57	274277,43	295080,0878	299009,6646	273122,1726	263579,7007	158619,6599	329033,0724
				020103					7624,3635	7254,5358	2143,81085	1782,74797	2142,24684	1640,86992

fuel_gr_abbr	NFR	nfr_name	snap_id	2000	2001	2002	2003	2004	2005	2006	2007
BIOGAS	1A1	Electricity and heat production	010102	25771	23338	20466	21787	16857	17439	16560	15827
			010103	134968	123991	90125	97272	78245	69932	105259	108688
			010105	1548734	1589322	1686300	1704661	1435085	1535656	1287413	1417509
			010203	21733	11129	12650	17130	23466	40546	17297	17601
			010205					36380	110366	155450	148721
		Other energy industries	010505	32507	28627	31216	31791	61257	100137	115743	98052
	1A2	Industry	030100	32593	27929	37953	33614	45593	142521	136853	145385
			030102	15755	59220	71672	95546	112700	48144	51665,74	34543,46
			030105	1487	23805	18459	14205	16947		103779	73148
	1A4	Commercial/ Institutional	020100	310904	354917	424989	321897	426323	473892	578066	657955
			020103	86680	84512	74286	85295	101260	354647	137540	101606,4
			020105	506512	504222	528119	531465	517152	543650	501074	421085
		Agriculture/ Forestry	020300	76487	80321	96277	134632	169187	84327	296083	325166
			020304	76539	108819	239386	455766	411338	408883	475369	348717
FISH & RAPE OIL	1A1	Electricity and heat production	010101								24669
			010102					521	1765		30122
			010103				2168	54570	151598	254209	276943
			010105					1819			
			010202				18807	4662	21230	23554	33200
			010203	48900	190810	126336	237665	588875	556556	691920	469419
	1A2	Industry	030100						193	5	
			030105			334	242		159	322	140
	1A4	Commercial/ Institutional	020105								896
		Agriculture/ Forestry	020304	146	665	102					
SEWAGE SLUDGE	1A2	Industry	030311	40162	375148	64508	55369	58266	58000		
STRAW	1A1	Electricity and heat production	010101	1119600	1587710	2643060	3191917	4366424	4088038	4421693	4473730
			010102	1826796	1746166	1640945	1712033	1815157	1765236	1488982,78	1448163
			010103	640340	1905033	1754340	1927521	1336411	1393993	1357693	1258569,5
			010104		101730	1215692	1706623	2476858	3118372	3174908,55	3098655
			010202	150510	97600			95414	95677	81998	88091
			010203	3290636	3418313	3555625	3338866	3007005	3180273	3257991	3122243
	1A2	Industry	030105	386	91						
	1A4	Residential	020200	3111555	2901450	2901450	2901450	2901450	2901450	2904930	2901450
		Agriculture/ Forestry	020300	2074370	1934300	1934300	1934300	1934300	1934300	1936620	1934300
			020302	5800	5800	5800	5800	5800	5820		5660
WOOD	1A1	Electricity and heat production	010101		920	65930	304980	231380	1246768	694801	621639
			010102	2274825	2186568	3175531	5854505	5626990	5965503	6354629,61	6086336,5
			010103	669817	747047	780122,8	446474	1061917	1078638	1128621	897366
			010104			120031	1656898	4488031	4478887	2608712,53	3758121
			010105	53468	60394	61748	369				
			010202	179937	249689	164347	196112	620370	416918	600053	581146
			010203	3882223	4297719	4650874	5066279	4798365	5017547	5312447	5394838
	1A2	Industry	030100	4450170	4596137	3313464	3534374	3425751	3763358	3784171	4178948
			030102	955	950					8586	1062759
			030103	439542	430608	410827	294774	342172	527045	521165	146610
	1A4	Commercial/ Institutional	020100	775926	665349	672399	680509	681209	816284	951627	1012405
			020105		97	796		110	145	338	1171
		Residential	020200	14624521	17483859	18067157	20855031	22274480	26399876	29423842	36107769

fuel_gr_abbr	NFR	nfr_name	snap_id	2000	2001	2002	2003	2004	2005	2006	2007
		Agriculture/ Forestry	020300	170093	147164	147000	111720	98280	86520	86520	86520
			020304	216	435						
NATURAL GAS	1A1	Electricity and heat production	010100	14558	11364	2	1188	1521		6126	27109
			010101	23541558,1	20514966	19246614	20165293	19287200	18925039	20812861,93	13886528
			010102	1589836	4250088	2893467,75	1877463	1581768	2007214	1080451,51	1469274,71
			010103	683789	733694	657392,37	1057907	837246	1651123	2238105,61	3195651,95
			010104	22973677,54	25003004,9	30030786,36	29928352	30713112	25116344	31959340,2	25440821,83
			010105	25639911	27865345	27701651	27012113	26392308	23502420	20418631	16283549
			010202	217700	286968	291201	278471	428248	319699	122889	251259
			010203	1427019	1768484	1482319	1849960	1611725	2256093	2136355	2140919
			010205	203414	228049	207211	171691	473922	552369	852803	302166
		Other energy industries	010502	340513,76	352650,31	379362,15	322830,99	360596,14	324727	379490,91	348025,1
			010504	25015663	24413386	26179968	26247274	27066780	27790542	28342254	28130892
			010505	13889	11887	11473	12396	12395	9150	7553	4708
	1A2	Industry	030100	28607521	30958244	29348181	28370078	26869444	27736761	27625245	29221598
			030102	2690206	2869051,5	1190135,91	2273628	2295787	2199817	2292944,76	1572608,78
			030103	116411	117965	14707	118562	124427	189988	130672	171882
			030104	6756339	6138931	6724144	6526151	6632596	5965285,12	4710799,26	4395576,71
			030105	1556394	1641970	1545466	1543942	1570267	1256372	951540	465230
			030106	50809	53712	25558	17229	22029	2196	2899	
			030315	1101274	1089048	1016242	945777	911205	874446	827157	833656
			030318	629280	588960	524160	552240	606880	557280	556560	631440
	1A4	Commercial/ Institutional	020100	7233923	7323256	7623549	9215179	9200426	9744985	10727760	10220750
			020103	43211	67208	165296	11053	50446	36133	24575	17402
			020104	23335	31001	42862	33669	22070	13397	39915	23970
			020105	1033132	1044813	1079590	1023163	1033012	861729	946464	832242
		Residential	020200	27568914	29262248	28081591	30023311	29857726	29523597	28541836	26639574
			020202	55319	69007	30105	63281	63692	17611	26392	21346
			020204	1439173	1450266	1392257	1451228	1475531	1466761	1499188	1254324
		Agriculture/ Forestry	020300	2383877	2687167	2543009	2319515	2257935	2248231	2008129	1897025
			020303	61906	59503	64374	53821	53805	57534	42023	29343
			020304	3109418	2934589	3116038	2855572	2863595	2493976	1811203	1165871
GAS OIL	1A1	Electricity and heat production	010101	135602,22	122718	92395	956997	220146	186474,23	476346,34	562765
			010102	278595	366847	279069,26	114717	138782	116061	93879,89	136248,24
			010103		34258	36567	16629	14604	22221	50943	4459,11
			010104	103191	40026	75242	79241	80590	125545	80601,32	96640
			010105	68733	84634	66390	63501	106919	72995	59934,03	46404
			010201					92649	52791	20717	25406
			010202	694229	830045	166763	256178	418842	178478	163714	304245
			010203	233116	354842	306816	1125856	492537	366718	301272	246371,4
			010204						7924	5882	7689
			010205					5416	574	865	865
		Petroleum refining	010306				3085	9469	2403	9613,01	8429,15
		Other energy industries	010505			151	116	114	172	98	69
	1A2	Industry	030100	2184437	3010994	2369234	2665880	2551498	1693595	664764	1600
			030102	3138	5071	222	3574	2830	3313	13021,16	10626,28
			030103	82107	19	165				7	
			030104	51		896,7			1848	83	225
			030105	103	511						
			030106	8070	9828	7066	6887	8716	9218	7353	
			030315	1650	2009	681	933	3802	6851	554	338
	1A4	Commercial/ Institutional	020100	4957566	4685349	4031236	4288708	4411382	3754635	3028642	1674929
			020103	71306	44010	43889,5	29646	19369	47991	31510,04	15852,76
			020105	1277	673	743	727	756	1538	803	1191
		Residential	020200	30275667	31506271	28997757	27027087	25290533	23863456	21196989	18660380
		Agriculture/ Forestry	020300	2156405	2566813	2193392	2309294	2049684	1335297	590044	
			020304	4774	2723	4846	6315		2073	22	4355
KEROSENE	1A2	Industry	030100	7552	25543	65146	48233	19836	13433	19279	13781

fuel_gr_abbr	NFR	nfr_name	snap_id	2000	2001	2002	2003	2004	2005	2006	2007
	1A4	Commercial/ Institutional	020100	63008	79642	69668	74131	76734	100870	58700	15253
		Residential	020200	91190	159051	110143	205243	110525	158320	136284	85737
		Agriculture/ Forestry	020300	8213	22550	11171	10823	7482	7621	6960	4106
LPG	1A1	Electricity and heat production	010101							108	
			010203	246					20		
	1A2	Industry	030100	1019122	761460	677846	730090	749425	739902	774840	492647
	1A4	Commercial/ Institutional	020100	121621	119345	136552	169985	214880	217661	210757	198786
			020105					21	9	90	1
		Residential	020200	650995	648947	607682	596053	650748	667241	688592	669326
		Agriculture/ Forestry	020300	93329	80125	55378	58087	53466	46476	45610	27045
ORIMULSION	1A1	Electricity and heat production	010101	34148181	30243677	23846404	1921399	18719			
PETROLEUM COKE	1A1	Electricity and heat production	010102					7130	1840		
	1A2	Industry	030100	285426	127929	223785	229902	180642	162602	163186	
			030311	6474742,8	7656728	7543476	7714392	8187958	7796337	8283791	9109000
	1A4	Commercial/ Institutional	020100	12070	12086	5355	9003		65455	8770	13757
		Residential	020200	513190	513393	509008	762464	1004800	1314544	1263840	1292341
		Agriculture/ Forestry	020300	6154	3328	31	754				
REFINERY GAS	1A1	Petroleum refining	010304	3907567	3978922	3855200	3804097	3796653	3219243	3533411	4357769
			010306	11648701	11776506	11341800	12750415	12093923	12127828,6	12582220,6	11558494,9
RESIDUAL OIL	1A1	Electricity and heat production	010101	4045724	5950549	5018057	7329328	5577981	5460921	4346080,41	5501698
			010102	513002	253635	278953	334256	595816	591328	884042,22	809557
			010103	108599	117384	120150	106040	17155			
			010104	117319	1767903	6694775	9358988	7484444	6336347	8396895,81	4501300
			010105	17206	533	656	5900	1681			
			010202	58729	86854	122795	83920	34421	26790	29550	56287
			010203	617493	611104	547566	323210	187263	259996	101773	85136
		Petroleum refining	010306	1322995	1442929	1362640	907082	1071635	690601,34	619384,48	821943
	1A2	Industry	030100	8156730	7629109	8617100	6610417	6144393	5040765	7764097	6016926
			030102	714098,55	791893,05	808652	1644621	1690130	1898209,2	1606035,2	1416846,5
			030103	140375	89987						
			030105		22	10	787	302	4949	28	
			030311	858853,2	501846	591804	587464	817378	694301	978754	1056000
	1A4	Commercial/ Institutional	020100	343022	173185	478286	170881	107544	120604	252003	234478
		Residential	020200	35611	26881	148870	47430	44417	48504	195015	12702
		Agriculture/ Forestry	020300	1778526	1640210	1365228	910801	720074	759139	903812	640319
			020302	3269	2069	1964	6081	5265	7068	17002	32385
			020304	4017	4570	3335	3417				
MUNICIP. WASTES	1A1	Electricity and heat production	010101	955849,7268	2181400,661	2719649,094	111391,2008				
			010102	14215671,19	13902383,68	14757023,69	17491557,42	19197071,33	19296004,02	20140015,94	20535243,62
			010103	6493126,199	6479050,091	6462179,807	6094679,004	6123453,252	6316218,117	6453597,077	6603369,163
			010104	323810,2758			485641,2512			51653,55355	
			010105							574863,7082	
			010203	1083772,55	1704600,66	1887340,239	1996005,446	1947214,329	1625738,423	1656643,191	2216482,988
	1A2	Industry	030100							201301,6988	
			030102				3573,77514	2774,68461	3100,06744	3363,32467	
			030311	392348,7908	824970,5018	1388206,627	1092162,612	1496111,029	1500333,24	1174173,84	1276681,08
	1A4	Commercial/ Institutional	020100	94865,7912			1006750,007	85395,52005	181613,3196	564074,0446	
			020103	10693,3689	9838,36533	9780,060454	58106,85025	58902,8345	134051,5134	141879,339	37834,4904
BROWN COAL BRI.	1A4	Residential	020200	25748	32903	18922	3056				
COAL	1A1	Electricity and heat production	010101	146911420	158990462	161608390	225396935	167930883	140018854	218346519,5	180898293
			010102	6224846	4970502	4684578	4578267	4511500	4048151	3288908	3050071
			010103	35480	24354	15476	33831	23637			
			010202	371	1494	363	371	636	3519		19257
			010203	3551	439				375		
	1A2	Industry	030100	3667193	3554471	2126818	2826288	3338374	2724083	2526876	2716428
			030102	1063375	997380,5	998228,9	1569871	1498728	1498977	1430721,7	1372444,26
			030311	5708047	4522597	4348589	3368675	3754171	3916553	4364609	4030000

fuel_gr_abbr	NFR	nfr_name	snap_id	2000	2001	2002	2003	2004	2005	2006	2007
	1A4	Commercial/ Institutional	020100					1298			
		Residential	020200	14442	12906	15370	318	292	7738	3975	6572
		Agriculture/ Forestry	020300	1079212	1234026	856215	1203478	1437068	1786868	2004275	2052875
			020304						2805		
COKE OVEN COKE	1A2	Industry	030100	238247	223280	279401	276382	302127	240691	245771	206436
			030102								37065
			030318	943920	883440	786240	693360	814320	738720	764640	876960
	1A4	Residential	020200	5010	2871	2813	25667	26604	293	147	1846
PLASTIC WASTE	1A1	Electricity and heat production	010101	275011,2732	627619,3386	782480,9059	32048,7992				
			010102	4090046,506	3999909,325	4245801,156	5032564,578	5523264,672	5551728,984	5794562,964	5908275,47
			010103	1868162,801	1864112,909	1859259,093	1753523,996	1761802,748	1817263,883	1856789,723	1899881,237
			010104	93164,72425			139725,7488			14861,44645	
			010105							165396,2918	
			010203	311816,4503	490437,3403	543014,0612	574278,5541	560240,6707	467747,577	476639,309	637713,0123
	1A2	Industry	030100							57917,30117	
			030102				1028,22486	798,31539	891,93256	967,67533	
			030311	112884,2092	237355,4982	399406,3726	314230,388	430451,9711	431666,76	337826,16	367318,92
	1A4	Commercial/ Institutional	020100	27294,2088			289655,9926	24569,47995	52252,68038	162291,9554	
			020103	3076,6311	2830,63467	2813,859546	16718,14975	16947,1655	38568,4866	40820,661	10885,5096

Appendix 2A-4 Lower Calorific Value (LCV) of fuels

Table 2A-31 Time-series for calorific values of fuels (Danish Energy Authority, DEA 2009b).

		1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Crude Oil, Average	GJ / 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
		34,80	34,80	34,80	34,80	34,80	34,80	34,80	34,80	34,80	34,80
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
		35,87	35,87	35,87	35,87	35,87	35,87	35,87	35,87	35,87	35,87
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
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
Bioethanol	GJ / ton	26,70	26,70	26,70	26,70	26,70	26,70	26,70	26,70	26,70	26,70
Biodiesel	GJ / ton	37,60	37,60	37,60	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	37,20	37,20	37,20

Continued		2000	2001	2002	2003	2004	2005	2006	2007
Crude Oil, Average	GJ / ton	43,00	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	41,80
Crude Oil, North Sea	GJ / ton	43,00	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	42,70
Refinery Gas	GJ / ton	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
Naphtha (LVN)	GJ / ton	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
Aviation Gasoline	GJ / ton	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
Other Kerosene	GJ / ton	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
Gas/Diesel Oil	GJ / ton	42,70	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	40,65
Orimulsion	GJ / ton	27,62	27,64	27,71	27,65	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	31,40
Waste Oil	GJ / ton	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
Bitumen	GJ / ton	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
Natural Gas	GJ / 1000 Nm3	40,15	39,99	40,06	39,94	39,77	39,67	39,54	39,59
Town Gas	GJ / 1000 m3	17,01	16,88	17,39	16,88	17,58	17,51	17,20	17,14
Electricity Plant Coal	GJ / ton	24,80	24,90	25,15	24,73	24,60	24,40	24,80	24,40
Other Hard Coal	GJ / ton	26,50	26,50	26,50	26,50	26,50	26,50	26,50	26,50
Coke	GJ / ton	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
Straw	GJ / ton	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
Firewood, Hardwood	GJ / m3	9,30	9,30	9,30	9,30	9,30	9,30	9,30	9,30
Firewood, Conifer	GJ / m3	10,40	10,40	10,40	10,40	10,40	10,40	10,40	10,40
Wood Pellets	GJ / ton	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
Wood Waste	GJ/Rummeter	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	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	10,50
Bioethanol	GJ / ton	26,70	26,70	26,70	26,70	26,70	26,70	26,70	26,70
Biodiesel	GJ / ton	37,60	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	37,20

Table 2A-32 Fuel category correspondence list, Danish Energy Authority, NERI and Climate convention reportings (IPCC).

Danish Energy Authority	NERI Emission database	IPCC fuel category
Other Hard Coal	Coal	Solid
Coke	Coke oven coke	Solid
Electricity Plant Coal	Coal	Solid
Brown Coal Briquettes	Brown coal briq.	Solid
Orimulsion	Orimulsion	Liquid
Petroleum Coke	Petroleum coke	Liquid
Fuel Oil	Residual oil	Liquid
Waste Oil	Residual oil	Liquid
Gas/Diesel Oil	Gas oil	Liquid
Other Kerosene	Kerosene	Liquid
LPG	LPG	Liquid
Refinery Gas	Refinery gas	Liquid
Town Gas	Natural gas	Gas
Natural Gas	Natural gas	Gas
Straw	Straw	Biomass
Wood Waste	Wood and simil.	Biomass
Wood Pellets	Wood and simil.	Biomass
Wood Chips	Wood and simil.	Biomass
Firewood, Hardwood & Conifer	Wood and simil.	Biomass
Waste Combustion	Municip. wastes	Biomass [1)]
Fish Oil	Fish & Rape oil	Biomass
Biogas	Biogas	Biomass
Biogas, other	Biogas	Biomass
Biogas, landfill	Biogas	Biomass
Biogas, sewage sludge	Biogas	Biomass

[1)] CO_2 from plastic part included in Other fuels

Appendix 2A-5 Emission factors

Table 2A-33 SO_2, NO_x, NMVOC and CO emission factors and references 2007.

Fuel	IPCC sector	SNAP	SO_2 g pr GJ	Ref.	NO_x g prGJ	Ref.	NMVOC g pr GJ	Ref.	CO g pr GJ	Ref.
COAL	1A1a	010101, 010102	40	18	98	18	1.5	1	10	3
COAL	1A1a, 1A2, 1A4c	010202, 030100, 020300	574	19	95	4	15	1	10	1
COAL	1A4b	020200	574	19	95	4	15	1	2000	32
COKE OVEN COKE	1A2	030100	574	29	95	29	15	29	10	29
COKE OVEN COKE	1A4b	020200	574	29	95	29	15	29	2000	29
PETROLEUM COKE	1A4a, 1A4b	020100, 020200	605	20	50	1	1.5	1	1000	1
WOOD AND SIMIL.	1A1a	010102, 010103, 010104	1.74	31	69	31	3.3	31	79	31
WOOD AND SIMIL.	1A1a, 1A2	010202, 010203, 030100, 030102, 030103	25	22, 21	90	22, 21, 4	48	1	240	4
WOOD AND SIMIL.	1A4a, 1A4c	020100, 020105, 020300	25	22, 21	90	22, 21, 4	600	1	240	4
WOOD AND SIMIL.	1A4b	020200	25	22, 21	120	22	540	39	3441	39
MUNICIP. WASTES	1A1a	010102, 010103	23.9	31	124	31	0.98	31	7.4	31
MUNICIP. WASTES	1A1a, 1A4a	010203, 020103	67	9	164	9	9	1	10	9
STRAW	1A1a	010101, 010102, 010103, 010104	47.1	31	131	31	0.8	31	63	31
STRAW	1A1a, 1A4c	010202, 010203, 020302	130	5	90	4, 28	50	1	325	4, 5
STRAW	1A4c	020300	130	5	90	4, 28	600	1	4000	1,6,7
STRAW	1A4b	020200	130	5	90	4, 28	400	41	4000	1,6,7
RESIDUAL OIL	1A1a	010101, 010102, 010104	206	18	98	18	3	1	15	3
RESIDUAL OIL	1A1a, 1A4a, 1A4b, 1A4c	010202, 010203, 020100, 020200, 020300, 020302	344	25, 10, 24	142	4	3	1	30	1
RESIDUAL OIL	1A1b	010306	537	33	142	4	3	1	30	1
RESIDUAL OIL	1A2	030100, 030102	344	25, 10, 24	130	28	3	1	30	1
GAS OIL	1A1a	010101, 010102	23	27	249	18	1.5	1	15	3
GAS OIL	1A1a, 1A2	Gas turbines: 010104, 010204, 030104	23	27	350	9	2	1	15	3
GAS OIL	1A1a, 1A1c, 1A4a, 1A4c	Engines: 010105, 010205, 010505, 020105, 020304	23	27	700	1	100	1	100	1
GAS OIL	1A1a	010103	23	27	65	28	1.5	1	15	3
GAS OIL	1A1a, 1A1b, 1A2f	010201, 010202, 010203, 010306, 030100, 030102	23	27	65	28	1.5	1	30	1
GAS OIL	1A4a, 1A4c	020100, 020103	23	27	52	4	3	1	30	1
GAS OIL	1A4b	020200	23	27	52	4	3	1	43	1
KEROSENE	all	all	5	30	50	1	3	1	20	1
FISH & RAPE OIL	1A1a	010101, 010102, 010103	1	37	220	38	1.5	15	15	15
FISH & RAPE OIL	1A1a	010202, 010203	1	37	65	15	1.5	15	15	15
FISH & RAPE OIL	1A2, 1A4c	030105, 020105	1	37	700	15	100	15	100	15
NATURAL GAS	1A1a	010100, 010101, 010102	0.3	17	97	9	2	14	15	3
NATURAL GAS	1A1a, 1A2f, 1A4a, 1A4c	Gas turbines: 010104, 030104, 020104, 020303	0.3	17	124	31	1.4	31	6.2	31
NATURAL GAS	1A1a, 1A1c, 1A2, 1A4a, 1A4b, 1A4c	Gas engines: 010105, 010205, 010505, 030105, 020105, 020204, 020304	0.3	17	148	40	105	40	115	40
NATURAL GAS	1A1a, 1A2	010103, 010202, 010203, 030100, 030103	0.3	17	42	36	2	14	28	4
NATURAL GAS	1A1c	010504	0.3	17	250	1, 8, 32	1.4	31	6.2	31
NATURAL GAS	1A4a, 1A4c	020100, 020103, 020300	0.3	17	30	1, 4, 11	2	14	28	4
NATURAL GAS	1A4b	020200, 020202	0.3	17	30	1, 4, 11	4	11	20	11
LPG	1A2	030100	0.13	23	96	32	2	1	25	1
LPG	1A4a, 1A4c	020100, 020105, 020300	0.13	23	71	32	2	1	25	1
LPG	1A4b	020200	0.13	23	47	32	2	1	25	1
REFINERY GAS	1A1b	010304, 010306	1	2	170	9	1.4	35	6.2	35
BIOGAS	1A1a, 1A2, 1A4a, 1A4c	010102, 010103, 010203, 030100, 020100, 020103, 020300	25	26	28	4	4	1	36	4
BIOGAS	1A1a, 1A1c, 1A2, 1A4a, 1A4c	Gas engines: 010105, 010205, 010505, 030105, 020105, 020304	19.2	31	540	31	14	31	273	31
BIOGAS	1A2	030102	25	26	59	4	4	1	36	4

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12. -
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15. Same emission factors as for gas oil is assumed (NERI assumption)
16. -
17. NERI calculation based on S content of natural gas 6mg(S)/m_n^3 gas. The S content refers to the Danish natural gas transmission company Gastra (http://www.gastra.dk/dk/index.asp)
18. Estimated by NERI based on 2007 data reported by the plant owners to the electricity transmission companies and the Danish Energy Authority. NERI calculations are based on data forwarded by the Danish Energy Authority: Nielsen M. 2008. Energistyrelsen, personal communication, e-mail 11-11-2008 and 13-11-2008.
19. NERI calculation based on a sulphur content of 0,8% and a retention of sulphur in ash of 5%. The sulphur content has been assumed just below the limit value of 0,9% (reference no. 24)
20. NERI calculation based on a sulphur content of 1% (reference no. 24) and a retention of sulphur in ash of 5%.
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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)
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34. -
35. Same emission factor as for natural gas fuelled gas turbines is assumed
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38. Assumed same emission factor as for gas oil (NERI assumption). However the emission factor is not correct – the emission factors 249 g/GJ and 65 g/GJ will be applied in future inventories.
39. Aggregated emission factor based on the technology distribution in the sector and guidebook (EEA, 2007) emission factors. Technology distribution based on: (Illerup, J. B., Henriksen, T. C., Lundhede, T., Breugel C. v., Jensen, N. Z. (2007) "Brændeovne og små kedler - partikelemissioner og reduktionstiltag". Miljøprojekt nr. 1164 2007. Miljøstyrelsen. Available on the Internet at: http://www2.mst.dk/common/Udgivramme/Frame.asp?pg=http://www2.mst.dk/Udgiv/publikationer/2007/978-87-7052-451-3/html/default.htm
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Table 2A-34 SO_2, NO_x, NMVOC and CO emission factors time-series, g/GJ.

						1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
						Data																	
pol_abbr	fuel_type	fuel_gr_abbr	nfr_id_E	nfr_name	snap_id																		
SO2	LIQUID	GAS OIL	1A1a	Electricity and heat production	010101					94	23	23	23	23	23	23	23	23	23	23	23	23	23
					010102					94	23	23	23	23	23	23	23	23	23	23	23	23	23
					010103					94	23	23	23	23	23		23	23	23	23	23	23	23
					010104	94	94	94	94	94	23	23	23	23	23	23	23	23	23	23	23	23	23
					010105	94	94	94	94	94	23	23	23	23	23	23	23	23	23	23	23	23	23
					010201					94	23									23	23	23	23
					010202					94	23	23	23	23	23	23	23	23	23	23	23	23	23
					010203					94	23	23	23	23	23	23	23	23	23	23	23	23	23
					010205					94					23					23	23	23	23
			1A1b	Petroleum refining	010306		94	94	94	94	23	23	23						23	23	23	23	23
			1A2	Industry	030100	94	94	94	94	94	23	23	23	23	23	23	23	23	23	23	23	23	23
					030103					94	23	23	23	23	23	23	23	23				23	
					030105			94	94	94						23	23						
					030106	94	94	94	94	94	23	23	23	23	23	23	23	23	23	23	23	23	
			1A4a	Commercial/ Institutional	020100	94	94	94	94	94	23	23	23	23	23	23	23	23	23	23	23	23	23
					020102					94		23		23									
					020103					94		23	23	23	23	23	23	23	23	23	23	23	23
					020105			94	94	94	23	23	23	23	23	23	23	23	23	23	23	23	23
			1A4b i	Residential	020200	94	94	94	94	94	23	23	23	23	23	23	23	23	23	23	23	23	23
			1A4c i	Agriculture/ Forestry	020300	94	94	94	94	94	23	23	23	23	23	23	23	23	23	23	23	23	
		ORIMULSION	1A1a	Electricity and heat production	010101							147	149				10	12	12	12			
		PETROLEUM COKE	1A2	Industry	030100	787		787	787		787	787	787	787	787	787	605	605	605	605	605	605	
			1A4a	Commercial/ Institutional	020100	787	787	787	787	787	787	787	787	787	787	787	605	605	605		605	605	605
			1A4b i	Residential	020200	787	787	787	787	787	787	787	787	787	787	787	605	605	605	605	605	605	605
			1A4c i	Agriculture/ Forestry	020300	787	787	787	787		787	787	787	787	787	787	605	605	605				
		REFINERY GAS	1A1b	Petroleum refining	010306	190	190	190	190												1	1	1
		RESIDUAL OIL	1A1a	Electricity and heat production	010100	446	470	490	475														
					010101						351	408	344	369	369	403	315	290	334	349	283	308	206
					010102	446	470	490	475	1564	351	408	344	369	369	403	315	290	334	349	283	308	206
					010103					1564	351	408	344	369	369	403	315	290	334	349			
					010104					1564	351	408	344	369	369	403	315	290	334	349	283	308	206
					010105	446	470	490	475	1564	351	408	344	369	369	403	315	290	334	349			
					010202					495	495	495	344	344	344	344	344	344	344	344	344	344	344
					010203					495	495	495	344	344	344	344	344	344	344	344	344	344	344
			1A1b	Petroleum refining	010306	643	38	222	389				537	537	537	537	537	537	537	537	537	537	537
			1A2	Industry	030100	495	495	495	495	495	495	495	344	344	344	344	344	344	344	344	344	344	344
					030102					495	495	495	344	344	344	344	344	344	344	344	344	344	344
					030103					495	495	495	344	344	344	344	344						
			1A4a	Commercial/ Institutional	020100	495	495	495	495	495	495	495	344	344	344	344	344	344	344	344	344	344	344
			1A4b i	Residential	020200	495	495	495	495	495	495	495	344	344	344	344	344	344	344	344	344	344	344
			1A4c i	Agriculture/ Forestry	020300	495	495	495	495	495	495	495	344	344	344	344	344	344	344	344	344	344	344
	OTHER 1	MUNICIP. WASTES	1A1a	Electricity and heat production	010100	138	116	95	73														
					010102					52	30			26	25	23,9	23,9	23,9	23,9	23,9	23,9	23,9	23,9
					010103					52	30	29	28	26	25	23,9	23,9	23,9	23,9	23,9	23,9	23,9	23,9
					010104					52	30	29	28	26	25	23,9			23,9			23,9	
					010200	138	131	124	117														
					010202					110	103												
					010203					110	103	95	88	81	74	67	67	67	67	67	67	67	67
			1A2	Industry	030100	138	131	124	117	110	103	95	88	81	74							67	
			1A4a	Commercial/ Institutional	020100	138	131	124	117	110	103	95	88	81	74	67			67	67	67	67	
					020103					110	103	95	88	81	74	67	67	67	67	67	67	67	67
	SOLID	COAL	1A1a	Electricity and heat production	010100	506	571	454	386														
					010101	506	571	454	386	343	312	420	215	263	193	64	47	45	61	42	41	37	40
					010102	506	571	454	386	343	312	420	215	263	193	64	47	45	61	42	41	37	40
					010103					343	312	420	215	263	193	64	47	45	61	42			
					010104					343	312	420	215										

						1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
						Data																	
pol_abbr	fuel_type	fuel_gr_abbr	nfr_id_E	nfr_name	snap_id																		
NOX	BIOMASS	BIOGAS	1A1a	Electricity and heat production	010105	711	696	681	665	650	635	616	597	578	559	540	540	540	540	540	540	540	540
					010205					650										540	540	540	540
			1A1c	Other energy industries	010505	711	696	681	665	650	635	616	597	578	559	540	540	540	540	540	540	540	540
			1A2	Industry	030105									578	559	540	540	540	540	540		540	540
			1A4a	Commercial/ Institutional	020105	711	696	681	665	650	635	616	597	578	559	540	540	540	540	540	540	540	540
			1A4c i	Agriculture/ Forestry	020304	711	696	681	665	650	635	616	597	578	559	540	540	540	540	540	540	540	540
		FISH & RAPE OIL	1A1a	Electricity and heat production	010200	100	95	90	85														
					010203					80	75	70	65	65	65	65	65	65	65	65	65	65	65
		WOOD	1A1a	Electricity and heat production	010202					130	130	130	130	130	90	90	90	90	90	90	90	90	90
					010203					130	130	130	130	130	90	90	90	90	90	90	90	90	90
			1A2	Industry	030100	130	130	130	130	130	130	130	130	130	90	90	90	90	90	90	90	90	90
					030102									130	90	90	90					90	90
					030103					130	130	130	130	130	90	90	90	90	90	90	90	90	90
			1A4a	Commercial/ Institutional	020100	130	130	130	130	130	130	130	130	130	90	90	90	90	90	90	90	90	90
					020105									130	90		90	90		90	90	90	90
			1A4c i	Agriculture/ Forestry	020300	130	130	130	130	130	130	130	130	130	90	90	90	90	90	90	90	90	90
					020304									130	90	90	90						
	GAS	NATURAL GAS	1A1a	Electricity and heat production	010100								115	115	115	115	115	115	115	97		97	97
					010101					115			115				115	115	115	97	97	97	97
					010102					115	115			115	115	115	115	115	115	97	97	97	97
					010104	161	157	153	149	145	141	138	134	131	127	124	124	124	124	124	124	124	124
					010105	276	241	235	214	199	194	193	170	167	167	168	168	168	168	161	154	148	148
					010205					199	194	193	170	167	167	168	168	168	168	161	154	148	148
			1A1c	Other energy industries	010505	276	241	235	214	199	194	193	170	167	167	168	168	168	168	161	154	148	148
			1A2	Industry	030104	161				145	141	138	134	131	127	124	124	124	124	124	124	124	124
					030105	276	241	235	214	199	194	193	170	167	167	168	168	168	168	161	154	148	148
			1A4a	Commercial/ Institutional	020104					145	141	138	134	131	127	124	124	124	124	124	124	124	124
					020105	276	241	235	214	199	194	193	170	167	167	168	168	168	168	161	154	148	148
			1A4b i	Residential	020204		241	235	214	199	194	193	170	167	167	168	168	168	168	161	154	148	148
			1A4c i	Agriculture/ Forestry	020303							138	134	131	127	124	124	124	124	124	124	124	124
					020304	276	241	235	214	199	194	193	170	167	167	168	168	168	168	161	154	148	148
	LIQUID	GAS OIL	1A1a	Electricity and heat production	010103					80	75	65	65	65	65		65	65	65	65	65	65	65
					010200	100	95	90	85														
					010201					80	75									65	65	65	65
					010202					80	75	70	65	65	65	65	65	65	65	65	65	65	65
					010203					80	75	70	65	65	65	65	65	65	65	65	65	65	65
			1A1b	Petroleum refining	010306		95	90	85	80	75	70	65						65	65	65	65	65
			1A2	Industry	030100	100	95	90	85	80	75	70	65	65	65	65	65	65	65	65	65	65	65
					030102						75			65	65	65	65	65	65	65	65	65	65
					030103					80	75	70	65	65	65	65	65	65				65	
					030106	100	95	90	85	80	75	70	65	65	65	65	65	65	65	65	65	65	
		ORIMULSION	1A1a	Electricity and heat production	010101							139	138				88	86	86	86			
		PETROLEUM COKE	1A2	Industry	030100	200		200	200		200	200	200	200	200	95	95	95	95	95	95	95	
		REFINERY GAS	1A1b	Petroleum refining	010306	100	100	100	100												170	170	170
		RESIDUAL OIL	1A1a	Electricity and heat production	010100	342	384	294	289														
					010101						239	250	200	177	152	129	122	130	144	131	127	109	98
					010102	342	384	294	289	267	239	250	200	177	152	129	122	130	144	131	127	109	98
					010103					267	239	250	200	177	152	129	122	130	144	131			
					010104					267	239	250	200	177	152	129	122	130	144	131	127	109	98
					010105	342	384	294	289	267	239	250	200	177	152	129	122	130	144	131			
	SOLID	BROWN COAL BRI.	1A4b i	Residential	020200	200	200	200	200	200	200	200	200	200	200	95	95	95	95				
		COAL	1A1a	Electricity and heat production	010100	342	384	294	289														
					010101	342	384	294	289	267	239	250	200	177	152	129	122	130	144	131	127	109	98
					010102	342	384	294	289	267	239	250	200	177	152	129	122	130	144	131	127	109	98
					010103					267	239	250	200	177	152	129	122	130	144	131			
					010104					267	239	250	200										
					010202					200	200	200	200	200	200	95	95	95	95	95	95		95
					010203					200	200	200	200	200	200	95	95				95		
			1A2	Industry	030100	200	200	200	200	200	200	200	200	200	200	95	95	95	95	95	95	95	95
			1A4a	Commercial/ Institutional	020100	200	200	200	200	200	200	200	200	200						95			
			1A4b i	Residential	020200	200	200	200	200	200	200	200	200	200	200	95	95	95	95	95	95	95	95
			1A4c i	Agriculture/ Forestry	020300	200	200	200	200	200	200	200	200	200	200	95	95	95	95	95	95	95	95
		COKE OVEN COKE	1A2	Industry	030100	200	200	200	200	200	200	200	200	200	200	95	95	95	95	95	95	95	95
			1A4b i	Residential	020200	200	200	200	200	200	200	200	200	200	200	95	95	95	95	95	95	95	95

						1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
						Data																	
pol_abbr	fuel_type	fuel_gr_abbr	nfr_id_E	nfr_name	snap_id																		
NMVOC	BIOMASS	WOOD	1A4b i	Residential	020200	703	703	703	703	703	703	703	703	703	703	703	630	602	599	594	570	549	540
	GAS	NATURAL GAS	1A1a	Electricity and heat production	010105	60	69	81	127	140	142	138	124	122	122	121	121	121	121	115	110	105	105
					010205					140	142	138	124	122	122	121	121	121	121	115	110	105	105
			1A1c	Other energy industries	010505	60	69	81	127	140	142	138	124	122	122	121	121	121	121	115	110	105	105
			1A2	Industry	030105	60	69	81	127	140	142	138	124	122	122	121	121	121	121	115	110	105	105
			1A4a	Commercial/ Institutional	020105	60	69	81	127	140	142	138	124	122	122	121	121	121	121	115	110	105	105
			1A4b i	Residential	020204		69	81	127	140	142	138	124	122	122	121	121	121	121	115	110	105	105
			1A4c i	Agriculture/ Forestry	020304	60	69	81	127	140	142	138	124	122	122	121	121	121	121	115	110	105	105
	LIQUID	REFINERY GAS	1A1b	Petroleum refining	010306	4	4	4	4												1,4	1,4	1,4

						1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
						Data																	
pol_abbr	fuel_type	fuel_gr_abbr	nfr_id_E	nfr_name	snap_id																		
CO	BIOMASS	BIOGAS	1A1a	Electricity and heat production	010105	230	234	239	243	248	252	256	260	265	269	273	273	273	273	273	273	273	273
					010205					248										273	273	273	273
			1A1c	Other energy industries	010505	230	234	239	243	248	252	256	260	265	269	273	273	273	273	273	273	273	273
			1A2	Industry	030105									265	269	273	273	273	273	273		273	273
			1A4a	Commercial/ Institutional	020105	230	234	239	243	248	252	256	260	265	269	273	273	273	273	273	273	273	273
			1A4c i	Agriculture/ Forestry	020304	230	234	239	243	248	252	256	260	265	269	273	273	273	273	273	273	273	273
		STRAW	1A1a	Electricity and heat production	010200	600	554	508	463														
					010202					417	371	325	325	325	325	325	325			325	325	325	325
					010203					417	371	325	325	325	325	325	325	325	325	325	325	325	325
			1A4b i	Residential	020200	8500	8500	8500	8500	8500	7500	6500	5500	4500	4000	4000	4000	4000	4000	4000	4000	4000	4000
			1A4c i	Agriculture/ Forestry	020300	8500	8500	8500	8500	8500	7500	6500	5500	4500	4000	4000	4000	4000	4000	4000	4000	4000	4000
		WOOD	1A1a	Electricity and heat production	010200	400	373	347	320														
					010202					293	267	240	240	240	240	240	240	240	240	240	240	240	240
					010203					293	267	240	240	240	240	240	240	240	240	240	240	240	240
			1A2	Industry	030100	400	373	347	320	293	267	240	240	240	240	240	240	240	240	240	240	240	240
					030103					293	267	240	240	240	240	240	240	240	240	240	240	240	240
			1A4a	Commercial/ Institutional	020100	400	373	347	320	293	267	240	240	240	240	240	240	240	240	240	240	240	240
			1A4b i	Residential	020200	4146	4146	4146	4146	4146	4146	4146	4146	4146	4146	4146	3779	3656	3659	3657	3546	3436	3441
			1A4c i	Agriculture/ Forestry	020300	400	373	347	320	293	267	240	240	240	240	240	240	240	240	240	240	240	240
	GAS	NATURAL GAS	1A1a	Electricity and heat production	010105	189	211	212	227	226	222	221	182	182	182	183	183	183	183	160	137	115	115
					010205					226	222	221	182	182	182	183	183	183	183	160	137	115	115
			1A1c	Other energy industries	010505	189	211	212	227	226	222	221	182	182	182	183	183	183	183	160	137	115	115
			1A2	Industry	030105	189	211	212	227	226	222	221	182	182	182	183	183	183	183	160	137	115	115
			1A4a	Commercial/ Institutional	020105	189	211	212	227	226	222	221	182	182	182	183	183	183	183	160	137	115	115
			1A4b i	Residential	020204		211	212	227	226	222	221	182	182	182	183	183	183	183	160	137	115	115
			1A4c i	Agriculture/ Forestry	020304	189	211	212	227	226	222	221	182	182	182	183	183	183	183	160	137	115	115
	LIQUID	REFINERY GAS	1A1b	Petroleum refining	010306	15	15	15	15												6,2	6,2	6,2
	OTHER 1	MUNICIP. WASTES	1A1a	Electricity and heat production	010200	100	85	70	55														
					010202					40	25												
					010203					40	25	10	10	10	10	10	10	10	10	10	10	10	10
			1A2	Industry	030100	100	85	70	55	40	25	10	10	10	10							10	
			1A4a	Commercial/ Institutional	020100	100	85	70	55	40	25	10	10	10	10	10			10	10	10	10	
					020103					40	25	10	10	10	10	10	10	10	10	10	10	10	10
	SOLID	COAL	1A4a	Commercial/ Institutional	020100	10	10	10	10	10	10	10	10	10						2000			

Table 2A-35 PM emission factors and references 2007.

Fuel	IPCC sector	SNAP	TSP, G pr GJ	Ref.	PM_{10} G pr GJ	Ref.	$PM_{2.5}$ G pr GJ	Ref.
COAL	1A1a	010101, 010102	3	12	2,6	12	2,1	12
COAL	1A1a	010202	6	9	6	9	5	9
COAL	1A2, 1A4b, 1A4c	030100, 020200, 020300	17	6	12	14	7	14
COKE OV.COKE	1A2, 1A4b	030100, 020200	17	16	12	16	7	16
PETROLEUM COKE	1A4a, 1A4b	020100, 020200	100	9	60	9	30	9
WOOD AND SIMIL.	1A1a	010102, 010103, 010104	7.9	3	1.94	3	1.23	3
WOOD AND SIMIL.	1A1a, 1A2f	010202, 010203, 030100, 030102, 030103	19	1	13	2	10	2
WOOD AND SIMIL.	1A4a, 1A4c	020100, 020105, 020300	143	1	143	9	135	9
WOOD AND SIMIL.	1A4b	020200	684	17	649	17	615	17
MUNICIP. WASTES	1A1a	010102, 010103	2.02	3	1.126	3	1.084	3
MUNICIP. WASTES	1A1a, 1A2, 1A4a	010203, 020103	6	10	5	11	4	11
STRAW	1A1a	010101, 010102, 010103, 010104	3.97	3	0.133	3	0.102	3
STRAW	1A1a, 1A4c	010202, 010203, 020302	21	1	15	2	12	2
STRAW	1A4b, 1A4c	020200, 020300	234	4	222	5	211	5
RESIDUAL OIL	1A1a	010101, 010102, 010104, 010202, 010203	3	9	3	9	2,5	9
RESIDUAL OIL	1A1b	010306	50	9	40	9	35	9
RESIDUAL OIL	1A2, 1A4a, 1A4b, 1A4c	030100, 030102, 020100, 020200, 020300, 020302	14	6	10,5	13	7	13
GAS OIL	all	all	5	9	5	9	5	9
KEROSENE	all	all	5	9	5	9	5	9
FISH & RAPE OIL	all	all	3	15	3	15	3	15
NATURAL GAS	1A1a, 1A1c, 1A2, 1A4a, 1A4b, 1A4c	010100, 010101, 010102, 010103, 010202, 010203, 030100, 030103, 020100, 020103, 020200, 020202, 020300	0.1	9	0.1	9	0.1	9
NATURAL GAS	1A1a, 1A1c, 1A2f, 1A4a, 1A4c	Gas turbines: 010104, 010504, 030104, 020104, 020303	0.1	3	0.061	3	0.051	3
NATURAL GAS	1A1a, 1A1c, 1A2, 1A4a, 1A4b, 1A4c	Gas engines: 010105, 010205, 010505, 030105, 020105, 020204, 020304	0.76	3	0.189	3	0.161	3
LPG	all	all	0.2	9	0.2	9	0.2	9
REFINERY GAS	1A1b	010304, 010306	5	9	5	9	5	9
BIOGAS	1A1a, 1A1c, 1A2, 1A4a, 1A4c	Gas engines: 010105, 010205, 010505, 030105, 020105, 020304	2.63	3	0.451	3	0.206	3
BIOGAS	1A1a, 1A2, 1A4a, 1A4c	010102, 010103, 010203, 030100, 030102, 020100, 020103, 020300	1.5	6	1.5	7	1.5	7

1. Danish legislation, Miljøstyrelsen 2001. Luftvejledningen, Begrænsning af luftforurening fra virksomheder, Vejledning fra Miljøstyrelsen nr 2 2001
2. Particulate size distribution for wood and straw combustion in power plants refers to the TNO CEPMEIP emission factor database 2001 (wood). Available on the internet at: http://www.air.sk/tno/cepmeip/ (25-02-2009)
3. 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://www.dmu.dk/1_viden/2_Publikationer/3_fagrapporter/rapporter/FR442.pdf (25-02-2009)
4. German, L., 2003. The Danish Technological Institute, Personal communication, rough estimate
5. Particulate size distribution for wood and straw combustion in residential plants refers to the TNO CEPMEIP emission factor database 2001 (wood). Available on the internet at: http://www.air.sk/tno/cepmeip/ (25-02-2009)
6. Danish legislation. Miljøstyrelsen 1990, Bekendtgørelse 689, 15/10/1990, Bekendtgørelse om begrænsning af emissioner af svovldioxid, kvælstofoxider og støv fra store fyringsanlæg. (and Bekendtgørelse 518/1995)
7. All TSP emission is assumed to be <2,5µm (NERI assumption)
8. -
9. The TNO CEPMEIP emission factor database 2001. Available on the internet at: http://www.air.sk/tno/cepmeip/ (25-02-2009)

10. Implied emission factor calculation based on annual environmental reports of a large number of municipal waste incineration plants, 2000
11. Particulate size distribution is unknown. The PM_{10} fraction is assumed to equal 85% of TSP and the $PM_{2.5}$ fraction is assumed to equal 70% of TSP (NERI assumption)
12. Livbjerg, H. Thellefsen, M. Sander, B. Simonsen, P., Lund, C., Poulsen, K.& Fogh, C.L., 2001. Feltstudier af Forbrænding-saerosoler, EFP -98 Projekt, Aerosollaboratoriet DTU, FLS Miljø, Forskningscenter Risø, Elsam, Energi E2 (in Danish)
13. Particulate size distribution for residual oil combustion refers to the TNO CEPMEIP emission factor database 2001. Available on the internet at: http://www.air.sk/tno/cepmeip/ (25-02-2009)
14. Particulate size distribution for coal combustion refers to the TNO CEPMEIP emission factor database 2001. Available on the internet at: http://www.air.sk/tno/cepmeip/
15. Assuming same emission factors as for gas oil (NERI assumption). The emission factor should have been 5 g/GJ. The error will be corrected in the next inventory.
16. Same emission factor as for coal is assumed (NERI assumption)
17. Illerup, J. B., Henriksen, T. C., Lundhede, T., Breugel C. v., Jensen, N. Z. (2007) "Brændeovne og små kedler - partikelemissioner og reduktionstiltag". Miljøprojekt nr. 1164 2007. Miljøstyrelsen. Available on the internet at: http://www2.mst.dk/common/Udgivramme/Frame.asp?pg=http://www2.mst.dk/Udgiv/publikationer/2007/978-87-7052-451-3/html/default.htm

Table 2A-36 PM emission factors, time series

						2000	2001	2002	2003	2004	2005	2006	2007
Pollutant	Fuel type	Fuel	CRF	CRF name	SNAP								
TSP	BIOMASS	WOOD	1A4b i	Residential	020200	883	791	756	750	744	713	687	684
PM10	BIOMASS	WOOD	1A4b i	Residential	020200	839	751	718	713	707	677	653	649
PM2,5	BIOMASS	WOOD	1A4b i	Residential	020200	795	712	680	675	670	642	619	615

Table 2A-37 HM emission factors and references 2007.

Fuel	IPCC sector	SNAP	As, mg/GJ	Ref.	Cd, mg/GJ	Ref.	Cr , mg/GJ	Reference	Cu, mg/GJ	Reference	Hg, mg/GJ	Reference	Ni, mg/GJ	Reference	Pb, mg/GJ	Reference	Se, mg/GJ	Reference	Zn, mg/GJ	Reference
COAL	all	all	3.2	1	0.1	1	2.3	1	3.1	1	1.7	1	4.4	1	6	1	0.5	1	10.5	1
COKE OV.COKE	all	all	3.2	1	0.1	1	2.3	1	3.1	1	1.7	1	4.4	1	6	1	0.5	1	10.5	1
PETROLEUM COKE	all	all	3.2	1	0.1	1	2.3	1	3.1	1	1.7	1	4.4	1	6	1	0.5	1	10.5	1
WOOD AND SIMIL.	1A1a	010102, 010103, 010104	2.34	2	0.9	2	2.34	2	2.6	2	0.72	2	2.34	2	3.62	2	-	-	136	1
WOOD AND SIMIL.	1A1a 1A2 1A4a 1A4b 1A4c	010202, 010203, 030100, 030102, 030103, 020100, 020105, 020200, 020300	-	-	6.8	1	-	-	6.8	1	6.8	1	-	-	3.4	1	-	-	136	1
MUNICIP. WASTES	1A1a	010102, 010103	6.74	2	4.73	2	2.43	2	10.03	2	7.39	2	4.71	2	123	2	-	-	359.5	1
MUNICIP. WASTES	1A1a 1A4a	010203, 020103	3.53	1	9.21	1	32.97	1	31.8	1	58.7	1	55.4	1	137.57	1			359.5	1
STRAW	1A1a	010101, 010102, 010103, 010104	2	2	0.72	2	1.52	2	1.66	2	0.53	2	1.62	2	6.12	2	-	-	8.39	1
STRAW	1A1a, 1A4b, 1A4c	010202, 010203, 020200, 020300, 020302			0.62	1	0.62	1	1.06	1	6.8	1	0.53	1	3.22	1	-	-	8.39	1
RESIDUAL OIL	all	all	14.07	1	13.5	1	33.33	1	12.96	1	4.3	1	642	1	23.46	1	12.3	1	2.72	1
GAS OIL	all	all	1.17	1	0.23	1	0.94	1	1.17	1	1.17	1	0.64	1	2.34	1	4.68	1	11.7	1
FISH & RAPE OIL	all	all	1.17	3	0.23	3	0.94	3	1.17	3	1.17	3	0.64	3	2.34	3	4.68	3	11.7	3

1. Illerup, J.B., Geertinger, A., Hoffmann, L. & Christiansen, K., 1999. Emissionsfaktorer for tungmetaller 1990-1996. Danmarks Miljøundersøgelser. 66 s. – Faglig rapport fra DMU nr. 301. (In Danish) Available on the internet at: http://www.dmu.dk/1_viden/2_Publikationer/3_fagrapporter/rapporter/fr301.pdf (26-02-2009).
2. 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://www.dmu.dk/1_viden/2_Publikationer/3_fagrapporter/rapporter/FR442.pdf (26-02-2009).
3. Assumed same emission factors as for gas oil (NERI assumption).

For large power plants combusting coal or residual oil other emission factors are applied for point sources than for area sources. The emission inventories are however mainly based on plants specific emission data from each plant. The large point source emission factors that differ from the area source emission factors are shown below.

Table 2A-38 HM emission factors 2007 for large point sources, mg/GJ. Only emission factors that differ from the area source emission factors are included.

Fuel	SNAP	As	Cd	Cr	Cu	Hg	Ni	Pb	Se	Zn
Coal	010102	3,3	0,1	8,02	4,41	2,2	6,81	6	13	10,5
Residual oil	010101, 010102	1,48	4,43	1,33	1,48	0,15	191	1,48	0,59	11,7

Time-series for emission factors for heavy metals is not constant for municipal waste. Time-series are shown in Table 2A-39. All other factors are constant in 1990-2007.

Table 2A-39 HM emission factors time-series for municipal waste, mg/GJ.

						1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
						Data																	
pol_abbr	fuel_type	fuel_gr_abbr	nfr_id_E	nfr_name	snap_id																		
As	OTHER 1	MUNICIP. WASTES	1A1a	Electricity and heat production	010100	7,82	7,207	6,74	6,74														
					010200	7,82	7,207	6,594	5,981														
			1A2	Industry	030100	7,82	7,207	6,594	5,981	5,369	4,756	4,143	3,53	3,53	3,53							3,53	
			1A4a	Commercial/ Institutional	020100	7,82	7,207	6,594	5,981	5,369	4,756	4,143	3,53	3,53	3,53	3,53			3,53	3,53	3,53	3,53	
Cd	OTHER 1	MUNICIP. WASTES	1A1a	Electricity and heat production	010100	31,32	28,161	25,003	21,844														
					010102					18,686	15,527			9,21	9,21	4,73	4,73	4,73	4,73	4,73	4,73	4,73	4,73
					010103					18,686	15,527	12,369	9,21	9,21	9,21	4,73	4,73	4,73	4,73	4,73	4,73	4,73	4,73
					010200	31,32	28,161	25,003	21,844														
			1A2	Industry	030100	31,32	28,161	25,003	21,844	18,686	15,527	12,369	9,21	9,21	9,21							9,21	
			1A4a	Commercial/ Institutional	020100	31,32	28,161	25,003	21,844	18,686	15,527	12,369	9,21	9,21	9,21	9,21			9,21	9,21	9,21	9,21	
Cr	OTHER 1	MUNICIP. WASTES	1A1a	Electricity and heat production	010100	186,1	164,224	142,349	120,473														
					010102					98,597	76,721			32,97	32,97	2,43	2,43	2,43	2,43	2,43	2,43	2,43	2,43
					010103					98,597	76,721	54,846	32,97	32,97	32,97	2,43	2,43	2,43	2,43	2,43	2,43	2,43	2,43
					010200	186,1	164,224	142,349	120,473														
			1A2	Industry	030100	186,1	164,224	142,349	120,473	98,597	76,721	54,846	32,97	32,97	32,97							32,97	
			1A4a	Commercial/ Institutional	020100	186,1	164,224	142,349	120,473	98,597	76,721	54,846	32,97	32,97	32,97	32,97			32,97	32,97	32,97	32,97	
Cu	OTHER 1	MUNICIP. WASTES	1A1a	Electricity and heat production	010100	123,49	110,391	97,293	84,194														
					010102					71,096	57,997			31,8	31,8	10,03	10,03	10,03	10,03	10,03	10,03	10,03	10,03
					010103					71,096	57,997	44,899	31,8	31,8	31,8	10,03	10,03	10,03	10,03	10,03	10,03	10,03	10,03
					010200	123,49	110,391	97,293	84,194														
			1A2	Industry	030100	123,49	110,391	97,293	84,194	71,096	57,997	44,899	31,8	31,8	31,8							31,8	
			1A4a	Commercial/ Institutional	020100	123,49	110,391	97,293	84,194	71,096	57,997	44,899	31,8	31,8	31,8	31,8			31,8	31,8	31,8	31,8	
Hg	OTHER 1	MUNICIP. WASTES	1A1a	Electricity and heat production	010100	132,42	121,889	111,357	100,826														
					010102					90,294	79,763			58,7	58,7	7,39	7,39	7,39	7,39	7,39	7,39	7,39	7,39
					010103					7,39	79,763	69,231	58,7	58,7	58,7	7,39	7,39	7,39	7,39	7,39	7,39	7,39	7,39
					010200	132,42	121,889	111,357	100,826														
			1A2	Industry	030100	132,42	121,889	111,357	100,826	90,294	79,763	69,231	58,7	58,7	58,7							58,7	
			1A4a	Commercial/ Institutional	020100	132,42	121,889	111,357	100,826	90,294	79,763	69,231	58,7	58,7	58,7	58,7			58,7	58,7	58,7	58,7	
Ni	OTHER 1	MUNICIP. WASTES	1A1a	Electricity and heat production	010100	191,96	172,451	152,943	133,434														
					010102					113,926	94,417			55,4	55,4	4,71	4,71	4,71	4,71	4,71	4,71	4,71	4,71
					010103					113,926	94,417	74,909	55,4	55,4	55,4	4,71	4,71	4,71	4,71	4,71	4,71	4,71	4,71
					010200	191,96	172,451	152,943	133,434														
			1A2	Industry	030100	191,96	172,451	152,943	133,434	113,926	94,417	74,909	55,4	55,4	55,4							55,4	
			1A4a	Commercial/ Institutional	020100	191,96	172,451	152,943	133,434	113,926	94,417	74,909	55,4	55,4	55,4	55,4			55,4	55,4	55,4	55,4	
Pb	OTHER 1	MUNICIP. WASTES	1A1a	Electricity and heat production	010100	639,024	639,024	555,449	471,873														
					010102					388,297	304,721			137,57	137,57	123	123	123	123	123	123	123	123
					010103					388,297	304,721	221,146	137,57	137,57	137,57	123	123	123	123	123	123	123	123
					010200	722,6	639,024	555,449	471,873														
			1A2	Industry	030100	722,6	639,024	555,449	471,873	388,297	304,721	221,146	137,57	137,57	137,57							137,57	
			1A4a	Commercial/ Institutional	020100	722,6	639,024	555,449	471,873	388,297	304,721	221,146	137,57	137,57	137,57	137,57			137,57	137,57	137,57	137,57	
Se	BIOMASS	STRAW	1A1a	Electricity and heat production	010101					0	0	0									0	0	1
Zn	OTHER 1	MUNICIP. WASTES	1A1a	Electricity and heat production	010100	804,88	741,254	677,629	614,003														
					010102					550,377	486,751			359,5	359,5	359,5	359,5	359,5	359,5	359,5	359,5	359,5	359,5
					010103					550,377	486,751	423,126	359,5	359,5	359,5	359,5	359,5	359,5	359,5	359,5	359,5	359,5	359,5
					010104					550,377	486,751	423,126	359,5	359,5	359,5	359,5			359,5			359,5	
					010200	804,88	741,254	677,629	614,003														
					010202					550,377	486,751												
					010203					550,377	486,751	423,126	359,5	359,5	359,5	359,5	359,5	359,5	359,5	359,5	359,5	359,5	359,5
			1A2	Industry	030100	804,88	741,254	677,629	614,003	550,377	486,751	423,126	359,5	359,5	359,5							359,5	
			1A4a	Commercial/ Institutional	020100	804,88	741,254	677,629	614,003	550,377	486,751	423,126	359,5	359,5	359,5	359,5			359,5	359,5	359,5	359,5	
					020103					550,377	486,751	423,126	359,5	359,5	359,5	359,5	359,5	359,5	359,5	359,5	359,5	359,5	359,5

Table 2A-40 PAH emission factors 2007.

Fuel	IPCC id	SNAP	Benzo(a)-pyrene µg pr GJ	Ref.	Benzo(b)-fluoranthene µg pr GJ	Ref.	Benzo(k)-fluoranthene µg pr GJ	Ref.	Indeno(1,2,3-c,d)-pyrene µg pr GJ	Ref.
COAL	1A1a	010101, 010102, 010202	0.14	4	0.29	4	0.29	4	0.28	4
COAL	1A2	030100	23	4	929	4	929	4	698	4
COAL	1A4b, 1A4c	020200, 020300	59524	4	63492	4	1984	4	119048	4
COKE OV.COKE	1A2	030100	23	4 (9)	929	4 (9)	929	4 (9)	698	4 (9)
COKE OV.COKE	1A4b	020200	59524	4 (9)	63492	4 (9)	1984	4 (9)	119048	4 (9)
PETROLEUM COKE	1A4a, 1A4b	020100, 020200	3184	5	9554	5	-	-	-	-
WOOD AND SIMIL.	1A1a	010102, 010103, 010104	3	8	2	8	2	8	2	8
WOOD AND SIMIL.	1A1a, 1A2	010202, 010203, 030100, 030102, 030103	6.46	4	1292.52	4	1292.52	4	11.56	4
WOOD AND SIMIL.	1A4a, 1A4c	020100, 020105, 020300	168707	4	221769	4	73469	4	119728	4
WOOD AND SIMIL.	1A4b	020200	125594	10	130661	10	76327	10	86045	10
MUNICIP. WASTES	1A1a	010102, 010103	0.8	8	1.7	8	0.8	8	0.9	8
MUNICIP. WASTES	1A1a, 1A4a	010203, 020103	67	5	571	5	1	5	1	5
STRAW	1A1a	010101, 010102	1.6	1	1.4	1	1	1	1.6	1
STRAW	1A1a	010103, 010104	21	8	157	8	90	8	23	8
STRAW	1A1a	010202, 010203	1529	2	3452	2	1400	2	1029	2
STRAW	1A4b, 1A4c	020200, 020300, 020302	12956	2	12828	2	6912	2	4222	2
RESIDUAL OIL	1A1a, 1A1b	010101, 010102, 010104, 010202, 010203, 010306	109.6	4	475.41	4	93.21	4	177.28	4
RESIDUAL OIL	1A2 1A4a 1A4b 1A4c	030100, 030102, 020100, 020200, 020300, 020302, 020304	80	4	42	4	66	4	160	4
GAS OIL	1A1a, 1A1b 1A1c	010101, 010102, 010103, 010104, 010105, 010201, 010202, 010203, 010205, 010306, 010505	109.6	4	475.41	4	93.21	4	177.28	4
GAS OIL	1A2 1A4a 1A4b 1A4c	030100, 030102, 030104, 020100, 020103, 020105, 020200, 020304	80	4	42	4	66	4	160	4
FISH & RAPE OIL	1A1a	010101, 010102, 010103, 010202, 010203	109.6	3	475.41	3	93.21	3	177.28	3

FISH & RAPE OIL	1A2, 1A4c	030105, 020105	80	3	42	3	66	3	160	3
NATURAL GAS	1A1a, 1A1c, 1A2, 1A4a, 1A4c	Gas turbines: 010104, 010504, 030104, 020104, 020303	1	8	1	8	2	8	3	8
NATURAL GAS	1A1a, 1A1c, 1A2f, 1A4a, 1A4b, 1A4c	Gas engines: 010105, 010205, 010505, 030105, 020105, 020204, 020304	3	8	42	8	24	8	6	8
NATURAL GAS	1A4b	020202	0.133	6	0.663	6	0.265	6	2.653	6
BIOGAS	1A1a, 1A1c, 1A2, 1A4a, 1A4c	Gas engines: 010105, 010205, 010505, 030105, 020105, 020304	1	8	1	8	0.4	8	1.1	8

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3. Same emission factors as for gas oil is assumed (NERI assumption)
4. Berdowski J.J.M., Veldt C., Baas J., Bloos J.P.J., Klein A.E. 1995, Technical Paper to the OSPARCOM-HELCOM-UNECE Emission Inventory of heavy Metals and Persistent Organic Pollutants, TNO-report, TNO-MEP – R 95/247
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8. Same emission factor as for coal is assumed (NERI assumption)
9. Aggregated emission factor based on the technology distribution in the sector and guidebook (EEA, 2007) emission factors. Technology distribution based on: (Illerup, J. B., Henriksen, T. C., Lundhede, T., Breugel C. v., Jensen, N. Z. (2007) "Brændeovne og små kedler - partikelemissioner og reduktionstiltag". Miljøprojekt nr. 1164 2007. Miljøstyrelsen. Available on the Internet at: http://www2.mst.dk/common/Udgivramme/Frame.asp?pg=http://www2.mst.dk/Udgiv/publikationer/2007/978-87-7052-451-3/html/default.htm

Time-series have been estimated for the PAH emission factors for residential wood combustion. All other emission factors are constant in 1990-2007. The time-series for residential wood combustion are shown below.

Table 2A-41 PAH emission factors time-series for residential wood combustion, µg pr GJ.

pol_abbr	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Benzo(a)pyrene	158978	158978	158978	158978	158978	158978	158978	158978	158978	158978
Benzo(b)flouranthene	169294	169294	169294	169294	169294	169294	169294	169294	169294	169294
Benzo(k)flouranthene	98916	98916	98916	98916	98916	98916	98916	98916	98916	98916
Indeno(1,2,3-c,d)pyrene	110462	110462	110462	110462	110462	110462	110462	110462	110462	110462
Continued	2000	2001	2002	2003	2004	2005	2006	2007		
Benzo(a)pyrene	158978	143819	138366	137886	137246	132394	127943	126833		
Benzo(b)flouranthene	169294	152421	145960	144786	143466	137800	133097	131168		
Benzo(k)flouranthene	98916	89076	85286	84566	83767	80458	77736	76191		
Indeno(1,2,3-c,d)pyrene	110462	99570	95544	95023	94398	90846	87681	86474		

Table 2A-42 Dioxin and HCB emission factors 2007.

fuel_type	fuel_gr_abbr	nfr_id_EA	nfr_name	snap_id	Dioxin, ng pr GJ	HCB, ng pr GJ
BIOMASS	WOOD	1A1a	Electricity and heat production	010102	1	4000
				010103	1	4000
				010104	1	4000
				010202	1	4000
				010203	1	4000
		1A2	Industry	030100	1	4000
				030102	1	4000
				030103	1	4000
		1A4a	Commercial/ Institutional	020100	400	4000
				020105	400	4000
		1A4b i	Residential	020200	422	4000
		1A4c i	Agriculture/ Forestry	020300	400	4000
	STRAW	1A1a	Electricity and heat production	010101	22	
				010102	22	
				010103	22	
				010104	22	
				010202	22	
				010203	22	
		1A4b i	Residential	020200	500	
		1A4c i	Agriculture/ Forestry	020300	400	
				020302	400	
	FISH & RAPE OIL	1A1a	Electricity and heat production	010101	0,882	
				010102	0,882	
				010103	0,882	
				010202	0,882	
				010203	0,882	
		1A2	Industry	030105	0,882	
		1A4a	Commercial/ Institutional	020105	10	
	BIOGAS	1A1a	Electricity and heat production	010102	0,025	
				010103	0,025	
				010105	0,025	
				010203	0,025	
				010205	0,025	
		1A1c	Other energy industries	010505	0,025	
		1A2	Industry	030100	0,025	
				030102	0,025	
				030105	0,025	
		1A4a	Commercial/ Institutional	020100	2	
				020103	2	
				020105	2	
		1A4c i	Agriculture/ Forestry	020300	2	
				020304	2	
OTHER 1	MUNICIP. WASTES	1A1a	Electricity and heat production	010102	61	95238
				010103	61	95238
				010203	61	95238
		1A4a	Commercial/ Institutional	020103	61	95238
GAS	NATURAL GAS	1A1a	Electricity and heat production	010100	0,025	
				010101	0,025	
				010102	0,025	
				010103	0,025	
				010104	0,025	
				010105	0,025	
				010202	0,025	
				010203	0,025	
				010205	0,025	
		1A1c	Other energy industries	010504	0,025	
				010505	0,025	
		1A2	Industry	030100	0,025	
				030103	0,025	
				030104	0,025	
				030105	0,025	
		1A4a	Commercial/ Institutional	020100	2	
				020103	2	
				020104	2	
				020105	2	
		1A4b i	Residential	020200	2	
				020202	2	
				020204	2	
		1A4c i	Agriculture/ Forestry	020300	2	
				020303	2	
				020304	2	
LIQUID	PETROLEUM COKE	1A4a	Commercial/ Institutional	020100	300	
		1A4b i	Residential	020200	800	
	RESIDUAL OIL	1A1a	Electricity and heat production	010101	0,882	
				010102	0,882	

				010104	0,882	
				010202	0,882	
				010203	0,882	
		1A1b	Petroleum refining	010306	0,882	
		1A2	Industry	030100	0,882	
				030102	0,882	
		1A4a	Commercial/ Institutional	020100	10	
		1A4b i	Residential	020200	10	
		1A4c i	Agriculture/ Forestry	020300	10	
				020302	10	
	GAS OIL	1A1a	Electricity and heat production	010101	0,882	
				010102	0,882	
				010103	0,882	
				010104	0,882	
				010105	0,882	
				010201	0,882	
				010202	0,882	
				010203	0,882	
				010204	0,882	
				010205	0,882	
		1A1b	Petroleum refining	010306	0,882	
		1A1c	Other energy industries	010505	0,882	
		1A2	Industry	030100	0,882	
				030102	0,882	
				030104	0,882	
		1A4a	Commercial/ Institutional	020100	10	
				020103	10	
				020105	10	
		1A4b i	Residential	020200	10	
		1A4c i	Agriculture/ Forestry	020304	10	
	KEROSENE	1A2	Industry	030100	0,882	
		1A4a	Commercial/ Institutional	020100	10	
		1A4b i	Residential	020200	10	
		1A4c i	Agriculture/ Forestry	020300	10	
	LPG	1A2	Industry	030100	0,025	
		1A4a	Commercial/ Institutional	020100	2	
				020105	2	
		1A4b i	Residential	020200	2	
		1A4c i	Agriculture/ Forestry	020300	2	
	REFINERY GAS	1A1b	Petroleum refining	010304	0,025	
				010306	0,025	
SOLID	COAL	1A1a	Electricity and heat production	010101	1,32	640
				010102	1,32	640
				010202	1,32	640
		1A2	Industry	030100	1,32	640
		1A4b i	Residential	020200	800	640
		1A4c i	Agriculture/ Forestry	020300	300	640
	COKE OVEN COKE	1A2	Industry	030100	1,32	
		1A4b i	Residential	020200	800	

Table 2A-43 Dioxin emission factor time-series.

Pollutant	Fuel type	Fuel	nfr_id_EA	nfr_name	SNAP	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
DIOXIN	BIOMASS	WOOD	1A4b i	Residential	020200	537	537	537	537	537	537	537	537	537	537	537
	OTHER 1	MUNICIP. WASTES	1A1a	Electricity and heat production	010100	2095	1746	1396	1047							
					010102					947	847			548	448	129
					010103					947	847	747	648	548	448	129
					010104					947	847	747	648	548	448	129
					010200	2095	1746	1396	1047							
					010202					947	847					
					010203					947	847	747	648	548	448	129
			1A2	Industry	030100	2095	1746	1396	1047	947	847	747	648	548	448	
					030102											
			1A4a	Commercial/ Institutional	020100	2095	1746	1396	1047	947	847	747	648	548	448	341
					020103					947	847	747	648	548	448	129
Pollutant	Fuel type	Fuel	nfr_id_EA	nfr_name	SNAP	2001	2002	1992	1993	1994	1995	1996	1997	1998	1999	2000
DIOXIN	BIOMASS	WOOD	1A4b i	Residential	020200	537	485	465	462	459	442	427	422	537	485	465
	OTHER 1	MUNICIP. WASTES	1A1a	Electricity and heat production	010100											
					010102	129	112	95	78	61	61	61	61	129	112	95
					010103	129	112	95	78	61	61	61	61	129	112	95
					010104	129			78			61		129		
					010200											
					010202											
					010203	129	112	95	78	61	61	61	61	129	112	95
			1A2	Industry	030100							61				
					030102				78	61	61	61				
			1A4a	Commercial/ Institutional	020100	341			78	61	61	61		341		
					020103	129	112	95	78	61	61	61	61	129	112	95

Appendix 2A-6 Implied emission factors for municipal waste incineration plants and power plants combustion coal

Table 2A-44 Implied emission factors for municipal waste incineration plants 2007.

Pollutant	Implied Emission factor	Unit
SO_2	8	g/GJ
NO_x	109	g/GJ
TSP	1.1	g/GJ
PM_{10}	0.9	g/GJ
$PM_{2.5}$	0.7	g/GJ
As	5	mg/GJ
Cd	4	mg/GJ
Cr	7	mg/GJ
Cu	12	mg/GJ
Hg	5	mg/GJ
Ni	16	mg/GJ
Pb	80	mg/GJ
Se	0.2	mg/GJ
Zn	361	mg/GJ

Table 2A-45 Implied emission factors for power plants combusting coal, 2007.

Pollutant	Implied Emission factor	Unit
SO_2	26	g/GJ
NO_x	109	g/GJ
TSP	3,4	g/GJ
PM_{10}	2.7	g/GJ
$PM_{2.5}$	2.2	g/GJ
As	0.71	mg/GJ
Cd	0.06	mg/GJ
Cr	1.06	mg/GJ
Cu	0.61	mg/GJ
Hg	0.98	mg/GJ
Ni	1.17	mg/GJ
Pb	0.93	mg/GJ
Se	6.71	mg/GJ
Zn	3.26	mg/GJ

Appendix 2A-7 Large point sources

Table 2A-46 Large point sources, fuel consumption in 2007 (1A1, 1A2 and 1A4).

nfr_id_EA	nfr_name	snap_id	lps_id	lps_name	part_id	fuel	fuel_gr_abbr	lpsrat_val
1A1a	Electricity and heat production	010101	001	Amagervaerket	02	111	WOOD	452553
1A1a	Electricity and heat production	010101	001	Amagervaerket	02	117	STRAW	881728
1A1a	Electricity and heat production	010101	001	Amagervaerket	02	203	RESIDUAL OIL	43800
1A1a	Electricity and heat production	010101	001	Amagervaerket	03	102	COAL	14149700
1A1a	Electricity and heat production	010101	001	Amagervaerket	03	203	RESIDUAL OIL	104900
1A1a	Electricity and heat production	010101	003	H.C.Oerstedsvaerket	03	203	RESIDUAL OIL	532318
1A1a	Electricity and heat production	010101	003	H.C.Oerstedsvaerket	03	204	GAS OIL	22309
1A1a	Electricity and heat production	010101	003	H.C.Oerstedsvaerket	03	215	FISH & RAPE OIL	4774
1A1a	Electricity and heat production	010101	003	H.C.Oerstedsvaerket	03	301	NATURAL GAS	5116528
1A1a	Electricity and heat production	010101	004	Kyndbyvaerket	21	204	GAS OIL	281923
1A1a	Electricity and heat production	010101	004	Kyndbyvaerket	22	203	RESIDUAL OIL	571067
1A1a	Electricity and heat production	010101	004	Kyndbyvaerket	26	203	RESIDUAL OIL	112637
1A1a	Electricity and heat production	010101	004	Kyndbyvaerket	26	204	GAS OIL	137425
1A1a	Electricity and heat production	010101	004	Kyndbyvaerket	28	203	RESIDUAL OIL	46803
1A1a	Electricity and heat production	010101	004	Kyndbyvaerket	28	204	GAS OIL	3886
1A1a	Electricity and heat production	010101	007	Stigsnaesvaerket	01	102	COAL	1264509
1A1a	Electricity and heat production	010101	007	Stigsnaesvaerket	01	203	RESIDUAL OIL	158297
1A1a	Electricity and heat production	010101	007	Stigsnaesvaerket	02	102	COAL	7999900
1A1a	Electricity and heat production	010101	007	Stigsnaesvaerket	02	203	RESIDUAL OIL	200877
1A1a	Electricity and heat production	010101	007	Stigsnaesvaerket	03	203	RESIDUAL OIL	99095
1A1a	Electricity and heat production	010101	007	Stigsnaesvaerket	03	204	GAS OIL	6152
1A1a	Electricity and heat production	010101	008	Asnaesvaerket	02	102	COAL	4539556
1A1a	Electricity and heat production	010101	008	Asnaesvaerket	02	203	RESIDUAL OIL	286726
1A1a	Electricity and heat production	010101	008	Asnaesvaerket	04	102	COAL	2132827
1A1a	Electricity and heat production	010101	008	Asnaesvaerket	04	203	RESIDUAL OIL	191138
1A1a	Electricity and heat production	010101	008	Asnaesvaerket	05	102	COAL	26551311
1A1a	Electricity and heat production	010101	008	Asnaesvaerket	05	203	RESIDUAL OIL	837640
1A1a	Electricity and heat production	010101	010	Avedoerevaerket	01	102	COAL	14002300
1A1a	Electricity and heat production	010101	010	Avedoerevaerket	01	203	RESIDUAL OIL	308000
1A1a	Electricity and heat production	010101	011	Fynsvaerket+Odense kraftvarmevaerk	03	102	COAL	7122500
1A1a	Electricity and heat production	010101	011	Fynsvaerket+Odense kraftvarmevaerk	03	203	RESIDUAL OIL	440810
1A1a	Electricity and heat production	010101	011	Fynsvaerket+Odense kraftvarmevaerk	07	102	COAL	11378390
1A1a	Electricity and heat production	010101	011	Fynsvaerket+Odense kraftvarmevaerk	07	203	RESIDUAL OIL	240930
1A1a	Electricity and heat production	010101	012	Studstrupvaerket	03	102	COAL	8030230
1A1a	Electricity and heat production	010101	012	Studstrupvaerket	03	117	STRAW	411680
1A1a	Electricity and heat production	010101	012	Studstrupvaerket	03	203	RESIDUAL OIL	195700
1A1a	Electricity and heat production	010101	012	Studstrupvaerket	04	102	COAL	16341090
1A1a	Electricity and heat production	010101	012	Studstrupvaerket	04	117	STRAW	1371740
1A1a	Electricity and heat production	010101	012	Studstrupvaerket	04	203	RESIDUAL OIL	334880
1A1a	Electricity and heat production	010101	014	Nordjyllandsvaerket	02	102	COAL	7155700
1A1a	Electricity and heat production	010101	014	Nordjyllandsvaerket	02	203	RESIDUAL OIL	97500
1A1a	Electricity and heat production	010101	014	Nordjyllandsvaerket	03	102	COAL	21953100
1A1a	Electricity and heat production	010101	014	Nordjyllandsvaerket	03	203	RESIDUAL OIL	116500
1A1a	Electricity and heat production	010101	018	Skaerbaekvaerket	03	204	GAS OIL	111070
1A1a	Electricity and heat production	010101	018	Skaerbaekvaerket	03	301	NATURAL GAS	8770000
1A1a	Electricity and heat production	010101	019	Enstedvaerket	03	102	COAL	19364700
1A1a	Electricity and heat production	010101	019	Enstedvaerket	03	203	RESIDUAL OIL	257310
1A1a	Electricity and heat production	010101	019	Enstedvaerket	04	111	WOOD	169086
1A1a	Electricity and heat production	010101	019	Enstedvaerket	04	117	STRAW	1808582
1A1a	Electricity and heat production	010101	019	Enstedvaerket	04	215	FISH & RAPE OIL	9820
1A1a	Electricity and heat production	010101	020	Esbjergvaerket	03	102	COAL	18912480
1A1a	Electricity and heat production	010101	020	Esbjergvaerket	03	203	RESIDUAL OIL	324770
1A1a	Electricity and heat production	010102	005	Masnedoevaerket	12	111	WOOD	86491
1A1a	Electricity and heat production	010102	005	Masnedoevaerket	12	117	STRAW	464757
1A1a	Electricity and heat production	010102	011	Fynsvaerket+Odense kraftvarmevaerk	08	114	MUNICIP. WASTES	2882000
1A1a	Electricity and heat production	010102	011	Fynsvaerket+Odense kraftvarmevaerk	08	204	GAS OIL	20000
1A1a	Electricity and heat production	010102	022	Oestkraft	05	203	RESIDUAL OIL	19218
1A1a	Electricity and heat production	010102	022	Oestkraft	06	102	COAL	590631
1A1a	Electricity and heat production	010102	022	Oestkraft	06	111	WOOD	29147
1A1a	Electricity and heat production	010102	022	Oestkraft	06	203	RESIDUAL OIL	29904
1A1a	Electricity and heat production	010102	025	Horsens Kraftvarmevaerk	01	111	WOOD	8657
1A1a	Electricity and heat production	010102	025	Horsens Kraftvarmevaerk	01	114	MUNICIP. WASTES	920885
1A1a	Electricity and heat production	010102	026	Herningvaerket	01	111	WOOD	2713530
1A1a	Electricity and heat production	010102	026	Herningvaerket	01	203	RESIDUAL OIL	111850
1A1a	Electricity and heat production	010102	026	Herningvaerket	01	301	NATURAL GAS	799604
1A1a	Electricity and heat production	010102	027	I/S Vestforbraending	01	114	MUNICIP. WASTES	2003946
1A1a	Electricity and heat production	010102	027	I/S Vestforbraending	01	204	GAS OIL	21449
1A1a	Electricity and heat production	010102	027	I/S Vestforbraending	02	114	MUNICIP. WASTES	676001
1A1a	Electricity and heat production	010102	027	I/S Vestforbraending	02	301	NATURAL GAS	13707
1A1a	Electricity and heat production	010102	027	I/S Vestforbraending	03	114	MUNICIP. WASTES	2772242
1A1a	Electricity and heat production	010102	027	I/S Vestforbraending	03	301	NATURAL GAS	25548
1A1a	Electricity and heat production	010102	028	Amagerforbraending	01	114	MUNICIP. WASTES	4390281
1A1a	Electricity and heat production	010102	029	Energi Randers Produktion	01	102	COAL	1932510

Continued								
1A1a	Electricity and heat production	010102	029	Energi Randers Produktion	01	111	WOOD	1114443
1A1a	Electricity and heat production	010102	029	Energi Randers Produktion	01	309	BIOGAS	15827
1A1a	Electricity and heat production	010102	029	Energi Randers Produktion	02	204	GAS OIL	62920
1A1a	Electricity and heat production	010102	030	Grenaa Kraftvarmevaerk	01	102	COAL	526930
1A1a	Electricity and heat production	010102	030	Grenaa Kraftvarmevaerk	01	111	WOOD	8991
1A1a	Electricity and heat production	010102	030	Grenaa Kraftvarmevaerk	01	117	STRAW	563406
1A1a	Electricity and heat production	010102	030	Grenaa Kraftvarmevaerk	01	203	RESIDUAL OIL	17780
1A1a	Electricity and heat production	010102	030	Grenaa Kraftvarmevaerk	01	204	GAS OIL	5129
1A1a	Electricity and heat production	010102	037	Maabjergvaerket	02	111	WOOD	336000
1A1a	Electricity and heat production	010102	037	Maabjergvaerket	02	114	MUNICIP. WASTES	1895000
1A1a	Electricity and heat production	010102	037	Maabjergvaerket	02	117	STRAW	420000
1A1a	Electricity and heat production	010102	037	Maabjergvaerket	02	301	NATURAL GAS	107604
1A1a	Electricity and heat production	010102	038	Soenderborg Kraftvarmevaerk	01	111	WOOD	2455
1A1a	Electricity and heat production	010102	038	Soenderborg Kraftvarmevaerk	01	114	MUNICIP. WASTES	714200
1A1a	Electricity and heat production	010102	039	I/S Kara Affaldsforbraendingsanlaeg	01	114	MUNICIP. WASTES	2145623
1A1a	Electricity and heat production	010102	039	I/S Kara Affaldsforbraendingsanlaeg	01	301	NATURAL GAS	8756
1A1a	Electricity and heat production	010102	042	I/S Nordforbraending	01	111	WOOD	149075
1A1a	Electricity and heat production	010102	042	I/S Nordforbraending	01	114	MUNICIP. WASTES	1334739
1A1a	Electricity and heat production	010102	046	Affaldscenter aarhus - Forbraend-sanlaegget	01	114	MUNICIP. WASTES	2499357
1A1a	Electricity and heat production	010102	053	Svendborg Kraftvarmevaerk	01	114	MUNICIP. WASTES	503126
1A1a	Electricity and heat production	010102	053	Svendborg Kraftvarmevaerk	01	301	NATURAL GAS	2235
1A1a	Electricity and heat production	010102	054	Kommunekemi	01	114	MUNICIP. WASTES	450250
1A1a	Electricity and heat production	010102	054	Kommunekemi	01	203	RESIDUAL OIL	234078
1A1a	Electricity and heat production	010102	054	Kommunekemi	01	204	GAS OIL	6743
1A1a	Electricity and heat production	010102	054	Kommunekemi	02	114	MUNICIP. WASTES	475829
1A1a	Electricity and heat production	010102	054	Kommunekemi	02	203	RESIDUAL OIL	190526
1A1a	Electricity and heat production	010102	054	Kommunekemi	02	204	GAS OIL	6887
1A1a	Electricity and heat production	010102	054	Kommunekemi	03	114	MUNICIP. WASTES	509324
1A1a	Electricity and heat production	010102	054	Kommunekemi	03	203	RESIDUAL OIL	172791
1A1a	Electricity and heat production	010102	054	Kommunekemi	03	204	GAS OIL	6169
1A1a	Electricity and heat production	010102	085	L90 Affaldsforbraending	01	114	MUNICIP. WASTES	2270717
1A1a	Electricity and heat production	010102	085	L90 Affaldsforbraending	01	204	GAS OIL	6951
1A1a	Electricity and heat production	010102	087	Koege Kraftvarmevaerk	07	111	WOOD	1637548
1A1a	Electricity and heat production	010102	087	Koege Kraftvarmevaerk	07	203	RESIDUAL OIL	33410
1A1a	Electricity and heat production	010103	036	Kolding Forbraendingsanlaeg	01	111	WOOD	2232
1A1a	Electricity and heat production	010103	036	Kolding Forbraendingsanlaeg	01	114	MUNICIP. WASTES	662760
1A1a	Electricity and heat production	010103	047	I/S Reno Nord	01	114	MUNICIP. WASTES	1930173
1A1a	Electricity and heat production	010103	047	I/S Reno Nord	01	204	GAS OIL	4459
1A1a	Electricity and heat production	010103	051	AVV Forbraendingsanlaeg	01	114	MUNICIP. WASTES	865788
1A1a	Electricity and heat production	010103	052	Affaldsforbraendingsanlaeg I/S REFA	01	114	MUNICIP. WASTES	1232994
1A1a	Electricity and heat production	010103	058	I/S Reno Syd	01	114	MUNICIP. WASTES	660849
1A1a	Electricity and heat production	010103	059	I/S Kraftvarmevaerk Thisted	01	114	MUNICIP. WASTES	539270
1A1a	Electricity and heat production	010103	059	I/S Kraftvarmevaerk Thisted	01	117	STRAW	10078
1A1a	Electricity and heat production	010103	060	Knudmosevaerket	01	114	MUNICIP. WASTES	500890
1A1a	Electricity and heat production	010103	060	Knudmosevaerket	01	301	NATURAL GAS	38413
1A1a	Electricity and heat production	010103	061	Kavo I/S Energien+Slagelse Kraftvarme-vaerk	01	114	MUNICIP. WASTES	220271
1A1a	Electricity and heat production	010103	061	Kavo I/S Energien+Slagelse Kraftvarme-vaerk	02	114	MUNICIP. WASTES	484726
1A1a	Electricity and heat production	010103	061	Kavo I/S Energien+Slagelse Kraftvarme-vaerk	02	117	STRAW	405282
1A1a	Electricity and heat production	010103	065	Haderslev Kraftvarmevaerk	01	114	MUNICIP. WASTES	614900
1A1a	Electricity and heat production	010103	065	Haderslev Kraftvarmevaerk	01	301	NATURAL GAS	15940
1A1a	Electricity and heat production	010103	066	Frederiskhavn Affaldskraftvarmevaerk	01	114	MUNICIP. WASTES	397630
1A1a	Electricity and heat production	010103	067	Vejen Kraftvarmevaerk	01	111	WOOD	2100
1A1a	Electricity and heat production	010103	067	Vejen Kraftvarmevaerk	01	114	MUNICIP. WASTES	393000
1A1a	Electricity and heat production	010104	002	Svanemoellevaerket	07	204	GAS OIL	20536
1A1a	Electricity and heat production	010104	002	Svanemoellevaerket	07	301	NATURAL GAS	4279718
1A1a	Electricity and heat production	010104	004	Kyndbyvaerket	51	204	GAS OIL	12539
1A1a	Electricity and heat production	010104	004	Kyndbyvaerket	52	204	GAS OIL	12685
1A1a	Electricity and heat production	010104	005	Masnedoevaerket	31	204	GAS OIL	17123
1A1a	Electricity and heat production	010104	010	Avedoerevaerket	02	111	WOOD	3758121
1A1a	Electricity and heat production	010104	010	Avedoerevaerket	02	117	STRAW	2510576
1A1a	Electricity and heat production	010104	010	Avedoerevaerket	02	203	RESIDUAL OIL	4501300
1A1a	Electricity and heat production	010104	010	Avedoerevaerket	02	301	NATURAL GAS	8442481
1A1a	Electricity and heat production	010104	025	Horsens Kraftvarmevaerk	02	301	NATURAL GAS	651396
1A1a	Electricity and heat production	010104	031	Hilleroed Kraftvarmevaerk	01	301	NATURAL GAS	2873789
1A1a	Electricity and heat production	010104	032	Helsingoer Kraftvarmevaerk	01	301	NATURAL GAS	1352468
1A1a	Electricity and heat production	010104	038	Soenderborg Kraftvarmevaerk	02	301	NATURAL GAS	1042438
1A1a	Electricity and heat production	010104	040	Viborg Kraftvarme	01	301	NATURAL GAS	2109698
1A1a	Electricity and heat production	010104	048	Silkeborg Kraftvarmevaerk	01	301	NATURAL GAS	2997034
1A1a	Electricity and heat production	010104	069	DTU	01	301	NATURAL GAS	1191908
1A1a	Electricity and heat production	010104	070	Naestved Kraftvarmevaerk	01	301	NATURAL GAS	86196
1A1a	Electricity and heat production	010104	072	Hjoerring Varmeforsyning	01	301	NATURAL GAS	154080
1A1a	Electricity and heat production	010105	004	Kyndbyvaerket	41	204	GAS OIL	1479
1A1a	Electricity and heat production	010105	032	Helsingoer Kraftvarmevaerk	02	301	NATURAL GAS	9812
1A1a	Electricity and heat production	010203	036	Kolding Forbraendingsanlaeg	05	114	MUNICIP. WASTES	567630
1A1a	Electricity and heat production	010203	036	Kolding Forbraendingsanlaeg	05	204	GAS OIL	3694

Continued								
1A1a	Electricity and heat production	010203	050	Fasan+Naestved Kraftvarmevaerk	01	114	MUNICIP. WASTES	1290377
1A1a	Electricity and heat production	010203	055	I/S Faelles Forbraending	01	114	MUNICIP. WASTES	330000
1A1a	Electricity and heat production	010203	068	Bofa I/S	01	114	MUNICIP. WASTES	219488
1A1a	Electricity and heat production	010203	086	Hammel Fjernvarme	01	114	MUNICIP. WASTES	320870
1A1a	Electricity and heat production	010203	086	Hammel Fjernvarme	01	215	FISH & RAPE OIL	6517
1A1a	Electricity and heat production	010203	088	Skagen Forbraendingen	01	114	MUNICIP. WASTES	125832
1A1b	Petroleum refining	010304	017	Shell Raffinaderi	05	308	REFINERY GAS	2299437
1A1b	Petroleum refining	010306	009	Statoil Raffinaderi	01	204	GAS OIL	7024
1A1b	Petroleum refining	010306	009	Statoil Raffinaderi	01	308	REFINERY GAS	7052384
1A1b	Petroleum refining	010306	017	Shell Raffinaderi	01	203	RESIDUAL OIL	792504
1A1b	Petroleum refining	010306	017	Shell Raffinaderi	01	308	REFINERY GAS	4506111
1A1c	Other energy industries	010502	024	Nybro Gasbehandlingsanlaeg	01	301	NATURAL GAS	348025
1A2	Industry	030100	081	Haldor Topsoee	02	204	GAS OIL	1600
1A2	Industry	030100	081	Haldor Topsoee	02	301	NATURAL GAS	516600
1A2	Industry	030100	081	Haldor Topsoee	02	303	LPG	200
1A2	Industry	030102	023	Danisco Grindsted	01	102	COAL	547050
1A2	Industry	030102	023	Danisco Grindsted	01	203	RESIDUAL OIL	12718
1A2	Industry	030102	023	Danisco Grindsted	01	301	NATURAL GAS	8571
1A2	Industry	030102	033	DanSteel	01	301	NATURAL GAS	1407236
1A2	Industry	030102	034	Dalum Papir	01	111	WOOD	1062759
1A2	Industry	030102	034	Dalum Papir	01	204	GAS OIL	4161
1A2	Industry	030102	034	Dalum Papir	01	301	NATURAL GAS	156801
1A2	Industry	030102	082	Danisco Sugar Nakskov	02	102	COAL	616998
1A2	Industry	030102	082	Danisco Sugar Nakskov	02	203	RESIDUAL OIL	595766
1A2	Industry	030102	082	Danisco Sugar Nakskov	02	204	GAS OIL	3372
1A2	Industry	030102	082	Danisco Sugar Nakskov	02	309	BIOGAS	30314
1A2	Industry	030102	083	Danisco Sugar Nykoebing	02	102	COAL	208396
1A2	Industry	030102	083	Danisco Sugar Nykoebing	02	107	COKE OVEN COKE	37065
1A2	Industry	030102	083	Danisco Sugar Nykoebing	02	203	RESIDUAL OIL	808362
1A2	Industry	030104	071	Maricogen	01	301	NATURAL GAS	1315454
1A2	Industry	030311	045	Aalborg Portland	01	102	COAL	4030000
1A2	Industry	030311	045	Aalborg Portland	01	110	PETROLEUM COKE	9109000
1A2	Industry	030311	045	Aalborg Portland	01	114	MUNICIP. WASTES	1644000
1A2	Industry	030311	045	Aalborg Portland	01	203	RESIDUAL OIL	1056000
1A2	Industry	030315	078	Rexam Glass Holmegaard A/S	01	204	GAS OIL	338
1A2	Industry	030315	078	Rexam Glass Holmegaard A/S	01	301	NATURAL GAS	833656
1A2	Industry	030318	075	Rockwool A/S Hedehusene	01	301	NATURAL GAS	46800
1A2	Industry	030318	076	Rockwool A/S Vamdrup	01	107	COKE OVEN COKE	470880
1A2	Industry	030318	076	Rockwool A/S Vamdrup	01	301	NATURAL GAS	313920
1A2	Industry	030318	077	Rockwool A/S Doense	01	107	COKE OVEN COKE	406080
1A2	Industry	030318	077	Rockwool A/S Doense	01	301	NATURAL GAS	270720
1A4a	Commercial/ Institutional	020103	049	Rensningsanlaegget Lynetten	01	114	MUNICIP. WASTES	48720
1A4a	Commercial/ Institutional	020103	049	Rensningsanlaegget Lynetten	01	204	GAS OIL	15853
1A4a	Commercial/ Institutional	020103	049	Rensningsanlaegget Lynetten	01	309	BIOGAS	101606

Table 2A-47 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	TSP	PM_{10} 2)	$PM_{2.5}$ 2)	As	Cd	Cr	Cu	Hg	Ni	Pb	Se	Zn
001	Amagervaerket	02	1A1a	010101	x	x			x	x	x	x	x	x	x	x	x	x	x	x
001	Amagervaerket	03	1A1a	010101	x	x			x	x	x	x	x	x	x	x	x	x	x	x
002	Svanemoellevaerket	05	1A1a	010101	x	x														
002	Svanemoellevaerket	07	1A1a	010104	X	x														
003	H.C.Oerstedsvaerket	03	1A1a	010101	x	x						x	x	x	x	x	x	x	x	x
003	H.C.Oerstedsvaerket	07	1A1a	010101	x	x						x	x	x	x	x	x	x	x	x
003	H.C.Oerstedsvaerket	08	1A1a	010101	x	x						x	x	x	x	x	x	x	x	x
004	Kyndbyvaerket	21	1A1a	010101	x	x			x	x	x	x	x	x	x	x	x	x	x	x
004	Kyndbyvaerket	22	1A1a	010101	x	x			x	x	x	x	x	x	x	x	x	x	x	x
004	Kyndbyvaerket	26	1A1a	010101	x	x			x	x	x	x	x	x	x	x	x	x	x	x
004	Kyndbyvaerket	28	1A1a	010101	x	x			x	x	x	x	x	x	x	x	x	x	x	x
004	Kyndbyvaerket	41	1A1a	010105					x	x	x	x	x	x	x	x	x	x	x	x
004	Kyndbyvaerket	51	1A1a	010104	x	x			x	x	x	x	x	x	x	x	x	x	x	x
004	Kyndbyvaerket	52	1A1a	010104	x	x			x	x	x	x	x	x	x	x	x	x	x	x
005	Masnedoevaerket	12	1A1a	010102	x	x			x	x	x									
005	Masnedoevaerket	31	1A1a	010104	x	x														
007	Stigsnaesvaerket	01	1A1a	010101	x	x			x	x	x	x	x	x	x	x	x	x	x	x
007	Stigsnaesvaerket	02	1A1a	010101	x	x			x	x	x	x	x	x	x	x	x	x	x	x
008	Asnaesvaerket	02	1A1a	010101	x	x			x	x	x	x	x	x	x	x	x	x	x	x
008	Asnaesvaerket	03	1A1a	010101	x	x			x	x	x	x	x	x	x	x	x	x	x	x
008	Asnaesvaerket	04	1A1a	010101	x	x			x	x	x	x	x	x	x	x	x	x	x	x
008	Asnaesvaerket	05	1A1a	010101	x	x			x	x	x	x	x	x	x	x	x	x	x	x
009	Statoil Raffinaderi	01	1A1b	010306	x	x														
010	Avedoerevaerket	01	1A1a	010101	x	x		x	x	x	x	x	x	x	x	x	x	x	x	x
010	Avedoerevaerket	02	1A1a	010104	x	x		x	x	x	x	x	x	x	x	x	x	x	x	x
011	Fynsvaerket	03	1A1a	010101	x	x			x	x	x	x	x	x	x	x	x	x	x	x
011	Fynsvaerket	07	1A1a	010101	x	x			x	x	x	x	x	x	x	x	x	x	x	x
011	Fynsvaerket	08	1A1a	010102	x	x		x	x	x	x	x	x	x	x	x	x	x		
012	Studstrupvaerket	03	1A1a	010101	x	x			x	x	x	x	x	x	x	x	x	x	x	x
012	Studstrupvaerket	04	1A1a	010101	x	x			x	x	x	x	x	x	x	x	x	x	x	x
014	Nordjyllandsvaerket	02	1A1a	010101	x	x			x	x	x	x	x	x	x	x	x	x	x	x
014	Nordjyllandsvaerket	03	1A1a	010101	x	x			x	x	x	x	x	x	x	x	x	x	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			x	x	x	x	x	x	x	x	x	x	x	x
018	Skaerbaekvaerket	03	1A1a	010101	x	x		x	x	x	x	x	x	x	x	x	x	x	x	x
019	Enstedvaerket	03	1A1a	010101	x	x			x	x	x	x	x	x	x	x	x	x	x	x
019	Enstedvaerket	04	1A1a	010101	x	x			x	x	x	x	x	x	x	x	x	x	x	x
020	Esbjergvaerket	03	1A1a	010101	x	x		x	x	x	x	x	x	x	x	x	x	x	x	x
022	Oestkraft	05	1A1a	010102	x	x														
022	Oestkraft	06	1A1a	010102	x	x														
023	Danisco Ingredients	01	1A2f	030102	x	x														
024	Dansk Naturgas Behandlingsanlaeg	01	1A1c	010502		x														
025	Horsens Kraftvarmevaerk	01	1A1a	010102	x	x		x	x	x	x	x	x	x	x	x	x	x		
025	Horsens Kraftvarmevaerk	02	1A1a	010104		x														
026	Herningvaerket	01	1A1a	010102	x	x		x	x	x	x	x	x	x	x	x	x	x	x	x
027	Vestforbraendingen	01	1A1a	010102	x	x			x	x	x					x				
027	Vestforbraendingen	02	1A1a	010102	x	x			x	x	x					x				
028	Amagerforbraendingen	01	1A1a	010102	x	x	x	x	x	x	x		x			x		x		
029	Randersvaerket	01	1A1a	010102	x	x			x	x	x									
030	Grenaavaerket	01	1A1a	010102	x	x		x	x	x	x	x	x	x	x	x	x	x		
031	Hilleroedvaerket	01	1A1a	010104	x	x														
032	Helsingoervaerket	01	1A1a	010104	x	x														
032	Helsingoervaerket	02	1A1a	010105	x	x														
033	Staalvalsevaerket	01	1A2f	030102		x			x	x	x									
034	Stora Dalum	01	1A2f	030102		x														
035	Assens Sukkerfabrik	01	1A2f	030102	x				x	x	x									
036	Kolding Kraftvarmevaerk	01	1A1a	010103	x		x	x	x	x	x									
036	Kolding Kraftvarmevaerk	03	1A1a	010103	x	x	x	x	x	x	x									
037	Maabjergvaerket	02	1A1a	010102	x	x		x	x	x	x	x	x	x	x	x	x	x		
038	Soenderborg Kraftvarmevaerk	01	1A1a	010102	x	x		x	x	x	x	x	x	x	x	x	x	x		
038	Soenderborg Kraftvarmevaerk	02	1A1a	010104		x														
039	Kara Affaldsforbraendingsanlaeg	01	1A1a	010102	x			x	x	x	x									

LPS_id	LPS name	LPS part	Sector (IPCC)	Sector (SNAP)	SO_2	NO_x	NMVOC	CO	TSP	PM_{10} 2)	$PM_{2.5}$ 2)	As	Cd	Cr	Cu	Hg	Ni	Pb	Se	Zn
040	Viborg Kraftvarmevaerk	01	1A1a	010104	x	x														
042	Nordforbraendingen	01	1A1a	010102	x	x		x	x	x	x							x		
045	Aalborg Portland	01/03	1A2f	030311	x	x		x	x	x	x									
046	Aarhus Nord	01	1A1a	010102	x	x	x		x	x	x							x		
047	Reno Nord	01	1A1a	010103	x	x		x												
048	Silkeborg Kraftvarmevaerk	01	1A1a	010104	x	x														
049	Rensningsanlægget Lynetten	01	1A4a	020103	x				x	x	x	x	x	x	x	x	x	x		
050	I/S Fasan	01	1A1a	010203	x	x		x	x	x	x									
051	AVV Forbrændingsanlæg	01	1A1a	010103	x			x	x	x	x									
052	I/S REFA Kraftvarmeværk	01	1A1a	010103																
053	Svendborg Kraftvarmeværk	01	1A1a	010102	x	x	x	x	x	x	x									
054	Kommunekemi	01	1A1a	010102	x			x	x	x	x					x				
054	Kommunekemi	02	1A1a	010102	x			x	x	x	x					x				
054	Kommunekemi	03	1A1a	010102	x			x	x	x	x					x				
058	I/S Reno Syd	01	1A1a	010103	x			x	x	x	x									
059	I/S Kraftvarmeværk Thisted	01	1A1a	010103	x			x	x	x	x									
060	Knudmoseværket	01	1A1a	010103	x			x	x	x	x									
061	Kavo I/S Energien	01	1A1a	010103	x		x	x	x	x	x					x				
061	Kavo I/S Energien	02	1A1a	010103	x	x														
065	Haderslev Kraftvarmeværk	01	1A1a	010103	x	x		x	x	x	x	x	x	x	x	x	x	x		
066	Frederiskhavn Affaldskraftvarmeværk	01	1A1a	010103	x	x		x	x	x	x	x	x	x	x	x	x	x		
067	Vejen Kraftvarmeværk	01	1A1a	010103	x	x		x	x	x	x	x	x	x	x	x	x	x		
068	Bofa I/S	01	1A1a	010203	x			x	x	x	x							x		
069	DTU	01	1A1a	010104	x	x														
070	Næstved Kraftvarmeværk	01	1A1a	010104		x		x												
071	Maricogen	01	1A2f	030104	x	x														
072	Hjørring KVV	01	1A1a	010104	x	x														
076	Rockwool A/S Vamdrup	01	1A2f	030318	x		x	x	x	x	x									
077	Rockwool A/S Doense	01	1A2f	030318	x		x	x	x	x	x									
078	Rexam Glass Holmegaard A/S	01	1A2f	030315		x		x	x	x	x							x	x	x
080	Saint-Gobain Isover A/S	01	1A2f	030316					x	x	x									
081	Haldor Topsøe	02	1A2f	0301					x	x	x									
082	Danisco Sugar Nakskov	02	1A2f	030102					x	x	x									
083	Danisco Sugar Nykøbing	02	1A2f	030102					x	x	x									
085	L90 Affaldsforbrænding	01	1A1a	010102	x	x		x	x	x	x									
086	Hammel Fjernvarme	01	1A1a	010203	x	x		x	x	x	x									
087	Koege Kraftvarmevaerk	01	1A1a	010102	x	x	x	x	x	x	x									
088	Skagen Forbraending	01	1A1a	010203	x		x	x	x	x	x									
	Total				10493	36413	21	12373	1219	987	725	141	24	264	167	240	923	337	1225	474

1) Emission of the pollutants marked with "x" is plant specific. Emission of other pollutants is estimated based on emission factors. The total shown *in this table* only includes plant specific data.

2) Based on particle size distribution

Appendix 2A-8 Uncertainty estimates 2007

Table 2A-48 Uncertainty estimation, SO_2.

SNAP	Gas	Base year emission	Year t emission	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	Combined uncertainty as % of total national emissions in year t	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions
		Input data	Input data	Input data	Input data							
		Mg SO_2	Mg SO_2	%	%	%	%	%	%	%	%	%
01	SO_2	129601	9074	2	10	10,198	4,492	-0,049	0,058	-0,493	0,163	0,519
02	SO_2	11491	4372	2	20	20,100	4,265	0,018	0,028	0,364	0,078	0,372
03	SO_2	16708	7157	2	10	10,198	3,543	0,031	0,045	0,315	0,128	0,340
Total	SO_2	157800	20604				50,913					0,524
Total uncertainties				Overall uncertainty in the year (%):				7,135		Trend uncertainty (%):		0,724

Table 2A-49 Uncertainty estimation, NO_x.

SNAP	Gas	Base year emission	Year t emission	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	Combined uncertainty as % of total national emissions in year t	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions
		Input data	Input data	Input data	Input data							
		Mg NO_x	Mg NO_x	%	%	%	%	%	%	%	%	%
01	NO_x	94738	42482	2	20	20,100	13,750	-0,073	0,3681	-1,459	1,041	1,792
02	NO_x	7518	8481	2	50	50,040	6,834	0,038	0,0735	1,920	0,208	1,932
03	NO_x	13167	11136	2	20	20,100	3,605	0,035	0,0965	0,701	0,273	0,753
Total	NO_x	115423	62100				248,764					7,510
Total uncertainties				Overall uncertainty in the year (%):				15,772		Trend uncertainty (%):		2,740

Table 2A-50 Uncertainty estimation, NMVOC.

SNAP	Gas	Base year emission	Year t emission	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	Combined uncertainty as % of total national emissions in year t	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions
		Input data	Input data	Input data	Input data							
		Mg NMVOC	Mg NMVOC	%	%	%	%	%	%	%	%	%
01	NMVOC	1075	2743	2	50	50,040	5,204	0,039	0,2177	1,956	0,616	2,051
02	NMVOC	10901	23067	2	50	50,040	43,753	0,019	1,8303	0,973	5,177	5,267
03	NMVOC	627	571	2	50	50,040	1,083	-0,059	0,0453	-2,937	0,128	2,940
Total	NMVOC	12603	26382				1942,589					40,596
Total uncertainties				Overall uncertainty in the year (%):				44,075		Trend uncertainty (%):		6,372

Table 2A-51 Uncertainty estimation, CO.

SNAP	Gas	Base year emission	Year t emission	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	Combined uncertainty as % of total national emissions in year t	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions
		Input data	Input data	Input data	Input data							
		Mg CO	Mg CO	%	%	%	%	%	%	%	%	%
01	CO	8262	9291	2	20	20,100	1,095	-0,006	0,066	-0,110	0,188	0,218
02	CO	115829	147602	2	50	50,040	43,328	0,046	1,055	2,315	2,983	3,775
03	CO	15877	13574	2	20	20,100	1,601	-0,041	0,097	-0,822	0,274	0,867
Total	CO	139967	170467				1881,075					15,053
Total uncertainties				Overall uncertainty in the year (%):				43,371		Trend uncertainty (%):		3,880

Table 2A-52 Uncertainty estimation, TSP.

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							
		kg TSP	kg TSP	%	%	%	%	%	%	%	%	%
01	TSP	1158	1124	2	50	50,040	1,986	-0,042	0,064	-2,124	0,181	2,132
02	TSP	15226	26278	2	500	500,004	463,961	0,096	1,498	47,930	4,237	48,117
03	TSP	1157	917	2	50	50,040	1,621	-0,054	0,052	-2,707	0,148	2,711
Total	TSP	17540	28319				215266,425					2327,157
Total uncertainties				Overall uncertainty in the year (%):				463,968		Trend uncertainty (%):		48,241

Table 2A-53 Uncertainty estimation, PM_{10}.

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							
		kg PM_{10}	kg PM_{10}	%	%	%	%	%	%	%	%	%
01	PM_{10}	941	894	2	50	50,040	1,693	-0,045	0,057	-2,229	0,162	2,235
02	PM_{10}	13834	24887	2	500	500,004	471,174	0,096	1,593	47,773	4,505	47,985
03	PM_{10}	851	629	2	50	50,040	1,192	-0,052	0,040	-2,588	0,114	2,590
Total	PM_{10}	15626	26410				222009,605					2314,217
Total uncertainties				Overall uncertainty in the year (%):				471,179		Trend uncertainty (%):		48,106

Table 2A-54 Uncertainty estimation, $PM_{2.5}$.

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							
		kg $PM_{2.5}$	kg $PM_{2.5}$	%	%	%	%	%	%	%	%	%
01	$PM_{2.5}$	804	742	2	50	50,040	1,507	-0,044	0,052	-2,198	0,146	2,203
02	$PM_{2.5}$	13094	23544	2	500	500,004	477,612	0,078	1,635	39,137	4,623	39,410
03	$PM_{2.5}$	506	361	2	50	50,040	0,734	-0,035	0,025	-1,749	0,071	1,751
Total	$PM_{2.5}$	14403	24648				228116,378					1561,035
Total uncertainties				Overall uncertainty in the year (%):				477,615		Trend uncertainty (%):		39,510

Table 2A-55 Uncertainty estimation, As.

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							
		kg As	kg As	%	%	%	%	%	%	%	%	%
01	As	965	360	2	100	100,020	58,998	-0,033	0,250	-3,348	0,706	3,422
02	As	127	48	2	1000	1000,002	78,499	-0,004	0,033	-4,093	0,094	4,094
03	As	349	202	2	100	100,020	33,171	0,038	0,140	3,771	0,397	3,792
Total	As	1442	610				10743,155					42,849
Total uncertainties				Overall uncertainty in the year (%):				103,649		Trend uncertainty (%):		6,546

Table 2A-56 Uncertainty estimation, Cd.

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							
		kg Cd	kg Cd	%	%	%	%	%	%	%	%	%
01	Cd	592	247	2	100	100,020	35,802	-0,134	0,235	-13,357	0,663	13,373
02	Cd	145	274	2	1000	1000,002	397,383	0,170	0,260	170,038	0,737	170,039
03	Cd	315	169	2	100	100,020	24,472	-0,036	0,160	-3,584	0,453	3,613
Total	Cd	1052	689				159794,071					29105,206
Total uncertainties				Overall uncertainty in the year (%):				399,743		Trend uncertainty (%):		170,602

Table 2A-57 Uncertainty estimation, Cr.

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							
		kg Cr	kg Cr	%	%	%	%	%	%	%	%	%
01	Cr	4674	660	2	100	100,020	60,467	-0,029	0,108	-2,863	0,306	2,879
02	Cr	326	61	2	1000	1000,002	55,813	0,000	0,010	0,437	0,028	0,438
03	Cr	1104	371	2	100	100,020	33,971	0,028	0,061	2,836	0,172	2,841
Total	Cr	6103	1092				7925,310					16,550
Total uncertainties				Overall uncertainty in the year (%):				89,024		Trend uncertainty (%):		4,068

Table 2A-58 Uncertainty estimation, Cu.

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							
		kg Cu	kg Cu	%	%	%	%	%	%	%	%	%
01	Cu	2915	734	2	100	100,020	60,238	-0,068	0,203	-6,761	0,573	6,785
02	Cu	301	305	2	1000	1000,002	250,248	0,056	0,084	56,139	0,238	56,140
03	Cu	405	180	2	100	100,020	14,752	0,012	0,050	1,195	0,140	1,203
Total	Cu	3622	1218				66470,520					3199,131
Total uncertainties				Overall uncertainty in the year (%):				257,819		Trend uncertainty (%):		56,561

Table 2A-59 Uncertainty estimation, Hg.

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							
		kg Hg	kg Hg	%	%	%	%	%	%	%	%	%
01	Hg	2509	486	2	100	100,020	45,767	-0,123	0,158	-12,252	0,447	12,261
02	Hg	330	321	2	1000	1000,002	302,854	0,067	0,104	67,458	0,296	67,459
03	Hg	238	254	2	100	100,020	23,962	0,056	0,083	5,595	0,234	5,600
Total	Hg	3076	1061				94389,409					4732,388
Total uncertainties				Overall uncertainty in the year (%):				307,229		Trend uncertainty (%):		68,792

Table 2A-60 Uncertainty estimation, Ni.

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							
		kg Ni	kg Ni	%	%	%	%	%	%	%	%	%
01	Ni	8384	2330	2	100	100,020	29,489	-0,036	0,109	-3,584	0,308	3,597
02	Ni	1852	621	2	1000	1000,002	78,637	-0,003	0,029	-2,948	0,082	2,949
03	Ni	11142	4951	2	100	100,020	62,666	0,039	0,232	3,873	0,655	3,928
Total	Ni	21377	7902				10980,437					37,066
Total uncertainties				Overall uncertainty in the year (%):				104,788		Trend uncertainty (%):		6,088

Table 2A-61 Uncertainty estimation, Pb.

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							
		kg Pb	kg Pb	%	%	%	%	%	%	%	%	%
01	Pb	11994	3565	2	100	100,020	77,365	-0,002	0,232	-0,218	0,656	0,692
02	Pb	945	232	2	1000	1000,002	50,351	-0,003	0,015	-3,358	0,043	3,359
03	Pb	2422	812	2	100	100,020	17,619	0,006	0,053	0,555	0,150	0,574
Total	Pb	15361	4609				8830,946					12,090
Total uncertainties				Overall uncertainty in the year (%):				93,973		Trend uncertainty (%):		3,477

Table 2A-62 Uncertainty estimation, Se.

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							
		kg Se	kg Se	%	%	%	%	%	%	%	%	%
01	Se	2961	1074	2	100	100,020	59,642	-0,036	0,248	-3,585	0,701	3,653
02	Se	308	135	2	1000	1000,002	74,787	0,002	0,031	1,551	0,088	1,554
03	Se	1065	593	2	100	100,020	32,897	0,034	0,137	3,446	0,387	3,467
Total	Se	4334	1802				10232,599					27,7775071
Total uncertainties				Overall uncertainty in the year (%):				101,156		Trend uncertainty (%):		5,270

Table 2A-63 Uncertainty estimation, Zn.

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							
		kg Zn	kg Zn	%	%	%	%	%	%	%	%	%
01	Zn	14801	15549	2	100	100,020	69,758	-0,078	0,804	-7,763	2,274	8,089
02	Zn	2810	5394	2	1000	1000,002	241,965	0,111	0,279	111,269	0,789	111,272
03	Zn	1729	1351	2	100	100,020	6,060	-0,033	0,070	-3,317	0,198	3,323
Total	Zn	19340	22294				63450,086					12457,992
Total uncertainties				Overall uncertainty in the year (%):				251,893		Trend uncertainty (%):		111,615

Table 2A-64 Uncertainty estimation, Benzo(b)fluoranthene.

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							
		kg	kg	%	%	%	%	%	%	%	%	%
01		31	29	2	100	100,020	0,540	-0,027	0,014	-2,680	0,041	2,681
02		1921	5187	2	1000	1000,002	975,075	0,040	2,592	39,600	7,331	40,273
03		49	104	2	100	100,020	1,954	-0,013	0,052	-1,317	0,147	1,325
Total		2001	5319				950776,319					1630,863
Total uncertainties				Overall uncertainty in the year (%):				975,078		Trend uncertainty (%):		40,384

Table 2A-65 Uncertainty estimation, Benzo(k)fluoranthene.

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							
		kg	kg	%	%	%	%	%	%	%	%	%
01		11	15	2	100	100,020	0,501	-0,016	0,014	-1,562	0,041	1,562
02		976	2871	2	1000	1000,002	989,432	0,064	2,843	63,619	8,042	64,125
03		23	16	2	100	100,020	0,556	-0,049	0,016	-4,861	0,045	4,861
Total		1010	2902				978976,440					4138,132
Total uncertainties				Overall uncertainty in the year (%):				989,432		Trend uncertainty (%):		64,328

Table 2A-66 Uncertainty estimation, Benzo(a)pyrene.

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							
		kg	kg	%	%	%	%	%	%	%	%	%
01		8	7	2	100	100,020	0,140	-0,008	0,004	-0,823	0,011	0,823
02		1792	4957	2	1000	1000,002	992,589	0,008	2,737	8,009	7,741	11,138
03		11	30	2	100	100,020	0,602	0,000	0,017	0,014	0,047	0,049
Total		1811	4994				985232,725					124,737
Total uncertainties				Overall uncertainty in the year (%):				992,589		Trend uncertainty (%):		11,169

Table 2A-67 Uncertainty estimation, Indeno(1,2,3-c,d)pyrene.

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							
		kg	kg	%	%	%	%	%	%	%	%	%
01		6	6	2	100	100,020	0,179	-0,006	0,004	-0,582	0,012	0,582
02		1469	3523	2	1000	1000,002	995,979	0,022	2,367	21,988	6,694	22,984
03		14	8	2	100	100,020	0,223	-0,016	0,005	-1,638	0,015	1,638
Total		1489	3538				991973,465					531,291
Total uncertainties				Overall uncertainty in the year (%):				995,979		Trend uncertainty (%):		23,050

Appendix 2A-9 Emission inventory 2007 based on SNAP sectors

Table 2A-68 Emission inventory 2007 based on SNAP sectors.

SNAP 2)	SO_2 Mg	NO_x Mg	NMVOC Mg	CO Mg	TSP Mg	PM_{10} Mg	$PM_{2.5}$ Mg	As kg	Cd kg	Cr kg	Cu kg	Hg kg	Ni kg	Pb kg
Total 01	9074	42482	2743	9291	1124	894	742	360	247	660	734	486	2330	3565
010100	0	3	0	0	0	0	0	0	0	0	0	0	0	0
010101	6789	20634	322	2236	627	504	416	130	11	180	102	181	935	155
010102	724	4503	51	613	77	60	49	143	116	319	400	121	539	2125
010103	134	1318	19	308	24	10	8	53	36	22	77	50	41	891
010104	275	2553	64	772	63	60	50	5	1	9	6	4	36	11
010105	33	3206	1734	2264	19	11	3	0	0	0	0	0	0	0
010201	1	2	0	1	0	0	0	0	0	0	0	0	0	0
010202	64	103	34	187	15	11	9	1	5	2	5	5	36	4
010203	618	1158	440	2399	175	123	97	16	66	100	133	121	215	360
010204	0	3	0	0	0	0	0	0	0	0	0	0	0	0
010205	3	126	34	75	1	0	0	0	0	0	0	0	0	0
010304	2	723	3	27	22	22	22	-	-	-	-	-	-	-
010306	421	1031	0	198	99	91	87	12	11	27	11	4	528	19
010502	0	33	1	10	0	0	0	-	-	-	-	-	-	-
010504	8	7033	39	174	3	2	1	-	-	-	-	-	-	-
010505	2	54	2	27	0	0	0	0	0	0	0	0	0	0
Total 02	4372	8481	23067	147602	26278	24887	23544	48	274	61	305	321	621	232
020100	172	552	637	629	160	159	149	5	10	9	12	10	152	13
020103	2	12	1	5	1	0	0	0	0	0	1	2	0	1
020104	0	3	0	0	0	0	0	-	-	-	-	-	-	-
020105	8	352	94	211	2	1	0	0	0	0	0	0	0	0
020200	2509	6467	20825	138516	25603	24252	22954	26	252	23	275	289	27	184
020202	0	1	0	0	0	0	0	-	-	-	-	-	-	-
020204	0	186	132	144	1	0	0	-	-	-	-	-	-	-
020300	1661	536	1250	7863	510	474	439	16	11	27	17	20	421	34
020302	12	5	0	3	1	0	0	0	0	1	0	0	21	1
020303	0	4	0	0	0	0	0	-	-	-	-	-	-	-
020304	7	364	128	230	2	0	0	0	0	0	0	0	0	0
Total 03	7157	11136	571	13574	917	629	361	202	169	371	180	254	4951	812
030100	3865	2715	323	2049	242	176	123	94	110	207	115	59	3876	173
030102	1126	506	80	357	104	39	18	24	26	50	30	16	916	45
030103	4	20	7	40	3	2	1	0	1	0	1	1	0	0
030104	1	438	6	27	0	0	0	0	0	0	0	0	0	0
030105	2	108	50	73	1	0	0	0	0	0	0	0	0	0
030303	-	-	-	-	148	44	7	22	10	82	-	-	96	534
030307	-	-	-	-	2	1	1	-	0	-	1	-	-	9
030308	-	-	-	-	1	1	1	-	-	-	-	-	-	-
030310	-	-	-	-	36	33	15	-	-	-	-	-	-	-
030311	1622	7080	92	1676	177	159	71	59	21	29	29	177	59	29
030312	-	-	-	-	27	13	3	-	-	-	-	-	-	-
030315	0	158	2	30	1	1	1	0	0	0	0	0	0	16
030316	-	-	-	-	52	47	36	-	-	-	-	-	-	-
030318	538	110	12	9322	124	112	86	3	0	2	3	1	4	5

1) Including CO_2 emission from biomass.

2) SNAP sector codes are shown in Appendix 2A-2.

Table 2A-68 *Continued* Emission inventory 2007 based on SNAP sectors.

SNAP 2)	Se kg	Zn kg	HCB kg	Dioxin g I-TEQ	Flouranthe kg	Benzo(b) kg	Benzo(k) kg	Benzo(a) kg	Benzo(g,,) kg	Indeno kg
Total 01	1242	15549	4	1	226	29	15	7	16	6
010100	0	0	-	0	0	0	0	0	0	0
010101	1148	408	0	0	15	3	1	1	3	1
010102	50	10030	3	1	3	1	0	0	0	0
010103	1	3193	1	0	3	0	0	0	0	0
010104	25	36	0	0	14	3	1	1	1	1
010105	0	1	0	0	3	1	0	0	0	0
010201	0	0	-	0	0	0	0	0	0	0
010202	2	84	0	0	6	1	1	0	0	0
010203	4	1795	0	0	181	20	11	5	11	3
010204	0	0	-	0	0	0	0	0	0	0
010205	0	0	-	0	0	0	0	0	0	0
010304	-	-	-	0	-	-	-	-	-	-
010306	10	2	-	0	1	0	0	0	0	0
010502	-	-	-	0	-	-	-	-	-	-
010504	-	-	-	0	0	0	0	0	0	0
010505	0	0	-	0	0	0	0	0	0	0
Total 02	108	5394	0	20	30568	5187	2871	4957	8729	3523
020100	11	158	0	0	804	225	75	171	232	122
020103	0	18	0	0	1	0	0	0	0	0
020104	-	-	-	0	0	0	0	0	0	0
020105	0	0	0	0	1	0	0	0	0	0
020200	88	5167	0	18	29157	4787	2772	4623	8306	3139
020202	-	-	-	0	0	0	0	0	0	0
020204	-	-	-	0	0	0	0	0	0	0
020300	9	51	0	1	604	174	24	162	191	263
020302	0	0	-	0	1	0	0	0	0	0
020303	-	-	-	0	0	0	0	0	0	0
020304	0	0	0	0	0	0	0	0	0	0
Total 03	538	1351	0	0	3968	104	16	30	8	8
030100	75	615	0	0	73	8	9	1	3	3
030102	18	163	0	0	28	3	3	0	1	1
030103	0	20	0	0	0	0	0	0	0	0
030104	0	0	-	0	0	0	0	0	0	0
030105	0	0	-	0	0	0	0	0	0	0
030303	371	371	-	-	-	-	-	-	-	-
030307	-	-	-	-	-	-	-	-	-	-
030308	-	0	-	-	-	-	-	-	-	-
030310	-	-	-	0	-	-	-	-	-	-
030311	21	147	0	0	3854	92	4	29	3	3
030312	-	-	-	-	-	-	-	-	-	-
030315	53	25	-	0	0	0	0	0	0	0
030316	-	-	-	-	-	-	-	-	-	-
030318	0	9	-	0	12	1	1	0	1	1

1) Including CO_2 emission from biomass.

2) SNAP sector codes are shown in Appendix 2A-2.

Appendix 2A-10 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 Table 2A-69.

Table 2A-69 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		

Appendix 2A-11 Key source analysis

Table 2A-70 Key source analysis, Level 2007, SO_2

NFR	NFR_name	Level Assessment Lx,t	Cumulative Total	001
1A1a	Public electricity and heat production	0,419	42%	KS
1A2	Industry	0,347	77%	KS
1A4b	Residential	0,122	89%	KS
1A4c	Agriculture / Forestry / Fisheries	0,082	97%	
1A1b	Petroleum refining	0,021	99%	
1A4a	Commercial / Institutional	0,009	100%	
1A1c	Other energy industries	0,001	100%	

Table 2A-71 Key source analysis, Level 2007, NO_x

NFR	NFR_name	Level Assessment Lx,t	Cumulative Total	002
1A1a	Public electricity and heat production	0,541	54%	KS
1A2	Industry	0,179	72%	KS
1A1c	Other energy industries	0,115	84%	KS
1A4b	Residential	0,107	94%	
1A1b	Petroleum refining	0,028	97%	
1A4a	Commercial / Institutional	0,015	99%	
1A4c	Agriculture / Forestry / Fisheries	0,015	100%	

Table 2A-72 Key source analysis, Level 2007, NMVOC

NFR	NFR_name	Level Assessment Lx,t	Cumulative Total	003
1A4b	Residential	0,794	79%	KS
1A1a	Public electricity and heat production	0,102	90%	KS
1A4c	Agriculture / Forestry / Fisheries	0,052	95%	
1A4a	Commercial / Institutional	0,028	98%	
1A2	Industry	0,022	100%	
1A1c	Other energy industries	0,002	100%	
1A1b	Petroleum refining	0,000	100%	

Table 2A-73 Key source analysis, Level 2007, CO

NFR	NFR_name	Level Assessment Lx,t	Cumulative Total	005
1A4b	Residential	0,813	81%	KS
1A2	Industry	0,080	89%	
1A1a	Public electricity and heat production	0,052	94%	
1A4c	Agriculture / Forestry / Fisheries	0,047	99%	
1A4a	Commercial / Institutional	0,005	100%	
1A1b	Petroleum refining	0,001	100%	
1A1c	Other energy industries	0,001	100%	

Table 2A-74 Key source analysis, Level 2007, TSP

NFR	NFR_name	Level Assessment Lx,t	Cumulative Total	009
1A4b	Residential	0,904	90%	KS
1A1a	Public electricity and heat production	0,035	94%	
1A2	Industry	0,032	97%	
1A4c	Agriculture / Forestry / Fisheries	0,018	99%	
1A4a	Commercial / Institutional	0,006	100%	
1A1b	Petroleum refining	0,004	100%	
1A1c	Other energy industries	0,000	100%	

Table 2A-75 Key source analysis, Level 2007, PM_{10}

NFR	NFR_name	Level Assessment Lx,t	Cumulative Total	011
1A4b	Residential	0,918	92%	KS
1A1a	Public electricity and heat production	0,030	95%	
1A2	Industry	0,024	97%	
1A4c	Agriculture / Forestry / Fisheries	0,018	99%	
1A4a	Commercial / Institutional	0,006	100%	
1A1b	Petroleum refining	0,004	100%	
1A1c	Other energy industries	0,000	100%	

Table 2A-76 Key source analysis, Level 2007, $PM_{2.5}$

NFR	NFR_name	Level Assessment Lx,t	Cumulative Total	012
1A4b	Residential	0,931	93%	KS
1A1a	Public electricity and heat production	0,026	96%	
1A4c	Agriculture / Forestry / Fisheries	0,018	97%	
1A2	Industry	0,015	99%	
1A4a	Commercial / Institutional	0,006	100%	
1A1b	Petroleum refining	0,004	100%	
1A1c	Other energy industries	0,000	100%	

Table 2A-77 Key source analysis, trend, SO_2, NO_x, NMVOC and CO

IPCC Category Code	IPCC Category	1990	1990	1990	1990	2007	2007	2007	2007
		SO_2	NO_x	NMVOC	CO	SO_2	NO_x	NMVOC	CO
1A1a	Public electricity and heat production	126187	90746	1002	7952	8641	33608	2698	8854
1A1b	Petroleum refining	3411	1616	60	249	423	1754	3	225
1A1c	Other energy industries	3	2376	13	61	10	7120	42	211
1A2	Industry	16708	13167	627	15877	7157	11136	571	13574
1A4a	Commercial / Institutional	1884	1399	193	892	183	919	732	846
1A4b	Residential	6415	4939	8566	85074	2509	6653	20957	138661
1A4c	Agriculture / Forestry / Fisheries	3192	1180	2142	29863	1680	909	1379	8096
		157800	115423	12603	139967	20604	62100	26382	170467

IPCC Category Code	IPCC Category	Trend Tx,t	Trend Tx,t	Trend Tx,t	Trend Tx,t	% Contri-bution to Trend	% Contri-bution to Trend	% Contri-bution to Trend	% Con-tribution to Trend
		SO_2	NO_x	NMVOC	CO	SO_2	NO_x	NMVOC	CO
1A1a	Public electricity and heat production	0,050	0,132	0,048	0,006	49,5%	50,0%	7,6%	1,2%
1A1b	Petroleum refining	0,000	0,008	0,010	0,001	0,1%	2,9%	1,5%	0,1%
1A1c	Other energy industries	0,000	0,051	0,001	0,001	0,1%	19,2%	0,2%	0,2%
1A2	Industry	0,032	0,035	0,059	0,041	31,4%	13,3%	9,3%	8,2%
1A4a	Commercial / Institutional	0,000	0,001	0,026	0,002	0,4%	0,5%	4,1%	0,3%
1A4b	Residential	0,011	0,035	0,240	0,250	10,6%	13,1%	38,1%	49,8%
1A4c	Agriculture / Forestry / Fisheries	0,008	0,002	0,246	0,202	8,0%	0,9%	39,1%	40,2%
		0,100	0,264	0,630	0,503	100%	100%	100%	100%

xxx: Key source

Appendix 2A-12 Fuel consumption time series 1980-2007

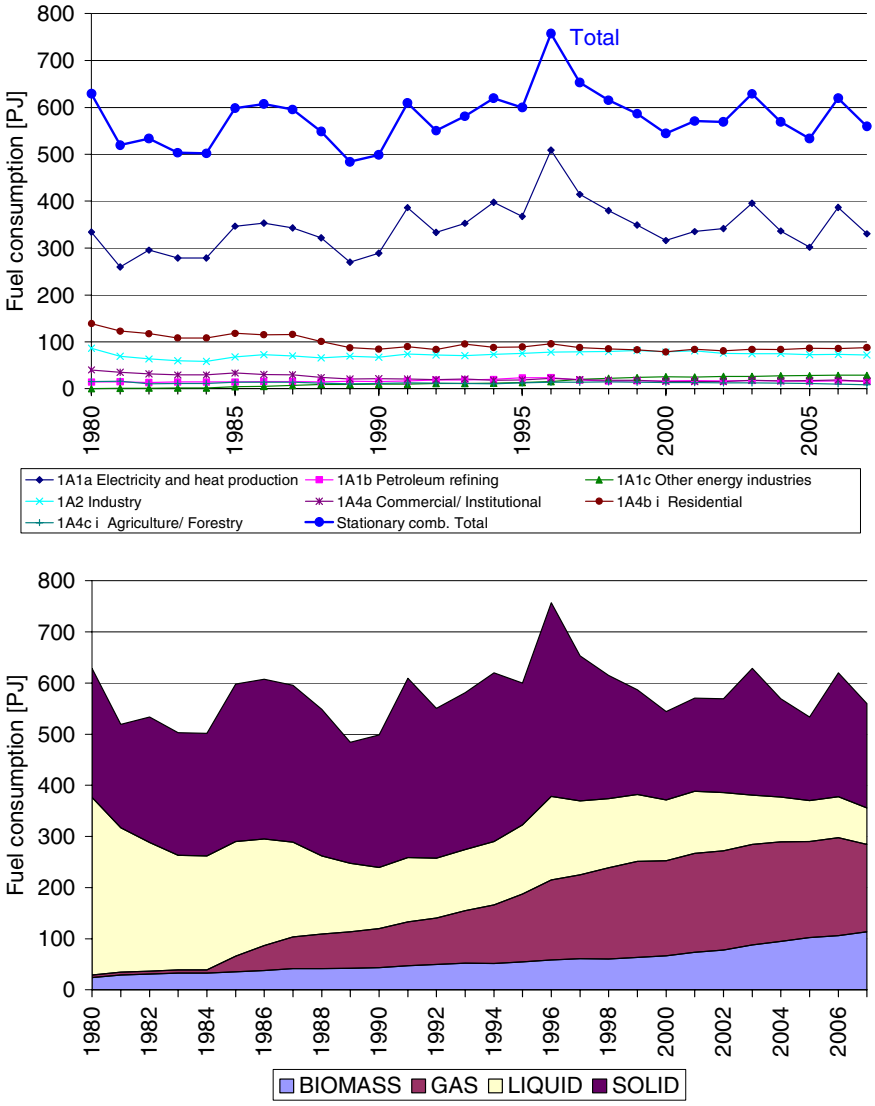

Figure 2A-25 Fuel consumption time-series, stationary combustion (based on DEA (2008a)).

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Transport

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Annex 2B-1: Fleet data 1985-2006 for road transport (No. vehicles)

Sector	Subsector	Tech 2	FYear	LYear	1985	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Passenger Cars	Gasoline <1,4 l	PRE ECE	0	1969	80570	46208	44014	42804	36466	39959	37597	37130	3434	2761	2103	1744
Passenger Cars	Gasoline <1,4 l	ECE 15/00-01	1970	1978	333715	187911	161642	139010	119424	80741	67991	53302	44338	31104	22511	17980
Passenger Cars	Gasoline <1,4 l	ECE 15/02	1979	1980	104223	86056	79240	72588	65797	49614	42976	34748	25889	17458	10806	7298
Passenger Cars	Gasoline <1,4 l	ECE 15/03	1981	1985	345946	301692	295677	288944	280769	262502	250449	233656	215509	183239	147178	118979
Passenger Cars	Gasoline <1,4 l	ECE 15/04	1986	1990		282011	280181	278685	278152	275859	272989	269953	275188	264791	254032	235890
Passenger Cars	Gasoline <1,4 l	Euro I	1991	1996			39608	73527	101489	139813	169133	205235	210861	208281	206803	204184
Passenger Cars	Gasoline <1,4 l	Euro II	1997	2000									38465	74495	108508	135030
Passenger Cars	Gasoline <1,4 l	Euro III	2001	2005												
Passenger Cars	Gasoline <1,4 l	Euro IV	2006	2010												
Passenger Cars	Gasoline 1,4 - 2,0 l	PRE ECE	0	1969	61592	35940	34233	33292	28362	31079	29242	28879	2671	2148	1635	1356
Passenger Cars	Gasoline 1,4 - 2,0 l	ECE 15/00-01	1970	1978	218180	127631	109640	94188	80844	54600	45991	36078	30465	21520	15647	12537
Passenger Cars	Gasoline 1,4 - 2,0 l	ECE 15/02	1979	1980	60836	55062	50674	46402	42040	31712	27445	22173	16509	11141	6870	4642
Passenger Cars	Gasoline 1,4 - 2,0 l	ECE 15/03	1981	1985	210574	174545	170749	166595	161591	150612	143385	133412	122642	103931	83270	67222
Passenger Cars	Gasoline 1,4 - 2,0 l	ECE 15/04	1986	1990		190297	188949	187872	187524	186044	184194	182297	186155	179510	172582	160800
Passenger Cars	Gasoline 1,4 - 2,0 l	Euro I	1991	1996			35647	75763	119562	201007	288096	375253	383870	378063	375137	370803
Passenger Cars	Gasoline 1,4 - 2,0 l	Euro II	1997	2000									95358	196046	274022	326268
Passenger Cars	Gasoline 1,4 - 2,0 l	Euro III	2001	2005												
Passenger Cars	Gasoline 1,4 - 2,0 l	Euro IV	2006	2010												
Passenger Cars	Gasoline >2,0 l	PRE ECE	0	1969	5923	3423	3260	3171	2701	2960	2785	2750	254	205	156	129
Passenger Cars	Gasoline >2,0 l	ECE 15/00-01	1970	1978	18532	10781	9234	7914	6781	4567	3849	3022	2619	1881	1366	1110
Passenger Cars	Gasoline >2,0 l	ECE 15/02	1979	1980	8730	4392	4043	3702	3354	2531	2191	1770	1318	888	549	371
Passenger Cars	Gasoline >2,0 l	ECE 15/03	1981	1985	31066	24667	24157	23595	22912	21429	20432	19053	17571	14934	12016	9722
Passenger Cars	Gasoline >2,0 l	ECE 15/04	1986	1990		25679	25524	25389	25338	25120	24844	24546	24977	23975	22975	21251
Passenger Cars	Gasoline >2,0 l	Euro I	1991	1996			3961	8129	12434	20068	27915	35770	36617	36081	35808	35388
Passenger Cars	Gasoline >2,0 l	Euro II	1997	2000									12432	27315	44923	61899
Passenger Cars	Gasoline >2,0 l	Euro III	2001	2005												
Passenger Cars	Gasoline >2,0 l	Euro IV	2006	2010												
Passenger Cars	Diesel <2,0 l	Conventional	0	1990	75828	79714	75794	72294	68535	62144	58848	55004	48251	43893	43004	42604
Passenger Cars	Diesel <2,0 l	Euro I	1991	1996			4042	8018	11872	18305	24557	31177	31314	31730	35118	39314
Passenger Cars	Diesel <2,0 l	Euro II	1997	2000									7046	14640	23084	31541
Passenger Cars	Diesel <2,0 l	Euro III	2001	2005												
Passenger Cars	Diesel <2,0 l	Euro IV	2006	2010												
Passenger Cars	Diesel >2,0 l	Conventional	0	1990	3451	3703	3556	3425	3281	3040	2906	2747	2461	2266	2237	2228
Passenger Cars	Diesel >2,0 l	Euro I	1991	1996			213	437	668	1078	1499	1921	1928	1952	2161	2420

Continued

Sector	Subsector	Tech 2	FYear	LYear	1985	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Passenger Cars	Diesel >2,0 l	Euro II	1997	2000									655	1478	2711	4232
Passenger Cars	Diesel >2,0 l	Euro III	2001	2005												
Passenger Cars	Diesel >2,0 l	Euro IV	2006	2010												
Passenger Cars	LPG	Conventional	0	1990	287	286	286	288	289	289	301	311	172	97	44	32
Passenger Cars	2-Stroke	Conventional	0	9999	4823	5417	4804	4308	3747	3029	2443	1824	1248	761	400	300
Light Duty Vehicles	Gasoline <3,5t	Conventional	0	1994	33049	42333	43215	44179	45486	47261	44601	41519	37209	34454	31489	28488
Light Duty Vehicles	Gasoline <3,5t	Euro I	1995	1998							4259	8524	12645	17212	16632	15979
Light Duty Vehicles	Gasoline <3,5t	Euro II	1999	2001											4705	9299
Light Duty Vehicles	Gasoline <3,5t	Euro III	2002	2006												
Light Duty Vehicles	Gasoline <3,5t	Euro IV	2007	2011												
Light Duty Vehicles	Diesel <3,5 t	Conventional	0	1994	121431	155543	158781	162324	167129	173650	163877	152553	142109	131572	122992	115695
Light Duty Vehicles	Diesel <3,5 t	Euro I	1995	1998							15648	31318	48292	65727	64964	64894
Light Duty Vehicles	Diesel <3,5 t	Euro II	1999	2001											18376	37766
Light Duty Vehicles	Diesel <3,5 t	Euro III	2002	2006												
Light Duty Vehicles	Diesel <3,5 t	Euro IV	2007	2011												
Heavy Duty Vehicles	Gasoline >3,5 t	Conventional	0	9999	251	250	255	260	268	279	288	295	261	274	253	257
Heavy Duty Vehicles	Diesel 3,5 - 7,5 t	Conventional	0	1993	5140	5108	5214	5330	5369	5087	4775	4418	3891	3585	2986	2329
Heavy Duty Vehicles	Diesel 3,5 - 7,5 t	Euro I	1994	1996					120	616	1121	1488	1421	1415	1251	1042
Heavy Duty Vehicles	Diesel 3,5 - 7,5 t	Euro II	1997	2001								132	655	1213	1598	1682
Heavy Duty Vehicles	Diesel 3,5 - 7,5 t	Euro III	2002	2006												114
Heavy Duty Vehicles	Diesel 3,5 - 7,5 t	Euro IV	2007	2009												
Heavy Duty Vehicles	Diesel 3,5 - 7,5 t	Euro V	2010	2014												
Heavy Duty Vehicles	Diesel 7,5 - 16 t	Conventional	0	1993	10350	10286	10500	10734	10811	10243	9615	8897	7590	6413	5443	4921
Heavy Duty Vehicles	Diesel 7,5 - 16 t	Euro I	1994	1996					241	1240	2257	2997	2772	2531	2281	2201
Heavy Duty Vehicles	Diesel 7,5 - 16 t	Euro II	1997	2001								265	1278	2171	2914	3556
Heavy Duty Vehicles	Diesel 7,5 - 16 t	Euro III	2002	2006												242
Heavy Duty Vehicles	Diesel 7,5 - 16 t	Euro IV	2007	2009												
Heavy Duty Vehicles	Diesel 7,5 - 16 t	Euro V	2010	2014												
Heavy Duty Vehicles	Diesel 16 - 32 t	Conventional	0	1993	13115	13034	13306	13602	13700	12981	12184	11274	10431	9548	8709	7677
Heavy Duty Vehicles	Diesel 16 - 32 t	Euro I	1994	1996					305	1571	2860	3798	3810	3768	3649	3434
Heavy Duty Vehicles	Diesel 16 - 32 t	Euro II	1997	2001								336	1757	3232	4662	5547
Heavy Duty Vehicles	Diesel 16 - 32 t	Euro III	2002	2006												377
Heavy Duty Vehicles	Diesel 16 - 32 t	Euro IV	2007	2009												
Heavy Duty Vehicles	Diesel 16 - 32 t	Euro V	2010	2014												
Heavy Duty Vehicles	Diesel >32t	Conventional	0	1993	11517	11446	11684	11944	12030	11398	10699	9900	9086	8469	7931	7123
Heavy Duty Vehicles	Diesel >32t	Euro I	1994	1996					268	1379	2511	3335	3318	3342	3323	3186

Continued

Sector	Subsector	Tech 2	FYear	LYear	1985	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Heavy Duty Vehicles	Diesel >32t	Euro II	1997	2001								295	1530	2866	4246	5147
Heavy Duty Vehicles	Diesel >32t	Euro III	2002	2006												350
Heavy Duty Vehicles	Diesel >32t	Euro IV	2007	2009												
Heavy Duty Vehicles	Diesel >32t	Euro V	2010	2014												
Buses	Urban Buses	Conventional	0	1993	4712	4753	4561	4522	4490	4083	3635	3261	2946	2792	2542	2319
Buses	Urban Buses	Euro I	1994	1996						390	746	1084	1060	972	913	852
Buses	Urban Buses	Euro II	1997	2001									390	729	1053	1345
Buses	Urban Buses	Euro III	2002	2006												
Buses	Urban Buses	Euro IV	2007	2009												
Buses	Coaches	Conventional	0	1993	3298	3327	2868	3007	3086	2927	4507	4156	3662	3369	3007	2724
Buses	Coaches	Euro I	1994	1996						280	925	1381	1318	1173	1080	1001
Buses	Coaches	Euro II	1997	2001									485	879	1246	1579
Buses	Coaches	Euro III	2002	2006												
Buses	Coaches	Euro IV	2007	2009												
Mopeds	<50 cm³	Conventional	0	1999	151000	120000	118000	113000	109000	105000	114167	123333	132500	141667	150833	143607
Mopeds	<50 cm³	Euro I	2000	2003												16393
Mopeds	<50 cm³	Euro II	2004	9999												
Motorcycles	2-stroke >50 cm³	Conventional	0	1999	6209	6617	6804	6904	7111	7406	7672	8214	8980	9598	10385	11054
Motorcycles	4-stroke <250 cm³	Conventional	0	1999	7037	7499	7712	7824	8059	8394	8695	9310	10177	10878	11769	11670
Motorcycles	4-stroke <250 cm³	Euro I	2000	2003												858
Motorcycles	4-stroke <250 cm³	Euro II	2004	2006												
Motorcycles	4-stroke <250 cm³	Euro III	2007	9999												
Motorcycles	4-stroke 250 - 750 cm³	Conventional	0	1999	19352	20622	21207	21516	22162	23083	23911	25602	27986	29914	32365	32093
Motorcycles	4-stroke 250 - 750 cm³	Euro I	2000	2003												2360
Motorcycles	4-stroke 250 - 750 cm³	Euro II	2004	2006												
Motorcycles	4-stroke >750 cm³	Conventional	0	1999	8796	9374	9639	9780	10074	10492	10869	11637	12721	13597	14712	14588
Motorcycles	4-stroke >750 cm³	Euro I	2000	2003												1073
Motorcycles	4-stroke >750 cm³	Euro II	2004	2006												

Continued

Sector	Subsector	Tech 2	FYear	LYear	2001	2002	2003	2004	2005	2006	2007
Passenger Cars	Gasoline <1,4 l	PRE ECE	0	1969	1614	1475	1392	1313	1313	1313	1313
Passenger Cars	Gasoline <1,4 l	ECE 15/00-01	1970	1978	15837	14155	13149	12404	12335	12279	12102
Passenger Cars	Gasoline <1,4 l	ECE 15/02	1979	1980	5510	4178	3128	2433	2882	2869	2828
Passenger Cars	Gasoline <1,4 l	ECE 15/03	1981	1985	97964	79041	60723	45824	25489	14555	8865

Continued

Sector	Subsector	Tech 2	FYear	LYear	2001	2002	2003	2004	2005	2006	2007
Passenger Cars	Gasoline <1,4 l	ECE 15/04	1986	1990	219216	194543	171430	142490	133653	117770	97775
Passenger Cars	Gasoline <1,4 l	Euro I	1991	1996	201708	197423	192152	185488	183896	185747	175728
Passenger Cars	Gasoline <1,4 l	Euro II	1997	2000	132812	130153	128898	126400	133689	129230	130820
Passenger Cars	Gasoline <1,4 l	Euro III	2001	2005	21858	47428	70311	99658	126777	128423	137270
Passenger Cars	Gasoline <1,4 l	Euro IV	2006	2010						31558	54861
Passenger Cars	Gasoline 1,4 - 2,0 l	PRE ECE	0	1969	1255	1147	1083	1021	1021	1021	1021
Passenger Cars	Gasoline 1,4 - 2,0 l	ECE 15/00-01	1970	1978	11077	9923	9230	8707	8852	8964	8986
Passenger Cars	Gasoline 1,4 - 2,0 l	ECE 15/02	1979	1980	3500	2659	1987	1545	1858	1892	1908
Passenger Cars	Gasoline 1,4 - 2,0 l	ECE 15/03	1981	1985	55300	44572	34238	25810	14529	8564	5515
Passenger Cars	Gasoline 1,4 - 2,0 l	ECE 15/04	1986	1990	149915	133745	118448	99092	86463	72814	58779
Passenger Cars	Gasoline 1,4 - 2,0 l	Euro I	1991	1996	367136	359959	351645	340424	286124	227403	169862
Passenger Cars	Gasoline 1,4 - 2,0 l	Euro II	1997	2000	320971	314678	311808	305621	334798	342059	322170
Passenger Cars	Gasoline 1,4 - 2,0 l	Euro III	2001	2005	49700	105323	147067	195430	250309	274132	321955
Passenger Cars	Gasoline 1,4 - 2,0 l	Euro IV	2006	2010						52995	96186
Passenger Cars	Gasoline >2,0 l	PRE ECE	0	1969	120	109	103	97	97	97	97
Passenger Cars	Gasoline >2,0 l	ECE 15/00-01	1970	1978	986	885	825	778	807	836	856
Passenger Cars	Gasoline >2,0 l	ECE 15/02	1979	1980	280	212	159	123	147	148	147
Passenger Cars	Gasoline >2,0 l	ECE 15/03	1981	1985	8009	6459	4964	3744	2045	1103	592
Passenger Cars	Gasoline >2,0 l	ECE 15/04	1986	1990	19699	17377	15265	12607	12107	10565	8778
Passenger Cars	Gasoline >2,0 l	Euro I	1991	1996	35024	34329	33516	32431	27636	23084	18339
Passenger Cars	Gasoline >2,0 l	Euro II	1997	2000	60799	59506	58896	57815	48867	39683	32828
Passenger Cars	Gasoline >2,0 l	Euro III	2001	2005	15179	30712	45080	65819	82828	77816	76346
Passenger Cars	Gasoline >2,0 l	Euro IV	2006	2010						22245	36980
Passenger Cars	Diesel <2,0 l	Conventional	0	1990	42641	42100	40525	38619	38012	37146	40829
Passenger Cars	Diesel <2,0 l	Euro I	1991	1996	43578	48670	53462	59968	62042	63663	71580
Passenger Cars	Diesel <2,0 l	Euro II	1997	2000	34764	38842	43327	49262	61839	72606	93778
Passenger Cars	Diesel <2,0 l	Euro III	2001	2005	5482	13338	21371	33648	49775	62020	95071
Passenger Cars	Diesel <2,0 l	Euro IV	2006	2010						13028	31275
Passenger Cars	Diesel >2,0 l	Conventional	0	1990	2229	2187	2096	1978	2005	1958	2149
Passenger Cars	Diesel >2,0 l	Euro I	1991	1996	2683	2998	3295	3698	3647	3556	3795
Passenger Cars	Diesel >2,0 l	Euro II	1997	2000	4658	5196	5790	6592	6450	6112	6792
Passenger Cars	Diesel >2,0 l	Euro III	2001	2005	1163	2682	4432	7505	10932	11986	15797
Passenger Cars	Diesel >2,0 l	Euro IV	2006	2010						3426	7652
Passenger Cars	LPG	Conventional	0	1990	63	21	15	15	15	15	10
Passenger Cars	2-Stroke	Conventional	0	9999	200	150	100	50			
Light Duty Vehicles	Gasoline <3,5t	Conventional	0	1994	25423	21615	18838	14576	12300	9827	6041

Continued

Sector	Subsector	Tech 2	FYear	LYear	2001	2002	2003	2004	2005	2006	2007
Light Duty Vehicles	Gasoline <3,5t	Euro I	1995	1998	15527	15049	13949	14793	14462	13766	10509
Light Duty Vehicles	Gasoline <3,5t	Euro II	1999	2001	14017	13917	13805	14126	14061	13667	10693
Light Duty Vehicles	Gasoline <3,5t	Euro III	2002	2006		5140	10719	16724	23033	29145	23176
Light Duty Vehicles	Gasoline <3,5t	Euro IV	2007	2011							5439
Light Duty Vehicles	Diesel <3,5 t	Conventional	0	1994	105397	92990	82927	66760	59477	51497	37477
Light Duty Vehicles	Diesel <3,5 t	Euro I	1995	1998	64370	64743	61406	67753	69932	72140	65198
Light Duty Vehicles	Diesel <3,5 t	Euro II	1999	2001	58112	59870	60771	64697	67990	71620	66341
Light Duty Vehicles	Diesel <3,5 t	Euro III	2002	2006		22112	47186	76596	111375	152728	143794
Light Duty Vehicles	Diesel <3,5 t	Euro IV	2007	2011							33742
Heavy Duty Vehicles	Gasoline >3,5 t	Conventional	0	9999	249	249	247	233	252	266	273
Heavy Duty Vehicles	Diesel 3,5 - 7,5 t	Conventional	0	1993	1910	1671	1351	1007	779	577	381
Heavy Duty Vehicles	Diesel 3,5 - 7,5 t	Euro I	1994	1996	936	938	796	883	817	756	695
Heavy Duty Vehicles	Diesel 3,5 - 7,5 t	Euro II	1997	2001	1720	1788	1608	1768	1677	1600	1508
Heavy Duty Vehicles	Diesel 3,5 - 7,5 t	Euro III	2002	2006	354	845	1279	1892	2350	2742	2655
Heavy Duty Vehicles	Diesel 3,5 - 7,5 t	Euro IV	2007	2009					16	95	502
Heavy Duty Vehicles	Diesel 3,5 - 7,5 t	Euro V	2010	2014					5	34	189
Heavy Duty Vehicles	Diesel 7,5 - 16 t	Conventional	0	1993	4063	3014	2468	1544	1195	885	585
Heavy Duty Vehicles	Diesel 7,5 - 16 t	Euro I	1994	1996	1992	1692	1454	1354	1253	1160	1065
Heavy Duty Vehicles	Diesel 7,5 - 16 t	Euro II	1997	2001	3660	3226	2939	2711	2572	2454	2312
Heavy Duty Vehicles	Diesel 7,5 - 16 t	Euro III	2002	2006	754	1525	2336	2901	3604	4205	4072
Heavy Duty Vehicles	Diesel 7,5 - 16 t	Euro IV	2007	2009					25	146	771
Heavy Duty Vehicles	Diesel 7,5 - 16 t	Euro V	2010	2014					8	52	289
Heavy Duty Vehicles	Diesel 16 - 32 t	Conventional	0	1993	6576	5309	4389	2930	2267	1678	1110
Heavy Duty Vehicles	Diesel 16 - 32 t	Euro I	1994	1996	3224	2981	2585	2569	2377	2201	2021
Heavy Duty Vehicles	Diesel 16 - 32 t	Euro II	1997	2001	5923	5683	5225	5144	4880	4656	4387
Heavy Duty Vehicles	Diesel 16 - 32 t	Euro III	2002	2006	1221	2686	4154	5505	6837	7978	7726
Heavy Duty Vehicles	Diesel 16 - 32 t	Euro IV	2007	2009					48	277	1462
Heavy Duty Vehicles	Diesel 16 - 32 t	Euro V	2010	2014					16	98	549
Heavy Duty Vehicles	Diesel >32t	Conventional	0	1993	6299	5272	4528	3092	2392	1771	1171
Heavy Duty Vehicles	Diesel >32t	Euro I	1994	1996	3088	2960	2667	2711	2508	2323	2133
Heavy Duty Vehicles	Diesel >32t	Euro II	1997	2001	5673	5643	5391	5428	5150	4914	4630
Heavy Duty Vehicles	Diesel >32t	Euro III	2002	2006	1169	2667	4286	5809	7215	8419	8153
Heavy Duty Vehicles	Diesel >32t	Euro IV	2007	2009					51	292	1543
Heavy Duty Vehicles	Diesel >32t	Euro V	2010	2014					17	103	579
Buses	Urban Buses	Conventional	0	1993	2159	1977	1859	1711	1551	1381	1210
Buses	Urban Buses	Euro I	1994	1996	792	752	713	663	643	614	581

Continued

Sector	Subsector	Tech 2	FYear	LYear	2001	2002	2003	2004	2005	2006	2007
Buses	Urban Buses	Euro II	1997	2001	1596	1525	1447	1345	1317	1273	1220
Buses	Urban Buses	Euro III	2002	2006		346	670	951	1275	1585	1534
Buses	Urban Buses	Euro IV	2007	2009							344
Buses	Coaches	Conventional	0	1993	2444	2165	1962	1773	1542	1328	1119
Buses	Coaches	Euro I	1994	1996	896	823	752	687	639	591	538
Buses	Coaches	Euro II	1997	2001	1807	1670	1527	1394	1309	1224	1128
Buses	Coaches	Euro III	2002	2006		379	706	986	1267	1524	1418
Buses	Coaches	Euro IV	2007	2009							318
Mopeds	<50 cm³	Conventional	0	1999	136249	128209	120305	112262	98369	82388	66597
Mopeds	<50 cm³	Euro I	2000	2003	28751	42791	48695	46069	45882	50386	53728
Mopeds	<50 cm³	Euro II	2004	9999				10669	24749	36226	48674
Motorcycles	2-stroke >50 cm³	Conventional	0	1999	11367	11582	11850	12326	13158	14241	15400
Motorcycles	4-stroke <250 cm³	Conventional	0	1999	12487	12882	13380	14078	14943	16241	17652
Motorcycles	4-stroke <250 cm³	Euro I	2000	2003	918	1348	1806	1816	2292	2766	3352
Motorcycles	4-stroke <250 cm³	Euro II	2004	2006				604	1187	1879	1831
Motorcycles	4-stroke <250 cm³	Euro III	2007	9999							4340
Motorcycles	4-stroke 250 - 750 cm³	Conventional	0	1999	34338	35424	36794	38714	41092	44663	48542
Motorcycles	4-stroke 250 - 750 cm³	Euro I	2000	2003	2525	3707	4967	4993	6302	7606	9218
Motorcycles	4-stroke 250 - 750 cm³	Euro II	2004	2006				1661	3263	5169	5036
Motorcycles	4-stroke >750 cm³	Conventional	0	1999	15608	16102	16725	17597	18678	20301	22064
Motorcycles	4-stroke >750 cm³	Euro I	2000	2003	1148	1685	2258	2270	2865	3457	4190
Motorcycles	4-stroke >750 cm³	Euro II	2004	2006				755	1483	2349	2289

Annex 2B-2: Mileage data 19852006 for road transport (km)

Sector	Subsector	Tech 2	FYear	LYear	1985	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Passenger Cars	Gasoline <1,4 l	PRE ECE	0	1969	9564	10458	11285	12005	12412	12729	12405	12060	12050	11999	11794	11677
Passenger Cars	Gasoline <1,4 l	ECE 15/00-01	1970	1978	12115	10458	11285	12005	12412	12729	12405	12060	12050	11999	11794	11677
Passenger Cars	Gasoline <1,4 l	ECE 15/02	1979	1980	16052	13358	12280	12005	12412	12729	12405	12060	12050	11999	11794	11677
Passenger Cars	Gasoline <1,4 l	ECE 15/03	1981	1985	18800	16553	17094	17157	16720	16142	14571	12958	12050	11999	11794	11677
Passenger Cars	Gasoline <1,4 l	ECE 15/04	1986	1990		20257	20778	21152	20734	20113	18818	17553	16474	14970	13688	12800
Passenger Cars	Gasoline <1,4 l	Euro I	1991	1996			24567	25667	25746	26068	24555	23306	22300	20949	19624	18422
Passenger Cars	Gasoline <1,4 l	Euro II	1997	2000									26232	25674	24561	23828
Passenger Cars	Gasoline <1,4 l	Euro III	2001	2005												
Passenger Cars	Gasoline <1,4 l	Euro IV	2006	2010												
Passenger Cars	Gasoline 1,4 - 2,0 l	PRE ECE	0	1969	9564	10458	11285	12005	12412	12729	12405	12060	12050	11999	11794	11677
Passenger Cars	Gasoline 1,4 - 2,0 l	ECE 15/00-01	1970	1978	12033	10458	11285	12005	12412	12729	12405	12060	12050	11999	11794	11677
Passenger Cars	Gasoline 1,4 - 2,0 l	ECE 15/02	1979	1980	16044	13352	12269	12005	12412	12729	12405	12060	12050	11999	11794	11677
Passenger Cars	Gasoline 1,4 - 2,0 l	ECE 15/03	1981	1985	18883	16515	17059	17121	16659	16068	14525	12940	12050	11999	11794	11677
Passenger Cars	Gasoline 1,4 - 2,0 l	ECE 15/04	1986	1990		20402	20935	21291	20886	20231	18942	17667	16584	15142	13875	12961
Passenger Cars	Gasoline 1,4 - 2,0 l	Euro I	1991	1996			24567	25726	25975	26475	25308	24084	23002	21643	20226	18954
Passenger Cars	Gasoline 1,4 - 2,0 l	Euro II	1997	2000									26232	25700	24547	23722
Passenger Cars	Gasoline 1,4 - 2,0 l	Euro III	2001	2005												
Passenger Cars	Gasoline 1,4 - 2,0 l	Euro IV	2006	2010												
Passenger Cars	Gasoline >2,0 l	PRE ECE	0	1969	9564	10458	11285	12005	12412	12729	12405	12060	12050	11999	11794	11677
Passenger Cars	Gasoline >2,0 l	ECE 15/00-01	1970	1978	12052	10458	11285	12005	12412	12729	12405	12060	12050	11999	11794	11677
Passenger Cars	Gasoline >2,0 l	ECE 15/02	1979	1980	16050	13361	12285	12005	12412	12729	12405	12060	12050	11999	11794	11677
Passenger Cars	Gasoline >2,0 l	ECE 15/03	1981	1985	18834	16582	17121	17200	16793	16180	14593	12966	12050	11999	11794	11677
Passenger Cars	Gasoline >2,0 l	ECE 15/04	1986	1990		20101	20643	21047	20575	20005	18715	17452	16353	14779	13551	12691
Passenger Cars	Gasoline >2,0 l	Euro I	1991	1996			24567	25712	25924	26398	25184	23952	22880	21524	20119	18864
Passenger Cars	Gasoline >2,0 l	Euro II	1997	2000									26232	25727	24744	24087
Passenger Cars	Gasoline >2,0 l	Euro III	2001	2005												
Passenger Cars	Gasoline >2,0 l	Euro IV	2006	2010												
Passenger Cars	Diesel <2,0 l	Conventional	0	1990	25365	28694	28549	27996	27386	26630	25416	24032	22779	21643	21021	20153
Passenger Cars	Diesel <2,0 l	Euro I	1991	1996			42600	42505	41806	41473	40106	38625	36268	33906	32434	30423
Passenger Cars	Diesel <2,0 l	Euro II	1997	2000									41813	40714	39790	38511
Passenger Cars	Diesel <2,0 l	Euro III	2001	2005												
Passenger Cars	Diesel <2,0 l	Euro IV	2006	2010												
Passenger Cars	Diesel >2,0 l	Conventional	0	1990	26523	29795	29621	28991	28185	27216	25845	24311	22873	21537	20880	20004
Passenger Cars	Diesel >2,0 l	Euro I	1991	1996			42600	42529	41894	41615	40354	38857	36471	34109	32607	30584

Continued

Sector	Subsector	Tech 2	FYear	LYear	1985	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Passenger Cars	Diesel >2,0 l	Euro II	1997	2000									41813	40769	40104	39052
Passenger Cars	Diesel >2,0 l	Euro III	2001	2005												
Passenger Cars	Diesel >2,0 l	Euro IV	2006	2010												
Passenger Cars	LPG	Conventional	0	1990	18832	16538	17080	17144	16698	16113	14553	12950	12050	11999	11794	11677
Passenger Cars	2-Stroke	Conventional	0	9999	18832	16538	17080	17144	16698	16113	14553	12950	12050	11999	11794	11677
Light Duty Vehicles	Gasoline <3,5t	Conventional	0	1994	20184	17544	18019	18706	18894	18937	18138	17727	17852	17884	17453	17612
Light Duty Vehicles	Gasoline <3,5t	Euro I	1995	1998							18138	17727	17852	17884	17453	17612
Light Duty Vehicles	Gasoline <3,5t	Euro II	1999	2001											17453	17612
Light Duty Vehicles	Gasoline <3,5t	Euro III	2002	2006												
Light Duty Vehicles	Gasoline <3,5t	Euro IV	2007	2011												
Light Duty Vehicles	Diesel <3,5 t	Conventional	0	1994	30638	33157	33484	32340	32311	34213	32818	32837	32567	32043	31268	30445
Light Duty Vehicles	Diesel <3,5 t	Euro I	1995	1998							32818	32837	32567	32043	31268	30445
Light Duty Vehicles	Diesel <3,5 t	Euro II	1999	2001											31268	30445
Light Duty Vehicles	Diesel <3,5 t	Euro III	2002	2006												
Light Duty Vehicles	Diesel <3,5 t	Euro IV	2007	2011												
Heavy Duty Vehicles	Gasoline >3,5 t	Conventional	0	9999	38144	37941	38562	39503	37263	36784	36280	35574	32740	33082	33668	34672
Heavy Duty Vehicles	Diesel 3,5 - 7,5 t	Conventional	0	1993	35978	48034	48003	45749	42687	44518	43972	44143	36450	37156	39923	40817
Heavy Duty Vehicles	Diesel 3,5 - 7,5 t	Euro I	1994	1996					42687	44518	43972	44143	36450	37156	39923	40817
Heavy Duty Vehicles	Diesel 3,5 - 7,5 t	Euro II	1997	2001								44143	36450	37156	39923	40817
Heavy Duty Vehicles	Diesel 3,5 - 7,5 t	Euro III	2002	2006												40817
Heavy Duty Vehicles	Diesel 3,5 - 7,5 t	Euro IV	2007	2009												
Heavy Duty Vehicles	Diesel 3,5 - 7,5 t	Euro V	2010	2014												
Heavy Duty Vehicles	Diesel 7,5 - 16 t	Conventional	0	1993	50128	58064	58026	55301	51600	53813	53153	53360	51118	49468	46549	44753
Heavy Duty Vehicles	Diesel 7,5 - 16 t	Euro I	1994	1996					51600	53813	53153	53360	51118	49468	46549	44753
Heavy Duty Vehicles	Diesel 7,5 - 16 t	Euro II	1997	2001								53360	51118	49468	46549	44753
Heavy Duty Vehicles	Diesel 7,5 - 16 t	Euro III	2002	2006												44753
Heavy Duty Vehicles	Diesel 7,5 - 16 t	Euro IV	2007	2009												
Heavy Duty Vehicles	Diesel 7,5 - 16 t	Euro V	2010	2014												
Heavy Duty Vehicles	Diesel 16 - 32 t	Conventional	0	1993	69684	80715	80662	76875	71730	74806	73889	74176	76580	76690	79456	76388
Heavy Duty Vehicles	Diesel 16 - 32 t	Euro I	1994	1996					71730	74806	73889	74176	76580	76690	79456	76388
Heavy Duty Vehicles	Diesel 16 - 32 t	Euro II	1997	2001								74176	76580	76690	79456	76388
Heavy Duty Vehicles	Diesel 16 - 32 t	Euro III	2002	2006												76388
Heavy Duty Vehicles	Diesel 16 - 32 t	Euro IV	2007	2009												
Heavy Duty Vehicles	Diesel 16 - 32 t	Euro V	2010	2014												
Heavy Duty Vehicles	Diesel >32t	Conventional	0	1993	69684	80715	80662	76875	71730	74806	73889	74176	76580	76690	79456	76388
Heavy Duty Vehicles	Diesel >32t	Euro I	1994	1996					71730	74806	73889	74176	76580	76690	79456	76388

Continued

Sector	Subsector	Tech 2	FYear	LYear	1985	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Heavy Duty Vehicles	Diesel >32t	Euro II	1997	2001								74176	76580	76690	79456	76388
Heavy Duty Vehicles	Diesel >32t	Euro III	2002	2006												76388
Heavy Duty Vehicles	Diesel >32t	Euro IV	2007	2009												
Heavy Duty Vehicles	Diesel >32t	Euro V	2010	2014												
Buses	Urban Buses	Conventional	0	1993	92802	112240	117691	113847	116744	127625	126231	126143	123791	120484	118268	115867
Buses	Urban Buses	Euro I	1994	1996						127625	126231	126143	123791	120484	118268	115867
Buses	Urban Buses	Euro II	1997	2001									123791	120484	118268	115867
Buses	Urban Buses	Euro III	2002	2006												
Buses	Urban Buses	Euro IV	2007	2009												
Buses	Coaches	Conventional	0	1993	58168	72331	84744	77381	79680	86020	62473	74025	74537	73139	72747	70668
Buses	Coaches	Euro I	1994	1996						86020	62473	74025	74537	73139	72747	70668
Buses	Coaches	Euro II	1997	2001									74537	73139	72747	70668
Buses	Coaches	Euro III	2002	2006												
Buses	Coaches	Euro IV	2007	2009												
Mopeds	<50 cm³	Conventional	0	1999	2334	2182	2282	2393	2449	2510	2470	2439	2481	2498	2125	1919
Mopeds	<50 cm³	Euro I	2000	2003												1919
Mopeds	<50 cm³	Euro II	2004	9999												
Motorcycles	2-stroke >50 cm³	Conventional	0	1999	6702	6471	6493	6824	6987	7148	7131	7033	7076	7168	7072	7170
Motorcycles	4-stroke <250 cm³	Conventional	0	1999	6702	6471	6493	6824	6987	7148	7131	7033	7076	7168	7072	7170
Motorcycles	4-stroke <250 cm³	Euro I	2000	2003												7170
Motorcycles	4-stroke <250 cm³	Euro II	2004	2006												
Motorcycles	4-stroke <250 cm³	Euro III	2007	9999												
Motorcycles	4-stroke 250 - 750 cm³	Conventional	0	1999	6702	6471	6493	6824	6987	7148	7131	7033	7076	7168	7072	7170
Motorcycles	4-stroke 250 - 750 cm³	Euro I	2000	2003												7170
Motorcycles	4-stroke 250 - 750 cm³	Euro II	2004	2006												
Motorcycles	4-stroke >750 cm³	Conventional	0	1999	6702	6471	6493	6824	6987	7148	7131	7033	7076	7168	7072	7170
Motorcycles	4-stroke >750 cm³	Euro I	2000	2003												7170
Motorcycles	4-stroke >750 cm³	Euro II	2004	2006												

Continued

Sector	Subsector	Tech 2	FYear	LYear	2001	2002	2003	2004	2005	2006	2007
Passenger Cars	Gasoline <1,4 l	PRE ECE	0	1969	11499	11628	11611	11646	11093	10740	10715
Passenger Cars	Gasoline <1,4 l	ECE 15/00-01	1970	1978	11499	11628	11611	11646	11093	10740	10715
Passenger Cars	Gasoline <1,4 l	ECE 15/02	1979	1980	11499	11628	11611	11646	11093	10740	10715

Continued

Sector	Subsector	Tech 2	FYear	LYear	2001	2002	2003	2004	2005	2006	2007
Passenger Cars	Gasoline <1,4 l	ECE 15/03	1981	1985	11499	11628	11611	11646	11093	10740	10715
Passenger Cars	Gasoline <1,4 l	ECE 15/04	1986	1990	11946	11628	11611	11646	11093	10740	10715
Passenger Cars	Gasoline <1,4 l	Euro I	1991	1996	17417	16703	15385	14480	12894	11814	11063
Passenger Cars	Gasoline <1,4 l	Euro II	1997	2000	22154	21228	20262	19167	17555	16294	15431
Passenger Cars	Gasoline <1,4 l	Euro III	2001	2005	25033	24934	25811	23998	22096	20092	19062
Passenger Cars	Gasoline <1,4 l	Euro IV	2006	2010						23380	22991
Passenger Cars	Gasoline 1,4 - 2,0 l	PRE ECE	0	1969	11499	11628	11611	11646	11093	10740	10715
Passenger Cars	Gasoline 1,4 - 2,0 l	ECE 15/00-01	1970	1978	11499	11628	11611	11646	11093	10740	10715
Passenger Cars	Gasoline 1,4 - 2,0 l	ECE 15/02	1979	1980	11499	11628	11611	11646	11093	10740	10715
Passenger Cars	Gasoline 1,4 - 2,0 l	ECE 15/03	1981	1985	11499	11628	11611	11646	11093	10740	10715
Passenger Cars	Gasoline 1,4 - 2,0 l	ECE 15/04	1986	1990	12030	11628	11611	11646	11093	10740	10715
Passenger Cars	Gasoline 1,4 - 2,0 l	Euro I	1991	1996	17934	17241	16099	15270	13761	12432	11275
Passenger Cars	Gasoline 1,4 - 2,0 l	Euro II	1997	2000	22066	21099	20154	19119	17565	16301	15454
Passenger Cars	Gasoline 1,4 - 2,0 l	Euro III	2001	2005	25033	24925	25554	23855	21973	20019	18984
Passenger Cars	Gasoline 1,4 - 2,0 l	Euro IV	2006	2010						23380	22972
Passenger Cars	Gasoline >2,0 l	PRE ECE	0	1969	11499	11628	11611	11646	11093	10740	10715
Passenger Cars	Gasoline >2,0 l	ECE 15/00-01	1970	1978	11499	11628	11611	11646	11093	10740	10715
Passenger Cars	Gasoline >2,0 l	ECE 15/02	1979	1980	11499	11628	11611	11646	11093	10740	10715
Passenger Cars	Gasoline >2,0 l	ECE 15/03	1981	1985	11499	11628	11611	11646	11093	10740	10715
Passenger Cars	Gasoline >2,0 l	ECE 15/04	1986	1990	11875	11628	11611	11646	11093	10740	10715
Passenger Cars	Gasoline >2,0 l	Euro I	1991	1996	17845	17147	15980	15139	13657	12326	11226
Passenger Cars	Gasoline >2,0 l	Euro II	1997	2000	22498	21546	20526	19375	17855	16503	15536
Passenger Cars	Gasoline >2,0 l	Euro III	2001	2005	25033	24906	25737	24025	22152	20194	19251
Passenger Cars	Gasoline >2,0 l	Euro IV	2006	2010						23380	23012
Passenger Cars	Diesel <2,0 l	Conventional	0	1990	19275	18818	18984	19491	19442	19442	19442
Passenger Cars	Diesel <2,0 l	Euro I	1991	1996	28953	27593	25909	25090	23523	22002	20261
Passenger Cars	Diesel <2,0 l	Euro II	1997	2000	36035	34206	33003	32021	30779	29504	28027
Passenger Cars	Diesel <2,0 l	Euro III	2001	2005	40832	40341	39594	40005	38582	36281	34487
Passenger Cars	Diesel <2,0 l	Euro IV	2006	2010						42323	41693
Passenger Cars	Diesel >2,0 l	Conventional	0	1990	19172	18818	18984	19491	19442	19442	19442
Passenger Cars	Diesel >2,0 l	Euro I	1991	1996	29108	27750	26127	25336	23934	22313	20369
Passenger Cars	Diesel >2,0 l	Euro II	1997	2000	36697	34869	33560	32425	31292	29875	28189
Passenger Cars	Diesel >2,0 l	Euro III	2001	2005	40832	40307	39605	40208	38823	36556	34929
Passenger Cars	Diesel >2,0 l	Euro IV	2006	2010						42323	41753
Passenger Cars	LPG	Conventional	0	1990	11499	11628	11611	11646	11093	10280	9368
Passenger Cars	2-Stroke	Conventional	0	9999	11499	11628	11611	11646			

Continued

Sector	Subsector	Tech 2	FYear	LYear	2001	2002	2003	2004	2005	2006	2007
Light Duty Vehicles	Gasoline <3,5t	Conventional	0	1994	17712	17891	17762	17528	16747	16213	16176
Light Duty Vehicles	Gasoline <3,5t	Euro I	1995	1998	17712	17891	17762	17528	16747	16213	16176
Light Duty Vehicles	Gasoline <3,5t	Euro II	1999	2001	17712	17891	17762	17528	16747	16213	16176
Light Duty Vehicles	Gasoline <3,5t	Euro III	2002	2006		17891	17762	17528	16747	16213	16176
Light Duty Vehicles	Gasoline <3,5t	Euro IV	2007	2011							16176
Light Duty Vehicles	Diesel <3,5 t	Conventional	0	1994	29844	29977	31949	32475	32758	32736	34062
Light Duty Vehicles	Diesel <3,5 t	Euro I	1995	1998	29844	29977	31949	32475	32758	32736	34062
Light Duty Vehicles	Diesel <3,5 t	Euro II	1999	2001	29844	29977	31949	32475	32758	32736	34062
Light Duty Vehicles	Diesel <3,5 t	Euro III	2002	2006		29977	31949	32475	32758	32736	34062
Light Duty Vehicles	Diesel <3,5 t	Euro IV	2007	2011							34062
Heavy Duty Vehicles	Gasoline >3,5 t	Conventional	0	9999	40372	41106	41246	41114	38707	37474	37388
Heavy Duty Vehicles	Diesel 3,5 - 7,5 t	Conventional	0	1993	53045	53769	59450	58777	56169	56132	58405
Heavy Duty Vehicles	Diesel 3,5 - 7,5 t	Euro I	1994	1996	53045	53769	59450	58777	56169	56132	58405
Heavy Duty Vehicles	Diesel 3,5 - 7,5 t	Euro II	1997	2001	53045	53769	59450	58777	56169	56132	58405
Heavy Duty Vehicles	Diesel 3,5 - 7,5 t	Euro III	2002	2006	53045	53769	59450	58777	56169	56132	58405
Heavy Duty Vehicles	Diesel 3,5 - 7,5 t	Euro IV	2007	2009					56169	56132	58405
Heavy Duty Vehicles	Diesel 3,5 - 7,5 t	Euro V	2010	2014					56169	56132	58405
Heavy Duty Vehicles	Diesel 7,5 - 16 t	Conventional	0	1993	25194	21993	24033	24842	23740	23724	24685
Heavy Duty Vehicles	Diesel 7,5 - 16 t	Euro I	1994	1996	25194	21993	24033	24842	23740	23724	24685
Heavy Duty Vehicles	Diesel 7,5 - 16 t	Euro II	1997	2001	25194	21993	24033	24842	23740	23724	24685
Heavy Duty Vehicles	Diesel 7,5 - 16 t	Euro III	2002	2006	25194	21993	24033	24842	23740	23724	24685
Heavy Duty Vehicles	Diesel 7,5 - 16 t	Euro IV	2007	2009					23740	23724	24685
Heavy Duty Vehicles	Diesel 7,5 - 16 t	Euro V	2010	2014					23740	23724	24685
Heavy Duty Vehicles	Diesel 16 - 32 t	Conventional	0	1993	82099	82221	87366	91037	86997	86939	90460
Heavy Duty Vehicles	Diesel 16 - 32 t	Euro I	1994	1996	82099	82221	87366	91037	86997	86939	90460
Heavy Duty Vehicles	Diesel 16 - 32 t	Euro II	1997	2001	82099	82221	87366	91037	86997	86939	90460
Heavy Duty Vehicles	Diesel 16 - 32 t	Euro III	2002	2006	82099	82221	87366	91037	86997	86939	90460
Heavy Duty Vehicles	Diesel 16 - 32 t	Euro IV	2007	2009					86997	86939	90460
Heavy Duty Vehicles	Diesel 16 - 32 t	Euro V	2010	2014					86997	86939	90460
Heavy Duty Vehicles	Diesel >32t	Conventional	0	1993	82099	82221	87366	91037	86997	86939	90460
Heavy Duty Vehicles	Diesel >32t	Euro I	1994	1996	82099	82221	87366	91037	86997	86939	90460
Heavy Duty Vehicles	Diesel >32t	Euro II	1997	2001	82099	82221	87366	91037	86997	86939	90460
Heavy Duty Vehicles	Diesel >32t	Euro III	2002	2006	82099	82221	87366	91037	86997	86939	90460
Heavy Duty Vehicles	Diesel >32t	Euro IV	2007	2009					86997	86939	90460
Heavy Duty Vehicles	Diesel >32t	Euro V	2010	2014					86997	86939	90460
Buses	Urban Buses	Conventional	0	1993	111518	111179	118562	120358	116665	116588	121309

Continued

Sector	Subsector	Tech 2	FYear	LYear	2001	2002	2003	2004	2005	2006	2007
Buses	Urban Buses	Euro I	1994	1996	111518	111179	118562	120358	116665	116588	121309
Buses	Urban Buses	Euro II	1997	2001	111518	111179	118562	120358	116665	116588	121309
Buses	Urban Buses	Euro III	2002	2006		111179	118562	120358	116665	116588	121309
Buses	Urban Buses	Euro IV	2007	2009							121309
Buses	Coaches	Conventional	0	1993	70397	72357	77557	83872	81298	81244	84535
Buses	Coaches	Euro I	1994	1996	70397	72357	77557	83872	81298	81244	84535
Buses	Coaches	Euro II	1997	2001	70397	72357	77557	83872	81298	81244	84535
Buses	Coaches	Euro III	2002	2006		72357	77557	83872	81298	81244	84535
Buses	Coaches	Euro IV	2007	2009							84535
Mopeds	<50 cm³	Conventional	0	1999	1526	1550	1547	1529	1460	1413	1410
Mopeds	<50 cm³	Euro I	2000	2003	1526	1550	1547	1529	1460	1413	1410
Mopeds	<50 cm³	Euro II	2004	9999				1529	1460	1413	1410
Motorcycles	2-stroke >50 cm³	Conventional	0	1999	7229	7387	7428	7387	7089	6864	6848
Motorcycles	4-stroke <250 cm³	Conventional	0	1999	7229	7387	7428	7387	7089	6864	6848
Motorcycles	4-stroke <250 cm³	Euro I	2000	2003	7229	7387	7428	7387	7089	6864	6848
Motorcycles	4-stroke <250 cm³	Euro II	2004	2006				7387	7089	6864	6848
Motorcycles	4-stroke <250 cm³	Euro III	2007	9999							6848
Motorcycles	4-stroke 250 - 750 cm³	Conventional	0	1999	7229	7387	7428	7387	7089	6864	6848
Motorcycles	4-stroke 250 - 750 cm³	Euro I	2000	2003	7229	7387	7428	7387	7089	6864	6848
Motorcycles	4-stroke 250 - 750 cm³	Euro II	2004	2006				7387	7089	6864	6848
Motorcycles	4-stroke >750 cm³	Conventional	0	1999	7229	7387	7428	7387	7089	6864	6848
Motorcycles	4-stroke >750 cm³	Euro I	2000	2003	7229	7387	7428	7387	7089	6864	6848
Motorcycles	4-stroke >750 cm³	Euro II	2004	2006				7387	7089	6864	6848

Annex 2B-3: EU directive emission limits for road transportation vehicles

Private cars and light duty vehicles I (<1305 kg).

G prkm		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 pr km		EURO 1	EURO 2	EURO 3[1)]	EURO 4	EURO 5	EURO 6
Normal temp.							
CO	Gasoline	5.17	4.0	4.17	1.81	1.81	1.81
	Diesel	5.17	1.25	0.80	0.63	0.63	0.63
HC	Gasoline	-	-	0.25	0.13	0.13	0.13
NMHC	Gasoline	-	-	-	-	0.9	0.9
NO_x	Gasoline	-	-	0.18	0.10	0.75	0.75
	Diesel	-	-	0.65	0.33	0.235	0.105
$HC+NO_x$	Gasoline	1.4	0.6	-	-	-	-
	Diesel	1.4	1.0/1.3[2)]	0.72	0.39	0.295	0.195
Particulates	Gasoline					0.005	0.005
	Diesel	0.19	0.12/0.14[2)]	0.07	0.04	0.005	0.005
Low temp.							
CO	Gasoline	-	-	-	24	24	24
HC	Gasoline	-	-		2.7	2.7	2.7
Evaporation							
HC[3)]	Gasoline	2.0	2.0	2.0	2.0	2.0	2.0

[1)] Changed test procedure at normal temperatures (40 s warm-up phase omitted) and for evaporation measurements

[2)] Less stringent emission limits for direct injection diesel engines

[3)] Unit: g/test

Light duty vehicles III (>1760 kg)

G pr km		EURO 1	EURO 2	EURO 3[1)]	EURO 4	EURO 5	EURO 6
Normal temp.							
CO	Gasoline	6.9	5.0	5.22	2.27	2.27	2.27
	Diesel	6.9	1.5	0.95	0.74	0.74	0.74
HC	Gasoline	-	-	0.29	0.16	0.16	0.16
NMHC	Gasoline					0.108	0.108
NO_x	Gasoline	-	-	0.21	0.11	0.082	0.082
	Diesel	-	-	0.78	0.39	0.28	0.125
$HC+NO_x$	Gasoline	1.7	0.7	-	-	-	-
	Diesel	1.7	1.2/1.6[2)]	0.86	0.46	0.35	0.215
Particulates	Gasoline					0.005	0.005
	Diesel	0.25	0.17/0.20[2)]	0.10	0.06	0.005	0.005
Low temp.							
CO	Gasoline	-	-	-	30	30	30
HC	Gasoline	-	-	-	3.2	3.2	3.2
Evaporation							
HC[3)]	Gasoline	2.0	2.0	2.0	2.0	2.0	2.0

[1)] Changed test procedure at normal temperatures (40 s warm-up phase omitted) and for evaporation measurements

[2)] Less stringent emission limits for direct injection diesel engines

[3)] Unit: g/test

Heavy duty diesel vehicles

(g pr kWh)		EURO 1	EURO 2	EURO 3	EURO 4	EURO 5	EEV[2)]
	Test[1)]	1993	1996	2001	2006	2009	2000
CO	ECE/ESC	4.5	4.0	2.1	1.5	1.5	1.5
	ETC	-	-	(5.45)	4.0	4.0	3.0
HC	ECE/ESC	1.1	1.1	0.66	0.46	0.46	0.25
	ETC	-	-	(0.78)	0.55	0.55	0.40
NO_x	ECE/ESC	8.0	7.0	5.0	3.5	2.0	2.0
	ETC	-	-	(5.0)	3.5	2.0	2.0
Particulates[3)]	ECE/ESC	0.36/0.61	0.15/0.25	0.10/0.13	0.02	0.02	0.02
	ETC	-	-	(0.16/0.21)	0.03	0.03	0.02
	ELR	-	-	0.8	0.5	0.5	0.15

[1)] Test procedure: Euro 1 og Euro 2: ECE (stationary)

Euro 3: ESC (stationary) + ELR (load response)

Euro 4, Euro 5 og EEV: ESC (stationary) + ETC (transient) + ELR (load response)

[2)] EEV: Emission limits for extra environmental friendly vehicles, used as a basis for economical incitaments (gas fueled vehicles).

[3)] For Euro 1, Euro 2 og Euro 3 less stringent emission limits apply for small engines:

Euro 1: <85 kW

Euro 2: <0,7 l

Euro 3: <0,75 l

Annex 2B-4: Basis emission factors (g pr km)

Sector	Subsector	Tech 2	FYear	LYear	FCu	FCr	FCh	COu	COr	COh	PMu	PMr	PMh	NOxu	NOxr	NOxh
Passenger Cars	Gasoline <1,4 l	PRE ECE	0	1969	67,499	55,000	62,743	27,505	19,333	15,520	0,063	0,044	0,041	1,849	2,062	2,023
Passenger Cars	Gasoline <1,4 l	ECE 15/00-01	1970	1978	58,240	44,460	48,600	18,966	14,480	18,620	0,063	0,044	0,041	1,849	2,062	2,023
Passenger Cars	Gasoline <1,4 l	ECE 15/02	1979	1980	53,248	45,170	51,200	15,859	8,200	8,260	0,063	0,044	0,041	1,619	2,102	2,909
Passenger Cars	Gasoline <1,4 l	ECE 15/03	1981	1985	53,248	45,170	51,200	16,752	8,793	7,620	0,042	0,029	0,029	1,680	2,253	3,276
Passenger Cars	Gasoline <1,4 l	ECE 15/04	1986	1990	51,420	43,440	47,700	9,087	4,956	4,292	0,030	0,020	0,020	1,691	2,089	2,662
Passenger Cars	Gasoline <1,4 l	Euro I	1991	1996	47,399	41,954	46,055	1,765	1,372	1,765	0,003	0,002	0,002	0,273	0,281	0,458
Passenger Cars	Gasoline <1,4 l	Euro II	1997	2000	46,486	39,509	44,016	0,659	0,575	0,749	0,003	0,002	0,002	0,154	0,154	0,181
Passenger Cars	Gasoline <1,4 l	Euro III	2001	2005	48,687	42,255	45,323	0,519	0,691	1,148	0,001	0,001	0,001	0,076	0,060	0,052
Passenger Cars	Gasoline <1,4 l	Euro IV	2006	2010	50,038	44,193	48,285	0,195	0,287	0,529	0,001	0,001	0,001	0,054	0,030	0,019
Passenger Cars	Gasoline 1,4 - 2,0 l	PRE ECE	0	1969	79,277	67,000	76,386	27,505	19,333	15,520	0,063	0,044	0,041	2,164	2,683	3,130
Passenger Cars	Gasoline 1,4 - 2,0 l	ECE 15/00-01	1970	1978	67,779	51,090	60,300	18,966	14,480	18,620	0,063	0,044	0,041	2,164	2,683	3,130
Passenger Cars	Gasoline 1,4 - 2,0 l	ECE 15/02	1979	1980	61,731	50,686	59,680	15,859	8,200	8,260	0,063	0,044	0,041	1,831	2,377	3,283
Passenger Cars	Gasoline 1,4 - 2,0 l	ECE 15/03	1981	1985	61,731	50,686	59,680	16,752	8,793	7,620	0,042	0,029	0,029	1,917	2,580	3,472
Passenger Cars	Gasoline 1,4 - 2,0 l	ECE 15/04	1986	1990	61,652	49,112	52,052	9,087	4,956	4,292	0,030	0,020	0,020	2,122	2,757	3,524
Passenger Cars	Gasoline 1,4 - 2,0 l	Euro I	1991	1996	57,521	48,522	51,518	1,765	1,372	1,765	0,003	0,002	0,002	0,273	0,281	0,458
Passenger Cars	Gasoline 1,4 - 2,0 l	Euro II	1997	2000	56,324	47,687	48,786	0,659	0,575	0,749	0,003	0,002	0,002	0,154	0,154	0,181
Passenger Cars	Gasoline 1,4 - 2,0 l	Euro III	2001	2005	58,259	49,897	53,092	0,519	0,691	1,148	0,001	0,001	0,001	0,076	0,060	0,052
Passenger Cars	Gasoline 1,4 - 2,0 l	Euro IV	2006	2010	60,486	52,793	55,293	0,195	0,287	0,529	0,001	0,001	0,001	0,054	0,030	0,019
Passenger Cars	Gasoline >2,0 l	PRE ECE	0	1969	96,536	80,000	88,267	27,505	19,333	15,520	0,063	0,044	0,041	2,860	4,090	5,500
Passenger Cars	Gasoline >2,0 l	ECE 15/00-01	1970	1978	73,798	57,090	66,300	18,966	14,480	18,620	0,063	0,044	0,041	2,860	4,090	5,500
Passenger Cars	Gasoline >2,0 l	ECE 15/02	1979	1980	75,270	63,260	70,700	15,859	8,200	8,260	0,063	0,044	0,041	2,066	2,675	3,680
Passenger Cars	Gasoline >2,0 l	ECE 15/03	1981	1985	75,270	63,260	70,700	16,752	8,793	7,620	0,042	0,029	0,029	2,806	3,441	4,604
Passenger Cars	Gasoline >2,0 l	ECE 15/04	1986	1990	71,055	58,080	69,900	9,087	4,956	4,292	0,030	0,020	0,020	2,293	2,750	3,687
Passenger Cars	Gasoline >2,0 l	Euro I	1991	1996	74,616	61,902	65,020	1,765	1,372	1,765	0,003	0,002	0,002	0,273	0,281	0,458
Passenger Cars	Gasoline >2,0 l	Euro II	1997	2000	76,837	65,226	66,732	0,659	0,575	0,749	0,003	0,002	0,002	0,154	0,154	0,181
Passenger Cars	Gasoline >2,0 l	Euro III	2001	2005	70,798	57,424	56,826	0,519	0,691	1,148	0,001	0,001	0,001	0,076	0,060	0,052
Passenger Cars	Gasoline >2,0 l	Euro IV	2006	2010	86,099	67,877	65,859	0,195	0,287	0,529	0,001	0,001	0,001	0,054	0,030	0,019
Passenger Cars	Diesel <2,0 l	Conventional	0	1990	57,529	41,209	50,089	0,651	0,472	0,384	0,199	0,132	0,170	0,520	0,433	0,528
Passenger Cars	Diesel <2,0 l	Euro I	1991	1996	47,836	42,807	48,388	0,419	0,215	0,208	0,057	0,062	0,107	0,603	0,562	0,663
Passenger Cars	Diesel <2,0 l	Euro II	1997	2000	50,442	44,117	48,779	0,343	0,110	0,035	0,047	0,039	0,050	0,651	0,555	0,665
Passenger Cars	Diesel <2,0 l	Euro III	2001	2005	48,920	43,427	45,585	0,099	0,041	0,012	0,029	0,030	0,045	0,716	0,665	0,750
Passenger Cars	Diesel <2,0 l	Euro IV	2006	2010	48,920	43,427	45,585	0,083	0,034	0,021	0,029	0,024	0,026	0,539	0,424	0,576
Passenger Cars	Diesel >2,0 l	Conventional	0	1990	57,529	41,209	50,089	0,651	0,472	0,384	0,199	0,132	0,170	0,824	0,723	0,861
Passenger Cars	Diesel >2,0 l	Euro I	1991	1996	65,267	58,299	64,360	0,419	0,215	0,208	0,057	0,062	0,107	0,603	0,562	0,663

Continued

Sector	Subsector	Tech 2	FYear	LYear	FCu	FCr	FCh	COu	COr	COh	PMu	PMr	PMh	NOxu	NOxr	NOxh
Passenger Cars	Diesel >2,0 l	Euro II	1997	2000	65,267	58,299	64,360	0,343	0,110	0,035	0,047	0,039	0,050	0,651	0,555	0,665
Passenger Cars	Diesel >2,0 l	Euro III	2001	2005	65,267	58,299	64,360	0,099	0,041	0,012	0,029	0,030	0,045	0,716	0,665	0,750
Passenger Cars	Diesel >2,0 l	Euro IV	2006	2010	65,267	58,299	64,360	0,083	0,034	0,021	0,029	0,024	0,026	0,539	0,424	0,576
Passenger Cars	LPG	Conventional	0	1990	59,000	45,000	54,000	2,043	2,373	9,723	0,040	0,030	0,025	2,203	2,584	2,861
Light Duty Vehicles	Gasoline <3,5t	Conventional	0	1994	82,270	59,883	56,470	14,925	6,075	7,389	0,040	0,040	0,040	2,671	3,118	3,387
Light Duty Vehicles	Gasoline <3,5t	Euro I	1995	1998	96,450	70,388	66,450	4,187	0,862	1,087	0,003	0,002	0,002	0,427	0,400	0,429
Light Duty Vehicles	Gasoline <3,5t	Euro II	1999	2001	96,450	70,388	66,450	2,554	0,526	0,663	0,003	0,002	0,002	0,145	0,136	0,146
Light Duty Vehicles	Gasoline <3,5t	Euro III	2002	2006	96,450	70,388	66,450	2,177	0,448	0,565	0,001	0,001	0,001	0,090	0,084	0,090
Light Duty Vehicles	Gasoline <3,5t	Euro IV	2007	2011	96,450	70,388	66,450	1,172	0,241	0,304	0,001	0,001	0,001	0,043	0,040	0,043
Light Duty Vehicles	Diesel <3,5 t	Conventional	0	1994	76,718	65,934	72,142	1,124	1,009	1,060	0,285	0,303	0,322	1,673	0,843	0,834
Light Duty Vehicles	Diesel <3,5 t	Euro I	1995	1998	68,860	58,185	63,660	0,393	0,328	0,423	0,070	0,066	0,090	1,138	0,975	1,022
Light Duty Vehicles	Diesel <3,5 t	Euro II	1999	2001	68,860	58,185	63,660	0,393	0,328	0,423	0,070	0,066	0,090	1,138	0,975	1,022
Light Duty Vehicles	Diesel <3,5 t	Euro III	2002	2006	68,860	58,185	63,660	0,322	0,269	0,347	0,047	0,044	0,061	0,740	0,634	0,664
Light Duty Vehicles	Diesel <3,5 t	Euro IV	2007	2011	68,860	58,185	63,660	0,255	0,213	0,275	0,024	0,023	0,032	0,319	0,273	0,286
Heavy Duty Vehicles	Gasoline >3,5 t	Conventional	0	9999	225,000	150,000	165,000	70,000	55,000	55,000	0,400	0,400	0,400	4,500	7,500	7,500
Heavy Duty Vehicles	Diesel 3,5 - 7,5 t	Conventional	0	1993	95,822	87,060	109,160	1,612	1,216	1,267	0,288	0,220	0,231	3,363	3,435	4,412
Heavy Duty Vehicles	Diesel 3,5 - 7,5 t	Euro I	1994	1996	77,226	74,990	96,471	0,533	0,417	0,496	0,111	0,085	0,090	2,343	2,497	3,204
Heavy Duty Vehicles	Diesel 3,5 - 7,5 t	Euro II	1997	2001	72,861	72,179	93,536	0,441	0,364	0,416	0,047	0,043	0,053	2,498	2,575	3,216
Heavy Duty Vehicles	Diesel 3,5 - 7,5 t	Euro III	2002	2006	77,798	76,111	97,038	0,528	0,372	0,375	0,051	0,037	0,037	1,955	1,896	2,330
Heavy Duty Vehicles	Diesel 3,5 - 7,5 t	Euro IV	2007	2009	72,942	71,399	91,133	0,042	0,030	0,031	0,010	0,007	0,006	1,186	1,206	1,520
Heavy Duty Vehicles	Diesel 3,5 - 7,5 t	Euro V	2010	2014	74,123	72,286	92,030	0,042	0,030	0,031	0,010	0,007	0,006	0,678	0,689	0,868
Heavy Duty Vehicles	Diesel 7,5 - 16 t	Conventional	0	1993	186,796	147,006	169,108	2,513	1,722	1,825	0,396	0,272	0,287	8,575	7,259	8,446
Heavy Duty Vehicles	Diesel 7,5 - 16 t	Euro I	1994	1996	157,382	126,707	149,418	1,190	0,822	0,874	0,235	0,160	0,170	5,118	4,333	5,002
Heavy Duty Vehicles	Diesel 7,5 - 16 t	Euro II	1997	2001	151,150	122,421	145,510	0,969	0,726	0,808	0,099	0,078	0,100	5,465	4,544	5,171
Heavy Duty Vehicles	Diesel 7,5 - 16 t	Euro III	2002	2006	158,817	127,460	150,203	1,163	0,780	0,821	0,104	0,071	0,076	4,431	3,535	3,915
Heavy Duty Vehicles	Diesel 7,5 - 16 t	Euro IV	2007	2009	148,977	119,369	139,890	0,085	0,058	0,059	0,020	0,013	0,013	2,649	2,173	2,456
Heavy Duty Vehicles	Diesel 7,5 - 16 t	Euro V	2010	2014	151,867	121,247	141,672	0,086	0,059	0,060	0,021	0,013	0,013	1,514	1,242	1,403
Heavy Duty Vehicles	Diesel 16 - 32 t	Conventional	0	1993	295,313	227,040	230,740	2,803	1,927	1,895	0,549	0,384	0,376	12,512	10,087	10,251
Heavy Duty Vehicles	Diesel 16 - 32 t	Euro I	1994	1996	255,466	198,864	203,490	1,975	1,387	1,365	0,389	0,264	0,255	8,507	6,835	6,905
Heavy Duty Vehicles	Diesel 16 - 32 t	Euro II	1997	2001	245,791	192,865	197,773	1,588	1,198	1,230	0,168	0,124	0,155	8,916	7,118	7,115
Heavy Duty Vehicles	Diesel 16 - 32 t	Euro III	2002	2006	255,628	198,692	202,461	1,886	1,298	1,279	0,168	0,114	0,111	7,153	5,549	5,512
Heavy Duty Vehicles	Diesel 16 - 32 t	Euro IV	2007	2009	238,931	185,357	188,314	0,134	0,092	0,087	0,032	0,021	0,019	4,345	3,428	3,456
Heavy Duty Vehicles	Diesel 16 - 32 t	Euro V	2010	2014	243,448	188,256	190,962	0,136	0,093	0,088	0,032	0,021	0,019	2,483	1,959	1,975
Heavy Duty Vehicles	Diesel >32t	Conventional	0	1993	392,838	311,460	297,380	3,143	2,293	2,190	0,683	0,506	0,478	16,482	13,628	12,693
Heavy Duty Vehicles	Diesel >32t	Euro I	1994	1996	346,235	276,687	264,125	2,662	2,009	1,913	0,524	0,373	0,347	11,621	9,581	8,935
Heavy Duty Vehicles	Diesel >32t	Euro II	1997	2001	336,196	270,809	257,607	2,161	1,731	1,720	0,237	0,175	0,223	12,060	9,895	9,161

Continued

Sector	Subsector	Tech 2	FYear	LYear	FCu	FCr	FCh	COu	COr	COh	PMu	PMr	PMh	NOxu	NOxr	NOxh
Heavy Duty Vehicles	Diesel >32t	Euro III	2002	2006	346,156	276,262	262,095	2,497	1,841	1,759	0,219	0,155	0,143	9,625	7,809	7,238
Heavy Duty Vehicles	Diesel >32t	Euro IV	2007	2009	322,306	256,680	243,232	0,170	0,122	0,112	0,040	0,027	0,024	5,943	4,830	4,589
Heavy Duty Vehicles	Diesel >32t	Euro V	2010	2014	328,104	260,582	246,667	0,172	0,124	0,113	0,041	0,027	0,024	3,396	2,760	2,622
Buses	Urban Buses	Conventional	0	1993	315,796	253,287	219,035	4,741	3,178	2,375	0,751	0,498	0,374	14,511	12,324	10,937
Buses	Urban Buses	Euro I	1994	1996	268,961	219,461	190,892	2,274	1,532	1,059	0,407	0,290	0,211	8,836	7,474	6,391
Buses	Urban Buses	Euro II	1997	2001	259,715	216,150	190,405	2,004	1,359	0,914	0,187	0,141	0,118	9,441	7,809	6,730
Buses	Urban Buses	Euro III	2002	2006	273,102	224,893	195,747	2,218	1,456	0,988	0,176	0,127	0,101	7,997	6,112	4,916
Buses	Urban Buses	Euro IV	2007	2009	257,454	211,375	184,295	0,181	0,112	0,081	0,037	0,024	0,018	4,704	3,850	3,045
Buses	Coaches	Conventional	0	1993	281,771	214,600	198,320	2,640	1,684	1,409	0,538	0,364	0,312	10,938	8,865	8,559
Buses	Coaches	Euro I	1994	1996	259,336	198,133	182,616	2,140	1,405	1,179	0,425	0,277	0,227	8,372	6,741	6,409
Buses	Coaches	Euro II	1997	2001	258,542	198,791	182,581	1,787	1,213	1,071	0,183	0,134	0,119	9,357	7,401	6,978
Buses	Coaches	Euro III	2002	2006	276,957	213,400	197,945	2,202	1,453	1,231	0,202	0,140	0,117	8,039	6,015	5,526
Buses	Coaches	Euro IV	2007	2009	262,234	201,251	186,759	0,171	0,112	0,093	0,040	0,026	0,022	4,796	3,677	3,407
Mopeds	<50 cm³	Conventional	0	1999	25,000	25,000	0,000	13,800	13,800	0,000	0,188	0,188	0,000	0,020	0,020	0,000
Mopeds	<50 cm³	Euro I	2000	2003	15,000	15,000	0,000	5,600	5,600	0,000	0,076	0,076	0,000	0,020	0,020	0,000
Mopeds	<50 cm³	Euro II	2004	9999	12,080	12,080	0,000	1,300	1,300	0,000	0,038	0,038	0,000	0,260	0,260	0,000
Motorcycles	2-stroke >50 cm³	Conventional	0	1999	30,368	32,375	36,950	23,380	25,490	27,500	0,200	0,200	0,200	0,032	0,088	0,133
Motorcycles	4-stroke <250 cm³	Conventional	0	1999	23,340	26,690	35,600	22,380	26,300	38,600	0,020	0,020	0,020	0,130	0,242	0,362
Motorcycles	4-stroke <250 cm³	Euro I	2000	2003	22,060	29,470	52,000	12,901	14,597	15,450	0,020	0,020	0,020	0,245	0,416	0,725
Motorcycles	4-stroke <250 cm³	Euro II	2004	2006	22,060	29,470	52,000	6,472	5,947	9,309	0,005	0,005	0,005	0,195	0,265	0,531
Motorcycles	4-stroke <250 cm³	Euro III	2007	9999	22,060	29,470	52,000	4,705	1,581	2,241	0,005	0,005	0,005	0,126	0,150	0,329
Motorcycles	4-stroke 250 - 750 cm³	Conventional	0	1999	28,580	28,640	34,700	20,440	21,517	25,810	0,020	0,020	0,020	0,136	0,251	0,374
Motorcycles	4-stroke 250 - 750 cm³	Euro I	2000	2003	28,964	29,336	41,300	9,538	13,315	19,810	0,020	0,020	0,020	0,292	0,477	0,757
Motorcycles	4-stroke 250 - 750 cm³	Euro II	2004	2006	28,964	29,336	41,300	6,472	5,947	9,309	0,005	0,005	0,005	0,195	0,265	0,531
Motorcycles	4-stroke >750 cm³	Conventional	0	1999	37,520	34,340	38,600	14,880	18,030	24,300	0,020	0,020	0,020	0,148	0,266	0,392
Motorcycles	4-stroke >750 cm³	Euro I	2000	2003	44,952	36,378	40,800	7,884	6,831	10,800	0,020	0,020	0,020	0,210	0,522	1,092
Motorcycles	4-stroke >750 cm³	Euro II	2004	2006	44,952	36,378	40,800	6,472	5,947	9,309	0,005	0,005	0,005	0,195	0,265	0,531

Sector	Subsector	Tech 2	FYear	LYear	CH4u	CH4r	CH4h	N2Ou	N2Or	N2Oh	NH3u	NH3r	NH3h	VOCu	VOCr	VOCh
Passenger Cars	Gasoline <1,4 l	PRE ECE	0	1969	0,092	0,029	0,026	0,010	0,007	0,007	0,002	0,002	0,002	2,354	1,597	1,247
Passenger Cars	Gasoline <1,4 l	ECE 15/00-01	1970	1978	0,092	0,029	0,026	0,010	0,007	0,007	0,002	0,002	0,002	1,862	1,256	1,121
Passenger Cars	Gasoline <1,4 l	ECE 15/02	1979	1980	0,092	0,029	0,026	0,010	0,007	0,007	0,002	0,002	0,002	1,849	1,061	0,950
Passenger Cars	Gasoline <1,4 l	ECE 15/03	1981	1985	0,092	0,029	0,026	0,010	0,007	0,007	0,002	0,002	0,002	1,849	1,061	0,950
Passenger Cars	Gasoline <1,4 l	ECE 15/04	1986	1990	0,092	0,029	0,026	0,010	0,007	0,007	0,002	0,002	0,002	1,480	0,895	0,698
Passenger Cars	Gasoline <1,4 l	Euro I	1991	1996	0,026	0,016	0,014	0,024	0,009	0,005	0,070	0,132	0,074	0,177	0,121	0,111
Passenger Cars	Gasoline <1,4 l	Euro II	1997	2000	0,017	0,013	0,011	0,012	0,005	0,003	0,163	0,149	0,084	0,071	0,047	0,042

Continued

Sector	Subsector	Tech 2	FYear	LYear	CH4u	CH4r	CH4h	N2Ou	N2Or	N2Oh	NH3u	NH3r	NH3h	VOCu	VOCr	VOCh
Passenger Cars	Gasoline <1,4 l	Euro III	2001	2005	0,003	0,002	0,004	0,001	0,000	0,000	0,002	0,030	0,065	0,015	0,015	0,025
Passenger Cars	Gasoline <1,4 l	Euro IV	2006	2010	0,002	0,002	0,000	0,002	0,000	0,000	0,002	0,029	0,065	0,012	0,014	0,017
Passenger Cars	Gasoline 1,4 - 2,0 l	PRE ECE	0	1969	0,092	0,029	0,026	0,010	0,007	0,007	0,002	0,002	0,002	2,354	1,597	1,247
Passenger Cars	Gasoline 1,4 - 2,0 l	ECE 15/00-01	1970	1978	0,092	0,029	0,026	0,010	0,007	0,007	0,002	0,002	0,002	1,862	1,256	1,121
Passenger Cars	Gasoline 1,4 - 2,0 l	ECE 15/02	1979	1980	0,092	0,029	0,026	0,010	0,007	0,007	0,002	0,002	0,002	1,849	1,061	0,950
Passenger Cars	Gasoline 1,4 - 2,0 l	ECE 15/03	1981	1985	0,092	0,029	0,026	0,010	0,007	0,007	0,002	0,002	0,002	1,849	1,061	0,950
Passenger Cars	Gasoline 1,4 - 2,0 l	ECE 15/04	1986	1990	0,092	0,029	0,026	0,010	0,007	0,007	0,002	0,002	0,002	1,480	0,895	0,698
Passenger Cars	Gasoline 1,4 - 2,0 l	Euro I	1991	1996	0,026	0,016	0,014	0,024	0,009	0,005	0,070	0,132	0,074	0,177	0,121	0,111
Passenger Cars	Gasoline 1,4 - 2,0 l	Euro II	1997	2000	0,017	0,013	0,011	0,012	0,005	0,003	0,163	0,149	0,084	0,071	0,047	0,042
Passenger Cars	Gasoline 1,4 - 2,0 l	Euro III	2001	2005	0,003	0,002	0,004	0,001	0,000	0,000	0,002	0,030	0,065	0,015	0,015	0,025
Passenger Cars	Gasoline 1,4 - 2,0 l	Euro IV	2006	2010	0,002	0,002	0,000	0,002	0,000	0,000	0,002	0,029	0,065	0,012	0,014	0,017
Passenger Cars	Gasoline >2,0 l	PRE ECE	0	1969	0,092	0,029	0,026	0,010	0,007	0,007	0,002	0,002	0,002	2,354	1,597	1,247
Passenger Cars	Gasoline >2,0 l	ECE 15/00-01	1970	1978	0,092	0,029	0,026	0,010	0,007	0,007	0,002	0,002	0,002	1,862	1,256	1,121
Passenger Cars	Gasoline >2,0 l	ECE 15/02	1979	1980	0,092	0,029	0,026	0,010	0,007	0,007	0,002	0,002	0,002	1,849	1,061	0,950
Passenger Cars	Gasoline >2,0 l	ECE 15/03	1981	1985	0,092	0,029	0,026	0,010	0,007	0,007	0,002	0,002	0,002	1,849	1,061	0,950
Passenger Cars	Gasoline >2,0 l	ECE 15/04	1986	1990	0,092	0,029	0,026	0,010	0,007	0,007	0,002	0,002	0,002	1,480	0,895	0,698
Passenger Cars	Gasoline >2,0 l	Euro I	1991	1996	0,026	0,016	0,014	0,024	0,009	0,005	0,070	0,132	0,074	0,177	0,121	0,111
Passenger Cars	Gasoline >2,0 l	Euro II	1997	2000	0,017	0,013	0,011	0,012	0,005	0,003	0,163	0,149	0,084	0,071	0,047	0,042
Passenger Cars	Gasoline >2,0 l	Euro III	2001	2005	0,003	0,002	0,004	0,001	0,000	0,000	0,002	0,029	0,065	0,015	0,015	0,025
Passenger Cars	Gasoline >2,0 l	Euro IV	2006	2010	0,002	0,002	0,000	0,002	0,000	0,000	0,002	0,029	0,065	0,012	0,014	0,017
Passenger Cars	Diesel <2,0 l	Conventional	0	1990	0,028	0,012	0,008	0,000	0,000	0,000	0,001	0,001	0,001	0,145	0,086	0,062
Passenger Cars	Diesel <2,0 l	Euro I	1991	1996	0,011	0,009	0,003	0,002	0,004	0,004	0,001	0,001	0,001	0,053	0,031	0,026
Passenger Cars	Diesel <2,0 l	Euro II	1997	2000	0,007	0,003	0,002	0,004	0,006	0,006	0,001	0,001	0,001	0,034	0,021	0,015
Passenger Cars	Diesel <2,0 l	Euro III	2001	2005	0,003	0,000	0,000	0,009	0,004	0,004	0,001	0,001	0,001	0,018	0,011	0,009
Passenger Cars	Diesel <2,0 l	Euro IV	2006	2010	0,000	0,000	0,000	0,009	0,004	0,004	0,001	0,001	0,001	0,038	0,017	0,012
Passenger Cars	Diesel >2,0 l	Conventional	0	1990	0,028	0,012	0,008	0,000	0,000	0,000	0,001	0,001	0,001	0,145	0,086	0,062
Passenger Cars	Diesel >2,0 l	Euro I	1991	1996	0,011	0,009	0,003	0,002	0,004	0,004	0,001	0,001	0,001	0,080	0,046	0,034
Passenger Cars	Diesel >2,0 l	Euro II	1997	2000	0,007	0,003	0,002	0,004	0,006	0,006	0,001	0,001	0,001	0,098	0,058	0,038
Passenger Cars	Diesel >2,0 l	Euro III	2001	2005	0,003	0,000	0,000	0,009	0,004	0,004	0,001	0,001	0,001	0,038	0,017	0,012
Passenger Cars	Diesel >2,0 l	Euro IV	2006	2010	0,000	0,000	0,000	0,009	0,004	0,004	0,001	0,001	0,001	0,011	0,006	0,006
Passenger Cars	LPG	Conventional	0	1990	0,080	0,035	0,025	0,000	0,000	0,000	0,000	0,000	0,000	1,082	0,667	0,490
Light Duty Vehicles	Gasoline <3,5t	Conventional	0	1994	0,150	0,040	0,025	0,010	0,007	0,007	0,002	0,002	0,002	1,877	0,729	0,446
Light Duty Vehicles	Gasoline <3,5t	Euro I	1995	1998	0,026	0,016	0,014	0,034	0,020	0,010	0,070	0,132	0,074	0,220	0,109	0,078
Light Duty Vehicles	Gasoline <3,5t	Euro II	1999	2001	0,017	0,013	0,011	0,023	0,013	0,008	0,163	0,149	0,084	0,053	0,026	0,019
Light Duty Vehicles	Gasoline <3,5t	Euro III	2002	2006	0,003	0,002	0,004	0,007	0,001	0,001	0,002	0,030	0,065	0,031	0,015	0,011
Light Duty Vehicles	Gasoline <3,5t	Euro IV	2007	2011	0,002	0,002	0,000	0,001	0,000	0,000	0,002	0,030	0,065	0,013	0,007	0,005

Continued

Sector	Subsector	Tech 2	FYear	LYear	CH4u	CH4r	CH4h	N2Ou	N2Or	N2Oh	NH3u	NH3r	NH3h	VOCu	VOCr	VOCh
Light Duty Vehicles	Diesel <3,5 t	Conventional	0	1994	0,028	0,012	0,008	0,000	0,000	0,000	0,001	0,001	0,001	0,131	0,106	0,101
Light Duty Vehicles	Diesel <3,5 t	Euro I	1995	1998	0,011	0,009	0,003	0,002	0,004	0,004	0,001	0,001	0,001	0,131	0,106	0,101
Light Duty Vehicles	Diesel <3,5 t	Euro II	1999	2001	0,007	0,003	0,002	0,004	0,006	0,006	0,001	0,001	0,001	0,131	0,106	0,101
Light Duty Vehicles	Diesel <3,5 t	Euro III	2002	2006	0,003	0,000	0,000	0,009	0,004	0,004	0,001	0,001	0,001	0,081	0,065	0,063
Light Duty Vehicles	Diesel <3,5 t	Euro IV	2007	2011	0,000	0,000	0,000	0,009	0,004	0,004	0,001	0,001	0,001	0,030	0,024	0,023
Heavy Duty Vehicles	Gasoline >3,5 t	Conventional	0	9999	0,140	0,110	0,070	0,006	0,006	0,006	0,002	0,002	0,002	7,000	5,500	3,500
Heavy Duty Vehicles	Diesel 3,5 - 7,5 t	Conventional	0	1993	0,085	0,023	0,020	0,030	0,030	0,030	0,003	0,003	0,003	1,432	0,865	0,648
Heavy Duty Vehicles	Diesel 3,5 - 7,5 t	Euro I	1994	1996	0,085	0,023	0,020	0,030	0,030	0,030	0,003	0,003	0,003	0,285	0,185	0,154
Heavy Duty Vehicles	Diesel 3,5 - 7,5 t	Euro II	1997	2001	0,054	0,020	0,019	0,030	0,030	0,030	0,003	0,003	0,003	0,184	0,118	0,096
Heavy Duty Vehicles	Diesel 3,5 - 7,5 t	Euro III	2002	2006	0,048	0,021	0,018	0,030	0,030	0,030	0,003	0,003	0,003	0,166	0,105	0,082
Heavy Duty Vehicles	Diesel 3,5 - 7,5 t	Euro IV	2007	2009	0,003	0,002	0,001	0,030	0,030	0,030	0,003	0,003	0,003	0,007	0,004	0,003
Heavy Duty Vehicles	Diesel 3,5 - 7,5 t	Euro V	2010	2014	0,003	0,002	0,001	0,030	0,030	0,030	0,003	0,003	0,003	0,007	0,004	0,003
Heavy Duty Vehicles	Diesel 7,5 - 16 t	Conventional	0	1993	0,085	0,023	0,020	0,030	0,030	0,030	0,003	0,003	0,003	1,317	0,833	0,680
Heavy Duty Vehicles	Diesel 7,5 - 16 t	Euro I	1994	1996	0,085	0,023	0,020	0,030	0,030	0,030	0,003	0,003	0,003	0,551	0,364	0,308
Heavy Duty Vehicles	Diesel 7,5 - 16 t	Euro II	1997	2001	0,054	0,020	0,019	0,030	0,030	0,030	0,003	0,003	0,003	0,355	0,231	0,193
Heavy Duty Vehicles	Diesel 7,5 - 16 t	Euro III	2002	2006	0,048	0,021	0,018	0,030	0,030	0,030	0,003	0,003	0,003	0,315	0,204	0,173
Heavy Duty Vehicles	Diesel 7,5 - 16 t	Euro IV	2007	2009	0,003	0,002	0,001	0,030	0,030	0,030	0,003	0,003	0,003	0,013	0,008	0,008
Heavy Duty Vehicles	Diesel 7,5 - 16 t	Euro V	2010	2014	0,003	0,002	0,001	0,030	0,030	0,030	0,003	0,003	0,003	0,014	0,008	0,008
Heavy Duty Vehicles	Diesel 16 - 32 t	Conventional	0	1993	0,175	0,080	0,070	0,030	0,030	0,030	0,003	0,003	0,003	1,094	0,690	0,561
Heavy Duty Vehicles	Diesel 16 - 32 t	Euro I	1994	1996	0,175	0,080	0,070	0,030	0,030	0,030	0,003	0,003	0,003	0,768	0,503	0,419
Heavy Duty Vehicles	Diesel 16 - 32 t	Euro II	1997	2001	0,112	0,070	0,065	0,030	0,030	0,030	0,003	0,003	0,003	0,492	0,319	0,261
Heavy Duty Vehicles	Diesel 16 - 32 t	Euro III	2002	2006	0,098	0,074	0,064	0,030	0,030	0,030	0,003	0,003	0,003	0,436	0,281	0,234
Heavy Duty Vehicles	Diesel 16 - 32 t	Euro IV	2007	2009	0,005	0,006	0,004	0,030	0,030	0,030	0,003	0,003	0,003	0,021	0,013	0,012
Heavy Duty Vehicles	Diesel 16 - 32 t	Euro V	2010	2014	0,005	0,006	0,004	0,030	0,030	0,030	0,003	0,003	0,003	0,021	0,013	0,012
Heavy Duty Vehicles	Diesel >32t	Conventional	0	1993	0,175	0,080	0,070	0,030	0,030	0,030	0,003	0,003	0,003	0,958	0,593	0,482
Heavy Duty Vehicles	Diesel >32t	Euro I	1994	1996	0,175	0,080	0,070	0,030	0,030	0,030	0,003	0,003	0,003	0,889	0,574	0,473
Heavy Duty Vehicles	Diesel >32t	Euro II	1997	2001	0,112	0,070	0,065	0,030	0,030	0,030	0,003	0,003	0,003	0,564	0,363	0,290
Heavy Duty Vehicles	Diesel >32t	Euro III	2002	2006	0,098	0,074	0,064	0,030	0,030	0,030	0,003	0,003	0,003	0,493	0,315	0,260
Heavy Duty Vehicles	Diesel >32t	Euro IV	2007	2009	0,005	0,006	0,004	0,030	0,030	0,030	0,003	0,003	0,003	0,025	0,016	0,014
Heavy Duty Vehicles	Diesel >32t	Euro V	2010	2014	0,005	0,006	0,004	0,030	0,030	0,030	0,003	0,003	0,003	0,025	0,017	0,015
Buses	Urban Buses	Conventional	0	1993	0,175	0,080	0,070	0,030	0,030	0,030	0,003	0,003	0,003	1,830	1,116	0,865
Buses	Urban Buses	Euro I	1994	1996	0,175	0,080	0,070	0,030	0,030	0,030	0,003	0,003	0,003	0,754	0,488	0,395
Buses	Urban Buses	Euro II	1997	2001	0,114	0,052	0,046	0,030	0,030	0,030	0,003	0,003	0,003	0,491	0,318	0,262
Buses	Urban Buses	Euro III	2002	2006	0,103	0,047	0,041	0,030	0,030	0,030	0,003	0,003	0,003	0,437	0,283	0,231
Buses	Urban Buses	Euro IV	2007	2009	0,005	0,002	0,002	0,030	0,030	0,030	0,003	0,003	0,003	0,022	0,015	0,011
Buses	Coaches	Conventional	0	1993	0,175	0,080	0,070	0,030	0,030	0,030	0,003	0,003	0,003	1,008	0,577	0,422

Continued

Sector	Subsector	Tech 2	FYear	LYear	CH4u	CH4r	CH4h	N2Ou	N2Or	N2Oh	NH3u	NH3r	NH3h	VOCu	VOCr	VOCh
Buses	Coaches	Euro I	1994	1996	0,175	0,080	0,070	0,030	0,030	0,030	0,003	0,003	0,003	0,936	0,563	0,441
Buses	Coaches	Euro II	1997	2001	0,114	0,052	0,046	0,030	0,030	0,030	0,003	0,003	0,003	0,623	0,380	0,290
Buses	Coaches	Euro III	2002	2006	0,103	0,047	0,041	0,030	0,030	0,030	0,003	0,003	0,003	0,575	0,354	0,289
Buses	Coaches	Euro IV	2007	2009	0,005	0,002	0,002	0,030	0,030	0,030	0,003	0,003	0,003	0,028	0,017	0,014
Mopeds	<50 cm³	Conventional	0	1999	0,219	0,219	0,000	0,001	0,001	0,001	0,001	0,001	0,001	13,910	13,910	0,000
Mopeds	<50 cm³	Euro I	2000	2003	0,044	0,044	0,000	0,001	0,001	0,001	0,001	0,001	0,001	2,730	2,730	0,000
Mopeds	<50 cm³	Euro II	2004	9999	0,024	0,024	0,000	0,001	0,001	0,001	0,001	0,001	0,001	1,560	1,560	0,000
Motorcycles	2-stroke >50 cm³	Conventional	0	1999	0,150	0,150	0,150	0,002	0,002	0,002	0,002	0,002	0,002	9,340	8,402	8,360
Motorcycles	4-stroke <250 cm³	Conventional	0	1999	0,200	0,200	0,200	0,002	0,002	0,002	0,002	0,002	0,002	1,550	0,960	1,320
Motorcycles	4-stroke <250 cm³	Euro I	2000	2003	0,142	0,144	0,132	0,002	0,002	0,002	0,002	0,002	0,002	1,103	0,870	0,870
Motorcycles	4-stroke <250 cm³	Euro II	2004	2006	0,136	0,092	0,092	0,002	0,002	0,002	0,002	0,002	0,002	1,053	0,557	0,612
Motorcycles	4-stroke <250 cm³	Euro III	2007	9999	0,082	0,032	0,028	0,002	0,002	0,002	0,002	0,002	0,002	0,628	0,193	0,179
Motorcycles	4-stroke 250 - 750 cm³	Conventional	0	1999	0,200	0,200	0,200	0,002	0,002	0,002	0,002	0,002	0,002	1,350	0,944	1,010
Motorcycles	4-stroke 250 - 750 cm³	Euro I	2000	2003	0,148	0,174	0,156	0,002	0,002	0,002	0,002	0,002	0,002	1,002	0,753	0,790
Motorcycles	4-stroke 250 - 750 cm³	Euro II	2004	2006	0,156	0,120	0,122	0,002	0,002	0,002	0,002	0,002	0,002	1,053	0,557	0,612
Motorcycles	4-stroke >750 cm³	Conventional	0	1999	0,200	0,200	0,200	0,002	0,002	0,002	0,002	0,002	0,002	2,520	1,610	1,190
Motorcycles	4-stroke >750 cm³	Euro I	2000	2003	0,092	0,092	0,154	0,002	0,002	0,002	0,002	0,002	0,002	1,170	0,742	0,920
Motorcycles	4-stroke >750 cm³	Euro II	2004	2006	0,084	0,062	0,102	0,002	0,002	0,002	0,002	0,002	0,002	1,053	0,557	0,612

Annex 2B-5: Reduction factors

Sector	Subsector	Tech 2	FYear	LYear	FCuR	FCrR	FChR	COuR	COrR	COhR	PMuR	PMrR	PMhR	NOxuR	NOxrR	NOxhR	VOCuR	VOCrR	VOChR
Passenger Cars	Gasoline <1,4 l	PRE ECE	0	1969	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Passenger Cars	Gasoline <1,4 l	ECE 15/00-01	1970	1978	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Passenger Cars	Gasoline <1,4 l	ECE 15/02	1979	1980	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Passenger Cars	Gasoline <1,4 l	ECE 15/03	1981	1985	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Passenger Cars	Gasoline <1,4 l	ECE 15/04	1986	1990	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Passenger Cars	Gasoline <1,4 l	Euro I	1991	1996	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Passenger Cars	Gasoline <1,4 l	Euro II	1997	2000	1,9	5,8	4,4	62,6	58,1	57,5	0,0	0,0	0,0	43,6	45,2	60,4	60,2	61,3	62,1
Passenger Cars	Gasoline <1,4 l	Euro III	2001	2005	-2,7	-0,7	1,6	70,6	49,6	34,9	60,2	54,6	37,4	72,2	78,5	88,7	91,7	87,5	77,0
Passenger Cars	Gasoline <1,4 l	Euro IV	2006	2010	-5,6	-5,3	-4,8	89,0	79,1	70,1	60,2	54,6	37,4	80,1	89,2	95,9	93,3	88,7	84,5
Passenger Cars	Gasoline 1,4 - 2,0 l	PRE ECE	0	1969	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Passenger Cars	Gasoline 1,4 - 2,0 l	ECE 15/00-01	1970	1978	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Passenger Cars	Gasoline 1,4 - 2,0 l	ECE 15/02	1979	1980	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Passenger Cars	Gasoline 1,4 - 2,0 l	ECE 15/03	1981	1985	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Passenger Cars	Gasoline 1,4 - 2,0 l	ECE 15/04	1986	1990	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Passenger Cars	Gasoline 1,4 - 2,0 l	Euro I	1991	1996	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Passenger Cars	Gasoline 1,4 - 2,0 l	Euro II	1997	2000	2,1	1,7	5,3	62,6	58,1	57,5	0,0	0,0	0,0	43,6	45,2	60,4	60,2	61,3	62,1
Passenger Cars	Gasoline 1,4 - 2,0 l	Euro III	2001	2005	-1,3	-2,8	-3,1	70,6	49,6	34,9	60,2	54,6	37,4	72,2	78,5	88,7	91,7	87,5	77,0
Passenger Cars	Gasoline 1,4 - 2,0 l	Euro IV	2006	2010	-5,2	-8,8	-7,3	89,0	79,1	70,1	60,2	54,6	37,4	80,1	89,2	95,9	93,3	88,7	84,5
Passenger Cars	Gasoline >2,0 l	PRE ECE	0	1969	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Passenger Cars	Gasoline >2,0 l	ECE 15/00-01	1970	1978	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Passenger Cars	Gasoline >2,0 l	ECE 15/02	1979	1980	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Passenger Cars	Gasoline >2,0 l	ECE 15/03	1981	1985	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Passenger Cars	Gasoline >2,0 l	ECE 15/04	1986	1990	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Passenger Cars	Gasoline >2,0 l	Euro I	1991	1996	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Passenger Cars	Gasoline >2,0 l	Euro II	1997	2000	-3,0	-5,4	-2,6	62,6	58,1	57,5	0,0	0,0	0,0	43,6	45,2	60,4	60,2	61,3	62,1
Passenger Cars	Gasoline >2,0 l	Euro III	2001	2005	5,1	7,2	12,6	70,6	49,6	34,9	60,2	54,6	37,4	72,2	78,5	88,7	91,7	87,5	77,0
Passenger Cars	Gasoline >2,0 l	Euro IV	2006	2010	-15,4	-9,7	-1,3	89,0	79,1	70,1	60,2	54,6	37,4	80,1	89,2	95,9	93,3	88,7	84,5
Passenger Cars	Diesel <2,0 l	Conventional	0	1990	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Passenger Cars	Diesel <2,0 l	Euro I	1991	1996	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Passenger Cars	Diesel <2,0 l	Euro II	1997	2000	-5,4	-3,1	-0,8	18,1	48,8	83,0	17,9	36,9	53,2	-7,9	1,2	-0,2	34,8	33,4	41,6
Passenger Cars	Diesel <2,0 l	Euro III	2001	2005	-2,3	-1,4	5,8	76,4	81,1	94,3	48,5	51,9	58,3	-18,7	-18,5	-13,0	65,9	63,3	66,2
Passenger Cars	Diesel <2,0 l	Euro IV	2006	2010	-2,3	-1,4	5,8	80,1	84,2	89,7	49,0	60,6	75,8	10,6	24,5	13,2	27,6	44,3	51,9
Passenger Cars	Diesel >2,0 l	Conventional	0	1990	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0

Continued

Sector	Subsector	Tech 2	FYear	LYear	FCuR	FCrR	FChR	COuR	COrR	COhR	PMuR	PMrR	PMhR	NOxuR	NOxrR	NOxhR	VOCuR	VOCrR	VOChR
Passenger Cars	Diesel >2,0 l	Euro I	1991	1996	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Passenger Cars	Diesel >2,0 l	Euro II	1997	2000	0,0	0,0	0,0	18,1	48,8	83,0	17,9	36,9	53,2	-7,9	1,2	-0,2	-22,1	-25,4	-11,5
Passenger Cars	Diesel >2,0 l	Euro III	2001	2005	0,0	0,0	0,0	76,4	81,1	94,3	48,5	51,9	58,3	-18,7	-18,5	-13,0	52,2	62,7	63,9
Passenger Cars	Diesel >2,0 l	Euro IV	2006	2010	0,0	0,0	0,0	80,1	84,2	89,7	49,0	60,6	75,8	10,6	24,5	13,2	86,4	86,1	83,2
Passenger Cars	LPG	Conventional	0	1990	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Light Duty Vehicles	Gasoline <3,5t	Conventional	0	1994	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Light Duty Vehicles	Gasoline <3,5t	Euro I	1995	1998	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Light Duty Vehicles	Gasoline <3,5t	Euro II	1999	2001	0,0	0,0	0,0	39,0	39,0	39,0	0,0	0,0	0,0	66,0	66,0	66,0	76,0	76,0	76,0
Light Duty Vehicles	Gasoline <3,5t	Euro III	2002	2006	0,0	0,0	0,0	48,0	48,0	48,0	60,2	54,6	37,4	79,0	79,0	79,0	86,0	86,0	86,0
Light Duty Vehicles	Gasoline <3,5t	Euro IV	2007	2011	0,0	0,0	0,0	72,0	72,0	72,0	60,2	54,6	37,4	90,0	90,0	90,0	94,0	94,0	94,0
Light Duty Vehicles	Diesel <3,5 t	Conventional	0	1994	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Light Duty Vehicles	Diesel <3,5 t	Euro I	1995	1998	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Light Duty Vehicles	Diesel <3,5 t	Euro II	1999	2001	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Light Duty Vehicles	Diesel <3,5 t	Euro III	2002	2006	0,0	0,0	0,0	18,0	18,0	18,0	33,0	33,0	33,0	35,0	35,0	35,0	38,0	38,0	38,0
Light Duty Vehicles	Diesel <3,5 t	Euro IV	2007	2011	0,0	0,0	0,0	35,0	35,0	35,0	65,0	65,0	65,0	72,0	72,0	72,0	77,0	77,0	77,0
Heavy Duty Vehicles	Gasoline >3,5 t	Conventional	0	9999	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Heavy Duty Vehicles	Diesel 3,5 - 7,5 t	Conventional	0	1993	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Heavy Duty Vehicles	Diesel 3,5 - 7,5 t	Euro I	1994	1996	19,4	13,9	11,6	67,0	65,7	60,8	61,5	61,4	61,1	30,3	27,3	27,4	80,1	78,6	76,2
Heavy Duty Vehicles	Diesel 3,5 - 7,5 t	Euro II	1997	2001	24,0	17,1	14,3	72,6	70,1	67,1	83,6	80,5	77,2	25,7	25,0	27,1	87,2	86,4	85,1
Heavy Duty Vehicles	Diesel 3,5 - 7,5 t	Euro III	2002	2006	18,8	12,6	11,1	67,3	69,4	70,4	82,2	83,1	84,0	41,9	44,8	47,2	88,4	87,8	87,3
Heavy Duty Vehicles	Diesel 3,5 - 7,5 t	Euro IV	2007	2009	23,9	18,0	16,5	97,4	97,5	97,6	96,6	97,0	97,2	64,7	64,9	65,6	99,4	99,4	99,4
Heavy Duty Vehicles	Diesel 3,5 - 7,5 t	Euro V	2010	2014	22,6	17,0	15,7	97,4	97,5	97,6	96,6	96,9	97,2	79,9	79,9	80,3	99,4	99,4	99,4
Heavy Duty Vehicles	Diesel 7,5 - 16 t	Conventional	0	1993	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Heavy Duty Vehicles	Diesel 7,5 - 16 t	Euro I	1994	1996	15,7	13,8	11,6	52,6	52,2	52,1	40,7	40,9	40,8	40,3	40,3	40,8	58,2	56,3	54,7
Heavy Duty Vehicles	Diesel 7,5 - 16 t	Euro II	1997	2001	19,1	16,7	14,0	61,4	57,8	55,7	75,0	71,3	65,3	36,3	37,4	38,8	73,1	72,3	71,6
Heavy Duty Vehicles	Diesel 7,5 - 16 t	Euro III	2002	2006	15,0	13,3	11,2	53,7	54,7	55,0	73,7	73,7	73,6	48,3	51,3	53,6	76,1	75,5	74,6
Heavy Duty Vehicles	Diesel 7,5 - 16 t	Euro IV	2007	2009	20,2	18,8	17,3	96,6	96,6	96,7	94,9	95,2	95,4	69,1	70,1	70,9	98,8	98,8	98,8
Heavy Duty Vehicles	Diesel 7,5 - 16 t	Euro V	2010	2014	18,7	17,5	16,2	96,6	96,6	96,7	94,8	95,1	95,3	82,3	82,9	83,4	98,8	98,8	98,7
Heavy Duty Vehicles	Diesel 16 - 32 t	Conventional	0	1993	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Heavy Duty Vehicles	Diesel 16 - 32 t	Euro I	1994	1996	13,5	12,4	11,8	29,5	28,0	28,0	29,2	31,4	32,1	32,0	32,2	32,6	29,8	27,2	25,4
Heavy Duty Vehicles	Diesel 16 - 32 t	Euro II	1997	2001	16,8	15,1	14,3	43,4	37,9	35,1	69,4	67,6	58,9	28,7	29,4	30,6	55,0	53,7	53,6
Heavy Duty Vehicles	Diesel 16 - 32 t	Euro III	2002	2006	13,4	12,5	12,3	32,7	32,7	32,5	69,4	70,2	70,5	42,8	45,0	46,2	60,2	59,2	58,3
Heavy Duty Vehicles	Diesel 16 - 32 t	Euro IV	2007	2009	19,1	18,4	18,4	95,2	95,2	95,4	94,2	94,6	94,9	65,3	66,0	66,3	98,0	98,0	97,9
Heavy Duty Vehicles	Diesel 16 - 32 t	Euro V	2010	2014	17,6	17,1	17,2	95,1	95,2	95,4	94,1	94,6	94,9	80,2	80,6	80,7	97,9	97,9	97,9
Heavy Duty Vehicles	Diesel >32t	Conventional	0	1993	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Heavy Duty Vehicles	Diesel >32t	Euro I	1994	1996	11,9	11,2	11,2	15,3	12,4	12,6	23,2	26,4	27,5	29,5	29,7	29,6	7,3	3,2	2,0

Continued

Sector	Subsector	Tech 2	FYear	LYear	FCuR	FCrR	FChR	COuR	COrR	COhR	PMuR	PMrR	PMhR	NOxuR	NOxrR	NOxhR	VOCuR	VOCrR	VOChR
Heavy Duty Vehicles	Diesel >32t	Euro II	1997	2001	14,4	13,1	13,4	31,3	24,5	21,4	65,2	65,4	53,4	26,8	27,4	27,8	41,2	38,8	40,0
Heavy Duty Vehicles	Diesel >32t	Euro III	2002	2006	11,9	11,3	11,9	20,6	19,7	19,7	68,0	69,4	70,0	41,6	42,7	43,0	48,6	46,9	46,2
Heavy Duty Vehicles	Diesel >32t	Euro IV	2007	2009	18,0	17,6	18,2	94,6	94,7	94,9	94,1	94,7	95,0	63,9	64,6	63,8	97,4	97,4	97,3
Heavy Duty Vehicles	Diesel >32t	Euro V	2010	2014	16,5	16,3	17,1	94,5	94,6	94,9	94,0	94,6	94,9	79,4	79,7	79,3	97,3	97,3	97,3
Buses	Urban Buses	Conventional	0	1993	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Buses	Urban Buses	Euro I	1994	1996	14,8	13,4	12,8	52,0	51,8	55,4	45,7	41,8	43,7	39,1	39,4	41,6	58,8	56,3	54,4
Buses	Urban Buses	Euro II	1997	2001	17,8	14,7	13,1	57,7	57,2	61,5	75,0	71,7	68,5	34,9	36,6	38,5	73,2	71,5	69,7
Buses	Urban Buses	Euro III	2002	2006	13,5	11,2	10,6	53,2	54,2	58,4	76,6	74,5	72,9	44,9	50,4	55,1	76,1	74,6	73,3
Buses	Urban Buses	Euro IV	2007	2009	18,5	16,5	15,9	96,2	96,5	96,6	95,0	95,2	95,2	67,6	68,8	72,2	98,8	98,7	98,7
Buses	Coaches	Conventional	0	1993	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Buses	Coaches	Euro I	1994	1996	8,0	7,7	7,9	18,9	16,5	16,3	20,9	23,8	27,1	23,5	24,0	25,1	7,2	2,5	-4,4
Buses	Coaches	Euro II	1997	2001	8,2	7,4	7,9	32,3	28,0	24,0	66,0	63,1	61,7	14,5	16,5	18,5	38,2	34,1	31,3
Buses	Coaches	Euro III	2002	2006	1,7	0,6	0,2	16,6	13,7	12,6	62,3	61,6	62,4	26,5	32,1	35,4	43,0	38,7	31,7
Buses	Coaches	Euro IV	2007	2009	6,9	6,2	5,8	93,5	93,3	93,4	92,5	92,9	92,9	56,1	58,5	60,2	97,0	96,9	96,6
Mopeds	<50 cm³	Conventional	0	1999	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Mopeds	<50 cm³	Euro I	2000	2003	40,0	40,0	0,0	59,4	59,4	0,0	59,8	59,8	0,0	0,0	0,0	0,0	80,4	80,4	0,0
Mopeds	<50 cm³	Euro II	2004	9999	51,7	51,7	0,0	90,6	90,6	0,0	80,0	80,0	0,0	-1200,0	-1200,0	0,0	88,8	88,8	0,0
Motorcycles	2-stroke >50 cm³	Conventional	0	1999	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Motorcycles	4-stroke <250 cm³	Conventional	0	1999	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Motorcycles	4-stroke <250 cm³	Euro I	2000	2003	5,5	-10,4	-46,1	42,4	44,5	60,0	0,0	0,0	0,0	-88,7	-72,0	-100,3	28,9	9,4	34,1
Motorcycles	4-stroke <250 cm³	Euro II	2004	2006	5,5	-10,4	-46,1	71,1	77,4	75,9	75,0	75,0	75,0	-50,0	-9,5	-46,7	32,1	42,0	53,6
Motorcycles	4-stroke <250 cm³	Euro III	2007	9999	5,5	-10,4	-46,1	79,0	94,0	94,2	75,0	75,0	75,0	3,1	38,0	9,1	59,5	79,9	86,4
Motorcycles	4-stroke 250 - 750 cm³	Conventional	0	1999	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Motorcycles	4-stroke 250 - 750 cm³	Euro I	2000	2003	-1,3	-2,4	-19,0	53,3	38,1	23,2	0,0	0,0	0,0	-114,6	-90,2	-102,4	25,7	20,2	21,8
Motorcycles	4-stroke 250 - 750 cm³	Euro II	2004	2006	-1,3	-2,4	-19,0	68,3	72,4	63,9	75,0	75,0	75,0	-43,4	-5,6	-42,0	22,0	41,0	39,4
Motorcycles	4-stroke >750 cm³	Conventional	0	1999	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Motorcycles	4-stroke >750 cm³	Euro I	2000	2003	-19,8	-5,9	-5,7	47,0	62,1	55,6	0,0	0,0	0,0	-41,9	-96,4	-178,6	53,6	53,9	22,7
Motorcycles	4-stroke >750 cm³	Euro II	2004	2006	-19,8	-5,9	-5,7	56,5	67,0	61,7	75,0	75,0	75,0	-31,8	0,4	-35,5	58,2	65,4	48,6

Annex 2B-6: Fuel use factors (MJ/km) and emission factors (g/km)

Sector	ForecastYear	FCu (MJ)	FCr (MJ)	FCh (MJ)	CO_2u	CO_2r	CO_2h	CH_4u	CH_4r	CH_4h	N_2Ou	N_2Or	N_2Oh	SO_2u	SO_2r	SO_2h	NO_xu	NO_xr	NO_xh
Passenger Cars	1985	3,236	2,105	2,413	236	154	176	0,143	0,028	0,025	0,009	0,006	0,006	0,063	0,039	0,047	1,871	2,218	2,839
Passenger Cars	1986	3,203	2,095	2,395	234	153	175	0,143	0,028	0,024	0,009	0,006	0,006	0,041	0,026	0,031	1,863	2,217	2,848
Passenger Cars	1987	3,190	2,083	2,372	233	152	173	0,143	0,028	0,024	0,009	0,006	0,006	0,042	0,026	0,032	1,861	2,210	2,839
Passenger Cars	1988	3,119	2,071	2,347	228	151	172	0,141	0,028	0,024	0,009	0,006	0,006	0,042	0,027	0,032	1,838	2,199	2,831
Passenger Cars	1989	3,089	2,065	2,336	226	151	171	0,140	0,028	0,024	0,009	0,006	0,006	0,031	0,020	0,023	1,828	2,196	2,836
Passenger Cars	1990	3,076	2,063	2,328	225	151	170	0,140	0,028	0,024	0,009	0,006	0,006	0,030	0,019	0,023	1,833	2,207	2,856
Passenger Cars	1991	3,094	2,059	2,315	226	150	169	0,135	0,027	0,024	0,010	0,006	0,006	0,029	0,018	0,022	1,750	2,070	2,686
Passenger Cars	1992	3,087	2,057	2,305	226	150	168	0,130	0,026	0,023	0,010	0,006	0,006	0,020	0,013	0,015	1,666	1,942	2,528
Passenger Cars	1993	3,098	2,054	2,293	226	150	168	0,124	0,025	0,022	0,011	0,006	0,006	0,012	0,008	0,009	1,598	1,825	2,387
Passenger Cars	1994	3,076	2,057	2,283	225	150	167	0,113	0,024	0,021	0,012	0,007	0,005	0,012	0,008	0,009	1,469	1,631	2,149
Passenger Cars	1995	3,110	2,058	2,274	227	150	166	0,106	0,023	0,020	0,013	0,007	0,005	0,012	0,008	0,009	1,387	1,481	1,964
Passenger Cars	1996	3,151	2,059	2,265	230	150	166	0,099	0,022	0,019	0,013	0,007	0,005	0,012	0,008	0,009	1,315	1,341	1,790
Passenger Cars	1997	3,079	2,045	2,232	225	149	163	0,088	0,020	0,018	0,013	0,007	0,005	0,011	0,008	0,009	1,189	1,174	1,584
Passenger Cars	1998	3,076	2,048	2,220	225	150	162	0,080	0,019	0,017	0,013	0,007	0,005	0,011	0,008	0,009	1,089	1,031	1,398
Passenger Cars	1999	3,057	2,049	2,212	223	150	162	0,073	0,018	0,016	0,013	0,006	0,004	0,009	0,006	0,007	1,006	0,915	1,241
Passenger Cars	2000	3,043	2,052	2,208	222	150	161	0,067	0,017	0,015	0,013	0,006	0,004	0,007	0,005	0,005	0,947	0,831	1,127
Passenger Cars	2001	3,072	2,056	2,209	225	150	161	0,062	0,016	0,014	0,012	0,006	0,004	0,007	0,005	0,005	0,900	0,768	1,037
Passenger Cars	2002	3,044	2,060	2,209	223	151	162	0,056	0,014	0,012	0,012	0,006	0,004	0,007	0,005	0,005	0,836	0,697	0,936
Passenger Cars	2003	3,056	2,064	2,209	223	151	162	0,051	0,013	0,011	0,011	0,005	0,003	0,007	0,005	0,005	0,783	0,635	0,846
Passenger Cars	2004	3,009	2,066	2,208	220	151	162	0,045	0,012	0,010	0,010	0,005	0,003	0,007	0,005	0,005	0,725	0,576	0,759
Passenger Cars	2005	3,026	2,059	2,198	221	151	161	0,041	0,010	0,009	0,009	0,004	0,003	0,001	0,001	0,001	0,677	0,520	0,674
Passenger Cars	2006	3,008	2,065	2,200	220	151	161	0,036	0,009	0,008	0,009	0,004	0,003	0,001	0,001	0,001	0,617	0,464	0,593
Passenger Cars	2007	2,981	2,066	2,200	218	151	161	0,030	0,007	0,007	0,008	0,003	0,003	0,001	0,001	0,001	0,570	0,422	0,528
Light Duty Vehicles	1985	3,939	2,786	2,988	291	206	221	0,048	0,016	0,011	0,002	0,001	0,001	0,764	0,560	0,613	2,038	1,188	1,222
Light Duty Vehicles	1986	3,918	2,788	2,995	289	206	221	0,046	0,016	0,010	0,001	0,001	0,001	0,464	0,341	0,373	2,018	1,162	1,193
Light Duty Vehicles	1987	3,926	2,788	2,996	290	206	221	0,046	0,016	0,010	0,001	0,001	0,001	0,465	0,341	0,373	2,023	1,160	1,190
Light Duty Vehicles	1988	3,875	2,789	2,997	286	206	221	0,046	0,016	0,010	0,001	0,001	0,001	0,460	0,342	0,374	1,991	1,157	1,186
Light Duty Vehicles	1989	3,853	2,790	3,001	285	206	222	0,045	0,016	0,010	0,001	0,001	0,001	0,308	0,230	0,252	1,973	1,140	1,168
Light Duty Vehicles	1990	3,846	2,791	3,004	284	206	222	0,044	0,016	0,010	0,001	0,001	0,001	0,310	0,231	0,253	1,965	1,129	1,155
Light Duty Vehicles	1991	3,877	2,791	3,003	286	206	222	0,044	0,016	0,010	0,001	0,001	0,001	0,311	0,231	0,252	1,986	1,133	1,160
Light Duty Vehicles	1992	3,877	2,789	2,998	286	206	222	0,046	0,016	0,010	0,001	0,001	0,001	0,201	0,149	0,163	1,987	1,152	1,181
Light Duty Vehicles	1993	3,909	2,789	2,997	289	206	221	0,046	0,016	0,010	0,001	0,001	0,001	0,079	0,058	0,063	2,007	1,155	1,184
Light Duty Vehicles	1994	3,946	2,790	3,001	291	206	222	0,045	0,016	0,010	0,001	0,001	0,001	0,080	0,058	0,063	2,008	1,140	1,168
Light Duty Vehicles	1995	3,938	2,770	2,979	291	205	220	0,043	0,015	0,010	0,002	0,001	0,001	0,079	0,058	0,063	1,953	1,123	1,153

Continued

Sector	ForecastYear	FCu (MJ)	FCr (MJ)	FCh (MJ)	CO_2u	CO_2r	CO_2h	CH_4u	CH_4r	CH_4h	N_2Ou	N_2Or	N_2Oh	SO_2u	SO_2r	SO_2h	NO_xu	NO_xr	NO_xh
Light Duty Vehicles	1996	3,974	2,752	2,958	293	203	219	0,040	0,015	0,009	0,002	0,002	0,002	0,080	0,057	0,062	1,919	1,102	1,133
Light Duty Vehicles	1997	3,904	2,732	2,938	288	202	217	0,038	0,014	0,009	0,003	0,002	0,002	0,079	0,057	0,062	1,829	1,082	1,114
Light Duty Vehicles	1998	3,888	2,714	2,916	287	200	215	0,036	0,014	0,008	0,003	0,003	0,002	0,078	0,056	0,061	1,773	1,071	1,105
Light Duty Vehicles	1999	3,853	2,698	2,899	284	199	214	0,033	0,013	0,008	0,004	0,003	0,003	0,043	0,031	0,034	1,704	1,049	1,084
Light Duty Vehicles	2000	3,822	2,682	2,881	282	198	213	0,031	0,012	0,007	0,004	0,003	0,003	0,009	0,006	0,007	1,642	1,032	1,067
Light Duty Vehicles	2001	3,840	2,667	2,864	284	197	212	0,028	0,011	0,007	0,005	0,004	0,003	0,009	0,006	0,007	1,604	1,015	1,052
Light Duty Vehicles	2002	3,787	2,648	2,844	280	196	210	0,025	0,010	0,006	0,006	0,004	0,003	0,009	0,006	0,007	1,487	0,965	1,001
Light Duty Vehicles	2003	3,773	2,631	2,829	279	194	209	0,022	0,008	0,005	0,006	0,004	0,004	0,009	0,006	0,007	1,403	0,915	0,950
Light Duty Vehicles	2004	3,694	2,608	2,806	273	193	207	0,018	0,007	0,004	0,007	0,004	0,004	0,009	0,006	0,007	1,276	0,867	0,902
Light Duty Vehicles	2005	3,705	2,591	2,792	274	191	206	0,015	0,006	0,004	0,008	0,004	0,004	0,002	0,001	0,001	1,219	0,830	0,864
Light Duty Vehicles	2006	3,666	2,575	2,778	271	190	205	0,013	0,005	0,003	0,008	0,004	0,004	0,002	0,001	0,001	1,148	0,797	0,831
Light Duty Vehicles	2007	3,621	2,557	2,765	267	189	204	0,011	0,004	0,002	0,009	0,004	0,004	0,002	0,001	0,001	1,044	0,738	0,770
Heavy Duty Vehicles	1985	11,446	9,610	10,448	847	711	773	0,138	0,063	0,062	0,030	0,030	0,030	2,668	2,244	2,443	11,406	10,062	10,757
Heavy Duty Vehicles	1986	11,447	9,611	10,449	847	711	773	0,138	0,063	0,062	0,030	0,030	0,030	1,602	1,347	1,466	11,410	10,063	10,757
Heavy Duty Vehicles	1987	11,447	9,611	10,449	847	711	773	0,138	0,063	0,062	0,030	0,030	0,030	1,602	1,347	1,466	11,410	10,063	10,757
Heavy Duty Vehicles	1988	11,447	9,612	10,449	847	711	773	0,138	0,063	0,062	0,030	0,030	0,030	1,602	1,347	1,466	11,410	10,063	10,757
Heavy Duty Vehicles	1989	11,447	9,612	10,449	847	711	773	0,138	0,063	0,062	0,030	0,030	0,030	1,068	0,898	0,978	11,412	10,064	10,758
Heavy Duty Vehicles	1990	11,329	9,541	10,413	838	706	771	0,137	0,062	0,062	0,030	0,030	0,030	1,057	0,892	0,974	11,283	9,984	10,718
Heavy Duty Vehicles	1991	11,463	9,543	10,372	848	706	767	0,139	0,062	0,061	0,030	0,030	0,030	1,070	0,892	0,970	11,410	9,985	10,682
Heavy Duty Vehicles	1992	11,462	9,542	10,371	848	706	767	0,139	0,062	0,061	0,030	0,030	0,030	0,695	0,580	0,631	11,408	9,985	10,681
Heavy Duty Vehicles	1993	11,245	9,567	10,323	832	708	764	0,137	0,063	0,061	0,030	0,030	0,030	0,262	0,224	0,241	11,151	9,963	10,588
Heavy Duty Vehicles	1994	11,060	9,418	10,184	818	697	754	0,136	0,062	0,061	0,030	0,030	0,030	0,258	0,220	0,238	10,785	9,638	10,263
Heavy Duty Vehicles	1995	10,936	9,374	10,015	809	694	741	0,136	0,063	0,060	0,030	0,030	0,030	0,255	0,219	0,234	10,484	9,422	9,922
Heavy Duty Vehicles	1996	10,908	9,253	9,918	807	685	734	0,136	0,062	0,060	0,030	0,030	0,030	0,254	0,216	0,232	10,296	9,151	9,662
Heavy Duty Vehicles	1997	11,112	9,366	9,935	822	693	735	0,136	0,064	0,061	0,030	0,030	0,030	0,259	0,219	0,232	10,370	9,129	9,528
Heavy Duty Vehicles	1998	11,080	9,342	9,875	820	691	731	0,133	0,064	0,061	0,030	0,030	0,030	0,259	0,218	0,231	10,211	8,975	9,326
Heavy Duty Vehicles	1999	11,177	9,399	9,868	827	696	730	0,132	0,065	0,062	0,030	0,030	0,030	0,144	0,121	0,127	10,191	8,915	9,193
Heavy Duty Vehicles	2000	11,111	9,345	9,803	822	692	725	0,128	0,064	0,061	0,030	0,030	0,030	0,026	0,022	0,023	9,995	8,729	8,983
Heavy Duty Vehicles	2001	11,398	9,530	9,861	843	705	730	0,129	0,067	0,063	0,030	0,030	0,030	0,027	0,022	0,023	10,006	8,675	8,807
Heavy Duty Vehicles	2002	11,354	9,502	9,808	840	703	726	0,124	0,067	0,063	0,030	0,030	0,030	0,027	0,022	0,023	9,656	8,359	8,460
Heavy Duty Vehicles	2003	11,312	9,474	9,770	837	701	723	0,119	0,067	0,062	0,030	0,030	0,030	0,026	0,022	0,023	9,350	8,080	8,164
Heavy Duty Vehicles	2004	11,173	9,378	9,668	827	694	715	0,114	0,067	0,062	0,030	0,030	0,030	0,026	0,022	0,023	8,892	7,675	7,744
Heavy Duty Vehicles	2005	11,108	9,326	9,613	822	690	711	0,109	0,066	0,061	0,030	0,030	0,030	0,005	0,004	0,005	8,592	7,402	7,463
Heavy Duty Vehicles	2006	11,040	9,272	9,555	817	686	707	0,104	0,065	0,060	0,030	0,030	0,030	0,005	0,004	0,004	8,270	7,113	7,167
Heavy Duty Vehicles	2007	10,927	9,177	9,453	809	679	699	0,093	0,059	0,054	0,030	0,030	0,030	0,005	0,004	0,004	7,720	6,634	6,685
Buses	1985	13,144	10,264	8,850	973	760	655	0,175	0,080	0,070	0,030	0,030	0,030	3,078	2,404	2,073	13,673	11,169	9,586

Continued

Sector	ForecastYear	FCu (MJ)	FCr (MJ)	FCh (MJ)	CO_2u	CO_2r	CO_2h	CH_4u	CH_4r	CH_4h	N_2Ou	N_2Or	N_2Oh	SO_2u	SO_2r	SO_2h	NO_xu	NO_xr	NO_xh
Buses	1986	13,142	10,261	8,849	973	759	655	0,175	0,080	0,070	0,030	0,030	0,030	1,847	1,442	1,243	13,669	11,164	9,582
Buses	1987	13,148	10,269	8,853	973	760	655	0,175	0,080	0,070	0,030	0,030	0,030	1,847	1,443	1,244	13,683	11,181	9,595
Buses	1988	13,157	10,282	8,861	974	761	656	0,175	0,080	0,070	0,030	0,030	0,030	1,849	1,445	1,245	13,705	11,207	9,615
Buses	1989	13,153	10,276	8,858	973	760	655	0,175	0,080	0,070	0,030	0,030	0,030	1,232	0,963	0,830	13,695	11,195	9,606
Buses	1990	13,137	10,253	8,844	972	759	654	0,175	0,080	0,070	0,030	0,030	0,030	1,231	0,961	0,828	13,656	11,148	9,569
Buses	1991	13,133	10,262	8,843	972	759	654	0,175	0,080	0,070	0,030	0,030	0,030	1,230	0,961	0,828	13,646	11,165	9,567
Buses	1992	13,143	10,245	8,844	973	758	654	0,175	0,080	0,070	0,030	0,030	0,030	0,800	0,624	0,538	13,672	11,130	9,568
Buses	1993	13,114	10,263	8,848	970	759	655	0,175	0,080	0,070	0,030	0,030	0,030	0,307	0,240	0,207	13,599	11,167	9,580
Buses	1994	12,998	10,108	8,772	962	748	649	0,175	0,080	0,070	0,030	0,030	0,030	0,304	0,237	0,205	13,260	10,722	9,310
Buses	1995	12,794	9,930	8,658	947	735	641	0,175	0,080	0,070	0,030	0,030	0,030	0,300	0,233	0,203	12,710	10,244	8,947
Buses	1996	12,605	9,778	8,555	933	724	633	0,175	0,080	0,070	0,030	0,030	0,030	0,295	0,229	0,200	12,202	9,832	8,623
Buses	1997	12,445	9,683	8,486	921	717	628	0,170	0,078	0,068	0,030	0,030	0,030	0,291	0,227	0,199	11,889	9,585	8,429
Buses	1998	12,349	9,632	8,447	914	713	625	0,165	0,075	0,066	0,030	0,030	0,030	0,289	0,226	0,198	11,726	9,459	8,328
Buses	1999	12,234	9,566	8,398	905	708	621	0,161	0,073	0,064	0,030	0,030	0,030	0,158	0,123	0,108	11,511	9,289	8,194
Buses	2000	12,134	9,511	8,357	898	704	618	0,157	0,072	0,063	0,030	0,030	0,030	0,028	0,022	0,020	11,327	9,147	8,080
Buses	2001	12,054	9,465	8,324	892	700	616	0,153	0,070	0,061	0,030	0,030	0,030	0,028	0,022	0,019	11,184	9,033	7,991
Buses	2002	12,011	9,449	8,323	889	699	616	0,149	0,068	0,060	0,030	0,030	0,030	0,028	0,022	0,019	10,907	8,781	7,766
Buses	2003	11,991	9,451	8,332	887	699	617	0,146	0,067	0,058	0,030	0,030	0,030	0,028	0,022	0,020	10,698	8,589	7,587
Buses	2004	11,961	9,432	8,332	885	698	617	0,143	0,065	0,057	0,030	0,030	0,030	0,028	0,022	0,020	10,485	8,387	7,413
Buses	2005	11,921	9,423	8,331	882	697	617	0,139	0,064	0,056	0,030	0,030	0,030	0,006	0,004	0,004	10,245	8,175	7,218
Buses	2006	11,882	9,412	8,330	879	697	616	0,136	0,062	0,054	0,030	0,030	0,030	0,006	0,004	0,004	10,015	7,969	7,030
Buses	2007	11,800	9,365	8,295	873	693	614	0,125	0,057	0,050	0,030	0,030	0,030	0,006	0,004	0,004	9,566	7,613	6,709
Mopeds	1985	1,095	1,095		80	80		0,219	0,219		0,001	0,001		0,003	0,003		0,020	0,020	
Mopeds	1986	1,095	1,095		80	80		0,219	0,219		0,001	0,001		0,003	0,003		0,020	0,020	
Mopeds	1987	1,095	1,095		80	80		0,219	0,219		0,001	0,001		0,003	0,003		0,020	0,020	
Mopeds	1988	1,095	1,095		80	80		0,219	0,219		0,001	0,001		0,003	0,003		0,020	0,020	
Mopeds	1989	1,095	1,095		80	80		0,219	0,219		0,001	0,001		0,003	0,003		0,020	0,020	
Mopeds	1990	1,095	1,095		80	80		0,219	0,219		0,001	0,001		0,003	0,003		0,020	0,020	
Mopeds	1991	1,095	1,095		80	80		0,219	0,219		0,001	0,001		0,003	0,003		0,020	0,020	
Mopeds	1992	1,095	1,095		80	80		0,219	0,219		0,001	0,001		0,003	0,003		0,020	0,020	
Mopeds	1993	1,095	1,095		80	80		0,219	0,219		0,001	0,001		0,003	0,003		0,020	0,020	
Mopeds	1994	1,095	1,095		80	80		0,219	0,219		0,001	0,001		0,003	0,003		0,020	0,020	
Mopeds	1995	1,095	1,095		80	80		0,219	0,219		0,001	0,001		0,003	0,003		0,020	0,020	
Mopeds	1996	1,095	1,095		80	80		0,219	0,219		0,001	0,001		0,003	0,003		0,020	0,020	
Mopeds	1997	1,095	1,095		80	80		0,219	0,219		0,001	0,001		0,003	0,003		0,020	0,020	
Mopeds	1998	1,095	1,095		80	80		0,219	0,219		0,001	0,001		0,003	0,003		0,020	0,020	

Continued

Sector	ForecastYear	FCu (MJ)	FCr (MJ)	FCh (MJ)	CO_2u	CO_2r	CO_2h	CH_4u	CH_4r	CH_4h	N_2Ou	N_2Or	N_2Oh	SO_2u	SO_2r	SO_2h	NO_xu	NO_xr	NO_xh
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	
Mopeds	2002	0,985	0,985		72	72		0,175	0,175		0,001	0,001		0,002	0,002		0,020	0,020	
Mopeds	2003	0,969	0,969		71	71		0,169	0,169		0,001	0,001		0,002	0,002		0,020	0,020	
Mopeds	2004	0,940	0,940		69	69		0,159	0,159		0,001	0,001		0,002	0,002		0,035	0,035	
Mopeds	2005	0,893	0,893		65	65		0,143	0,143		0,001	0,001		0,000	0,000		0,055	0,055	
Mopeds	2006	0,842	0,842		61	61		0,125	0,125		0,001	0,001		0,000	0,000		0,071	0,071	
Mopeds	2007	0,793	0,793		58	58		0,107	0,107		0,001	0,001		0,000	0,000		0,089	0,089	
Motorcycles	1985	1,308	1,318	1,578	95	96	115	0,193	0,193	0,193	0,002	0,002	0,002	0,003	0,003	0,004	0,122	0,228	0,340
Motorcycles	1986	1,308	1,318	1,578	95	96	115	0,193	0,193	0,193	0,002	0,002	0,002	0,003	0,003	0,004	0,122	0,228	0,340
Motorcycles	1987	1,308	1,318	1,578	95	96	115	0,193	0,193	0,193	0,002	0,002	0,002	0,003	0,003	0,004	0,122	0,228	0,340
Motorcycles	1988	1,308	1,318	1,578	95	96	115	0,193	0,193	0,193	0,002	0,002	0,002	0,003	0,003	0,004	0,122	0,228	0,340
Motorcycles	1989	1,308	1,318	1,578	95	96	115	0,193	0,193	0,193	0,002	0,002	0,002	0,003	0,003	0,004	0,122	0,228	0,340
Motorcycles	1990	1,308	1,318	1,578	95	96	115	0,193	0,193	0,193	0,002	0,002	0,002	0,003	0,003	0,004	0,122	0,228	0,340
Motorcycles	1991	1,308	1,318	1,578	95	96	115	0,193	0,193	0,193	0,002	0,002	0,002	0,003	0,003	0,004	0,122	0,228	0,340
Motorcycles	1992	1,308	1,318	1,578	95	96	115	0,193	0,193	0,193	0,002	0,002	0,002	0,003	0,003	0,004	0,122	0,228	0,340
Motorcycles	1993	1,308	1,318	1,578	95	96	115	0,193	0,193	0,193	0,002	0,002	0,002	0,003	0,003	0,004	0,122	0,228	0,340
Motorcycles	1994	1,308	1,318	1,578	95	96	115	0,193	0,193	0,193	0,002	0,002	0,002	0,003	0,003	0,004	0,122	0,228	0,340
Motorcycles	1995	1,308	1,318	1,578	95	96	115	0,193	0,193	0,193	0,002	0,002	0,002	0,003	0,003	0,004	0,122	0,228	0,340
Motorcycles	1996	1,308	1,318	1,578	95	96	115	0,193	0,193	0,193	0,002	0,002	0,002	0,003	0,003	0,004	0,122	0,228	0,340
Motorcycles	1997	1,308	1,318	1,578	95	96	115	0,193	0,193	0,193	0,002	0,002	0,002	0,003	0,003	0,004	0,122	0,228	0,340
Motorcycles	1998	1,308	1,318	1,578	95	96	115	0,193	0,193	0,193	0,002	0,002	0,002	0,003	0,003	0,004	0,122	0,228	0,340
Motorcycles	1999	1,308	1,318	1,578	95	96	115	0,193	0,193	0,193	0,002	0,002	0,002	0,003	0,003	0,004	0,122	0,228	0,340
Motorcycles	2000	1,312	1,321	1,597	96	96	117	0,189	0,189	0,190	0,002	0,002	0,002	0,003	0,003	0,004	0,129	0,241	0,366
Motorcycles	2001	1,312	1,321	1,597	96	96	117	0,189	0,190	0,190	0,002	0,002	0,002	0,003	0,003	0,004	0,130	0,242	0,368
Motorcycles	2002	1,314	1,321	1,604	96	96	117	0,188	0,189	0,189	0,002	0,002	0,002	0,003	0,003	0,004	0,133	0,248	0,379
Motorcycles	2003	1,316	1,322	1,611	96	97	118	0,186	0,188	0,188	0,002	0,002	0,002	0,003	0,003	0,004	0,136	0,254	0,390
Motorcycles	2004	1,317	1,323	1,618	96	97	118	0,185	0,185	0,186	0,002	0,002	0,002	0,003	0,003	0,004	0,138	0,253	0,393
Motorcycles	2005	1,320	1,325	1,630	96	97	119	0,183	0,182	0,183	0,002	0,002	0,002	0,001	0,001	0,001	0,141	0,257	0,404
Motorcycles	2006	1,321	1,325	1,638	96	97	119	0,181	0,180	0,181	0,002	0,002	0,002	0,001	0,001	0,001	0,144	0,260	0,413
Motorcycles	2007	1,311	1,325	1,662	95	96	121	0,178	0,175	0,176	0,002	0,002	0,002	0,001	0,001	0,001	0,145	0,259	0,415

Sector	Fore-castYear	NMVOCu (exh)	NMVOCr (exh)	NMVOCh (exh)	NMVOCu (tot)	NMVOCr (tot)	NMVOCh (tot)	COu	COr	COh	NH_3u	NH_3r	NH_3h	TSPu	TSPr	TSPh
Passenger Cars	1985	3,143	1,062	0,936	5,045	1,456	1,012	37,285	10,257	10,681	0,002	0,002	0,002	0,079	0,045	0,047
Passenger Cars	1986	3,039	1,039	0,910	4,949	1,435	0,986	35,123	9,742	10,035	0,002	0,002	0,002	0,077	0,043	0,045
Passenger Cars	1987	2,995	1,013	0,879	4,879	1,404	0,954	33,562	9,142	9,335	0,002	0,002	0,002	0,077	0,042	0,045
Passenger Cars	1988	2,749	0,979	0,838	4,699	1,384	0,916	29,204	8,350	8,386	0,002	0,002	0,002	0,072	0,041	0,043
Passenger Cars	1989	2,646	0,959	0,815	4,616	1,368	0,894	27,434	7,938	7,844	0,002	0,002	0,002	0,071	0,040	0,043
Passenger Cars	1990	2,605	0,948	0,801	4,575	1,357	0,879	26,526	7,643	7,434	0,002	0,002	0,002	0,068	0,039	0,041
Passenger Cars	1991	2,601	0,884	0,746	4,447	1,249	0,818	26,591	7,128	6,907	0,005	0,011	0,007	0,064	0,036	0,038
Passenger Cars	1992	2,490	0,824	0,695	4,318	1,169	0,754	25,326	6,664	6,450	0,009	0,019	0,011	0,058	0,033	0,035
Passenger Cars	1993	2,478	0,767	0,647	4,110	1,074	0,699	25,146	6,214	6,035	0,012	0,027	0,016	0,055	0,030	0,033
Passenger Cars	1994	2,271	0,677	0,569	3,784	0,949	0,616	22,657	5,521	5,328	0,017	0,039	0,023	0,048	0,027	0,029
Passenger Cars	1995	2,235	0,607	0,510	3,643	0,847	0,547	22,105	5,027	4,906	0,020	0,049	0,028	0,044	0,024	0,027
Passenger Cars	1996	2,248	0,542	0,455	3,478	0,750	0,483	22,063	4,570	4,511	0,024	0,059	0,033	0,041	0,022	0,025
Passenger Cars	1997	1,889	0,453	0,382	2,966	0,635	0,406	17,933	3,773	3,853	0,034	0,072	0,040	0,034	0,018	0,021
Passenger Cars	1998	1,732	0,388	0,328	2,608	0,536	0,348	16,485	3,314	3,426	0,042	0,082	0,046	0,030	0,016	0,018
Passenger Cars	1999	1,517	0,333	0,282	2,276	0,462	0,299	14,324	2,921	3,070	0,049	0,090	0,051	0,028	0,015	0,017
Passenger Cars	2000	1,388	0,294	0,249	1,898	0,381	0,260	13,097	2,649	2,831	0,054	0,095	0,053	0,026	0,014	0,017
Passenger Cars	2001	1,339	0,264	0,224	1,779	0,339	0,234	12,853	2,465	2,693	0,051	0,091	0,054	0,027	0,013	0,017
Passenger Cars	2002	1,167	0,232	0,198	1,551	0,297	0,207	11,308	2,251	2,517	0,049	0,086	0,055	0,025	0,013	0,016
Passenger Cars	2003	1,084	0,204	0,174	1,411	0,259	0,182	10,696	2,046	2,336	0,046	0,081	0,055	0,025	0,013	0,016
Passenger Cars	2004	0,908	0,175	0,151	1,186	0,222	0,157	9,023	1,837	2,147	0,043	0,076	0,054	0,024	0,013	0,017
Passenger Cars	2005	0,860	0,147	0,127	1,109	0,189	0,133	8,885	1,606	1,921	0,039	0,071	0,053	0,026	0,013	0,017
Passenger Cars	2006	0,721	0,121	0,106	0,937	0,158	0,111	7,517	1,374	1,676	0,035	0,063	0,052	0,026	0,013	0,018
Passenger Cars	2007	0,590	0,097	0,085	0,758	0,125	0,089	6,284	1,139	1,417	0,029	0,054	0,048	0,028	0,014	0,019
Light Duty Vehicles	1985	0,695	0,184	0,143	0,965	0,236	0,154	6,539	1,779	2,022	0,001	0,001	0,001	0,465	0,263	0,279
Light Duty Vehicles	1986	0,648	0,177	0,139	0,900	0,226	0,150	6,069	1,721	1,950	0,001	0,001	0,001	0,460	0,266	0,282
Light Duty Vehicles	1987	0,653	0,177	0,139	0,901	0,225	0,149	6,102	1,717	1,944	0,001	0,001	0,001	0,467	0,267	0,282
Light Duty Vehicles	1988	0,608	0,176	0,138	0,864	0,225	0,149	5,706	1,708	1,934	0,001	0,001	0,001	0,433	0,267	0,283
Light Duty Vehicles	1989	0,574	0,171	0,136	0,820	0,219	0,146	5,375	1,672	1,888	0,001	0,001	0,001	0,423	0,269	0,285
Light Duty Vehicles	1990	0,556	0,168	0,134	0,793	0,214	0,144	5,201	1,647	1,857	0,001	0,001	0,001	0,422	0,270	0,286
Light Duty Vehicles	1991	0,584	0,170	0,135	0,820	0,215	0,145	5,447	1,656	1,869	0,001	0,001	0,001	0,443	0,270	0,286
Light Duty Vehicles	1992	0,601	0,174	0,138	0,862	0,224	0,148	5,642	1,698	1,921	0,001	0,001	0,001	0,431	0,267	0,284
Light Duty Vehicles	1993	0,629	0,175	0,138	0,882	0,223	0,148	5,889	1,705	1,929	0,001	0,001	0,001	0,451	0,267	0,283
Light Duty Vehicles	1994	0,625	0,171	0,136	0,903	0,216	0,145	5,842	1,672	1,889	0,001	0,001	0,001	0,461	0,269	0,285
Light Duty Vehicles	1995	0,613	0,166	0,133	0,868	0,206	0,141	5,735	1,576	1,787	0,002	0,003	0,002	0,440	0,250	0,267
Light Duty Vehicles	1996	0,624	0,159	0,129	0,850	0,194	0,136	5,799	1,472	1,675	0,002	0,004	0,003	0,441	0,233	0,251
Light Duty Vehicles	1997	0,563	0,152	0,125	0,772	0,185	0,131	5,245	1,370	1,566	0,003	0,005	0,003	0,383	0,216	0,234
Light Duty Vehicles	1998	0,551	0,148	0,123	0,736	0,176	0,128	5,168	1,292	1,485	0,003	0,007	0,004	0,354	0,199	0,217

Continued

Sector	Fore-castYear	NMVOCu (exh)	NMVOCr (exh)	NMVOCh (exh)	NMVOCu (tot)	NMVOCr (tot)	NMVOCh (tot)	COu	COr	COh	NH_3u	NH_3r	NH_3h	TSPu	TSPr	TSPh
Light Duty Vehicles	1999	0,509	0,141	0,119	0,678	0,167	0,124	4,736	1,196	1,380	0,004	0,008	0,005	0,323	0,185	0,203
Light Duty Vehicles	2000	0,478	0,136	0,116	0,595	0,154	0,119	4,446	1,114	1,292	0,005	0,009	0,006	0,293	0,170	0,189
Light Duty Vehicles	2001	0,478	0,131	0,113	0,580	0,147	0,116	4,404	1,034	1,207	0,006	0,010	0,006	0,284	0,156	0,175
Light Duty Vehicles	2002	0,418	0,121	0,106	0,504	0,135	0,108	3,855	0,920	1,080	0,006	0,010	0,007	0,244	0,139	0,158
Light Duty Vehicles	2003	0,381	0,112	0,099	0,448	0,122	0,101	3,426	0,809	0,954	0,006	0,009	0,007	0,227	0,126	0,144
Light Duty Vehicles	2004	0,316	0,102	0,092	0,365	0,110	0,094	2,801	0,684	0,816	0,005	0,009	0,007	0,180	0,106	0,125
Light Duty Vehicles	2005	0,302	0,095	0,087	0,340	0,101	0,088	2,576	0,599	0,720	0,005	0,008	0,007	0,173	0,095	0,113
Light Duty Vehicles	2006	0,269	0,089	0,083	0,298	0,094	0,084	2,190	0,526	0,637	0,004	0,007	0,006	0,153	0,084	0,103
Light Duty Vehicles	2007	0,228	0,080	0,076	0,246	0,083	0,076	1,713	0,449	0,550	0,003	0,006	0,005	0,132	0,073	0,091
Heavy Duty Vehicles	1985	1,054	0,662	0,491	1,054	0,662	0,491	3,054	2,162	2,090	0,003	0,003	0,003	0,511	0,386	0,400
Heavy Duty Vehicles	1986	1,051	0,660	0,491	1,051	0,660	0,491	3,021	2,143	2,081	0,003	0,003	0,003	0,511	0,386	0,400
Heavy Duty Vehicles	1987	1,051	0,660	0,491	1,051	0,660	0,491	3,019	2,141	2,080	0,003	0,003	0,003	0,511	0,386	0,400
Heavy Duty Vehicles	1988	1,051	0,659	0,491	1,051	0,659	0,491	3,014	2,139	2,078	0,003	0,003	0,003	0,511	0,386	0,400
Heavy Duty Vehicles	1989	1,049	0,658	0,490	1,049	0,658	0,490	2,995	2,127	2,072	0,003	0,003	0,003	0,511	0,386	0,400
Heavy Duty Vehicles	1990	1,054	0,661	0,491	1,054	0,661	0,491	2,979	2,120	2,069	0,003	0,003	0,003	0,508	0,384	0,399
Heavy Duty Vehicles	1991	1,047	0,661	0,494	1,047	0,661	0,494	2,984	2,123	2,073	0,003	0,003	0,003	0,512	0,384	0,398
Heavy Duty Vehicles	1992	1,049	0,662	0,494	1,049	0,662	0,494	3,007	2,137	2,081	0,003	0,003	0,003	0,512	0,384	0,398
Heavy Duty Vehicles	1993	1,050	0,655	0,492	1,050	0,655	0,492	2,993	2,126	2,073	0,003	0,003	0,003	0,503	0,382	0,394
Heavy Duty Vehicles	1994	1,009	0,636	0,481	1,009	0,636	0,481	2,896	2,068	2,025	0,003	0,003	0,003	0,487	0,370	0,382
Heavy Duty Vehicles	1995	0,968	0,614	0,473	0,968	0,614	0,473	2,821	2,022	1,986	0,003	0,003	0,003	0,474	0,362	0,370
Heavy Duty Vehicles	1996	0,921	0,593	0,458	0,921	0,593	0,458	2,735	1,970	1,941	0,003	0,003	0,003	0,460	0,348	0,358
Heavy Duty Vehicles	1997	0,852	0,552	0,429	0,852	0,552	0,429	2,622	1,900	1,878	0,003	0,003	0,003	0,441	0,333	0,343
Heavy Duty Vehicles	1998	0,799	0,520	0,405	0,799	0,520	0,405	2,549	1,858	1,837	0,003	0,003	0,003	0,416	0,314	0,326
Heavy Duty Vehicles	1999	0,748	0,489	0,382	0,748	0,489	0,382	2,468	1,812	1,794	0,003	0,003	0,003	0,396	0,299	0,313
Heavy Duty Vehicles	2000	0,708	0,464	0,363	0,708	0,464	0,363	2,425	1,784	1,766	0,003	0,003	0,003	0,372	0,282	0,297
Heavy Duty Vehicles	2001	0,662	0,435	0,340	0,662	0,435	0,340	2,443	1,792	1,754	0,003	0,003	0,003	0,358	0,270	0,283
Heavy Duty Vehicles	2002	0,615	0,404	0,317	0,615	0,404	0,317	2,399	1,761	1,721	0,003	0,003	0,003	0,330	0,249	0,262
Heavy Duty Vehicles	2003	0,575	0,378	0,298	0,575	0,378	0,298	2,343	1,724	1,688	0,003	0,003	0,003	0,307	0,231	0,243
Heavy Duty Vehicles	2004	0,517	0,342	0,272	0,517	0,342	0,272	2,237	1,658	1,631	0,003	0,003	0,003	0,274	0,206	0,218
Heavy Duty Vehicles	2005	0,486	0,321	0,255	0,486	0,321	0,255	2,210	1,635	1,605	0,003	0,003	0,003	0,254	0,191	0,202
Heavy Duty Vehicles	2006	0,451	0,298	0,238	0,451	0,298	0,238	2,148	1,588	1,558	0,003	0,003	0,003	0,233	0,175	0,185
Heavy Duty Vehicles	2007	0,395	0,261	0,208	0,395	0,261	0,208	1,948	1,438	1,408	0,003	0,003	0,003	0,204	0,153	0,162
Buses	1985	1,462	0,856	0,544	1,462	0,856	0,544	4,248	2,679	1,826	0,003	0,003	0,003	0,701	0,453	0,339
Buses	1986	1,461	0,855	0,543	1,461	0,855	0,543	4,245	2,677	1,825	0,003	0,003	0,003	0,700	0,453	0,339
Buses	1987	1,465	0,858	0,545	1,465	0,858	0,545	4,254	2,684	1,830	0,003	0,003	0,003	0,701	0,454	0,339
Buses	1988	1,470	0,862	0,549	1,470	0,862	0,549	4,266	2,695	1,838	0,003	0,003	0,003	0,702	0,455	0,339

Continued

Sector	Fore-castYear	NMVOCu (exh)	NMVOCr (exh)	NMVOCh (exh)	NMVOCu (tot)	NMVOCr (tot)	NMVOCh (tot)	COu	COr	COh	NH_3u	NH_3r	NH_3h	TSPu	TSPr	TSPh
Buses	1989	1,467	0,860	0,547	1,467	0,860	0,547	4,261	2,690	1,835	0,003	0,003	0,003	0,702	0,454	0,339
Buses	1990	1,458	0,853	0,541	1,458	0,853	0,541	4,237	2,670	1,820	0,003	0,003	0,003	0,700	0,452	0,338
Buses	1991	1,456	0,855	0,540	1,456	0,855	0,540	4,232	2,677	1,819	0,003	0,003	0,003	0,699	0,453	0,338
Buses	1992	1,462	0,850	0,540	1,462	0,850	0,540	4,247	2,662	1,819	0,003	0,003	0,003	0,701	0,452	0,338
Buses	1993	1,445	0,856	0,543	1,445	0,856	0,543	4,204	2,678	1,824	0,003	0,003	0,003	0,696	0,453	0,338
Buses	1994	1,393	0,804	0,527	1,393	0,804	0,527	4,083	2,531	1,766	0,003	0,003	0,003	0,676	0,435	0,328
Buses	1995	1,293	0,747	0,493	1,293	0,747	0,493	3,836	2,369	1,669	0,003	0,003	0,003	0,644	0,415	0,316
Buses	1996	1,204	0,701	0,465	1,204	0,701	0,465	3,611	2,235	1,587	0,003	0,003	0,003	0,615	0,398	0,305
Buses	1997	1,124	0,660	0,443	1,124	0,660	0,443	3,436	2,137	1,528	0,003	0,003	0,003	0,573	0,373	0,287
Buses	1998	1,073	0,634	0,428	1,073	0,634	0,428	3,332	2,080	1,492	0,003	0,003	0,003	0,544	0,355	0,274
Buses	1999	1,015	0,604	0,411	1,015	0,604	0,411	3,206	2,009	1,450	0,003	0,003	0,003	0,513	0,336	0,260
Buses	2000	0,963	0,578	0,397	0,963	0,578	0,397	3,098	1,949	1,413	0,003	0,003	0,003	0,485	0,319	0,248
Buses	2001	0,922	0,557	0,385	0,922	0,557	0,385	3,011	1,900	1,384	0,003	0,003	0,003	0,462	0,306	0,239
Buses	2002	0,873	0,531	0,371	0,873	0,531	0,371	2,932	1,856	1,359	0,003	0,003	0,003	0,437	0,290	0,227
Buses	2003	0,837	0,512	0,361	0,837	0,512	0,361	2,882	1,830	1,345	0,003	0,003	0,003	0,419	0,279	0,219
Buses	2004	0,800	0,492	0,349	0,800	0,492	0,349	2,822	1,794	1,327	0,003	0,003	0,003	0,400	0,267	0,210
Buses	2005	0,756	0,470	0,338	0,756	0,470	0,338	2,753	1,758	1,305	0,003	0,003	0,003	0,378	0,254	0,200
Buses	2006	0,713	0,448	0,326	0,713	0,448	0,326	2,686	1,721	1,284	0,003	0,003	0,003	0,357	0,241	0,191
Buses	2007	0,648	0,409	0,300	0,648	0,409	0,300	2,480	1,593	1,189	0,003	0,003	0,003	0,326	0,221	0,175
Mopeds	1985	13,691	13,691		14,001	14,001		13,800	13,800		0,001	0,001		0,188	0,188	
Mopeds	1986	13,691	13,691		14,008	14,008		13,800	13,800		0,001	0,001		0,188	0,188	
Mopeds	1987	13,691	13,691		14,006	14,006		13,800	13,800		0,001	0,001		0,188	0,188	
Mopeds	1988	13,691	13,691		14,027	14,027		13,800	13,800		0,001	0,001		0,188	0,188	
Mopeds	1989	13,691	13,691		14,041	14,041		13,800	13,800		0,001	0,001		0,188	0,188	
Mopeds	1990	13,691	13,691		14,034	14,034		13,800	13,800		0,001	0,001		0,188	0,188	
Mopeds	1991	13,691	13,691		14,019	14,019		13,800	13,800		0,001	0,001		0,188	0,188	
Mopeds	1992	13,691	13,691		14,022	14,022		13,800	13,800		0,001	0,001		0,188	0,188	
Mopeds	1993	13,691	13,691		14,001	14,001		13,800	13,800		0,001	0,001		0,188	0,188	
Mopeds	1994	13,691	13,691		14,013	14,013		13,800	13,800		0,001	0,001		0,188	0,188	
Mopeds	1995	13,691	13,691		14,014	14,014		13,800	13,800		0,001	0,001		0,188	0,188	
Mopeds	1996	13,691	13,691		14,001	14,001		13,800	13,800		0,001	0,001		0,188	0,188	
Mopeds	1997	13,691	13,691		14,017	14,017		13,800	13,800		0,001	0,001		0,188	0,188	
Mopeds	1998	13,691	13,691		14,002	14,002		13,800	13,800		0,001	0,001		0,188	0,188	
Mopeds	1999	13,691	13,691		14,037	14,037		13,800	13,800		0,001	0,001		0,188	0,188	
Mopeds	2000	12,563	12,563		12,849	12,849		12,960	12,960		0,001	0,001		0,176	0,176	
Mopeds	2001	11,773	11,773		12,084	12,084		12,371	12,371		0,001	0,001		0,168	0,168	

Continued

Sector	Fore-castYear	NMVOCu (exh)	NMVOCr (exh)	NMVOCh (exh)	NMVOCu (tot)	NMVOCr (tot)	NMVOCh (tot)	COu	COr	COh	NH_3u	NH_3r	NH_3h	TSPu	TSPr	TSPh
Mopeds	2002	10,937	10,937		11,256	11,256		11,748	11,748		0,001	0,001		0,160	0,160	
Mopeds	2003	10,520	10,520		10,837	10,837		11,437	11,437		0,001	0,001		0,156	0,156	
Mopeds	2004	9,924	9,924		10,241	10,241		10,776	10,776		0,001	0,001		0,148	0,148	
Mopeds	2005	8,923	8,923		9,274	9,274		9,743	9,743		0,001	0,001		0,135	0,135	
Mopeds	2006	7,805	7,805		8,173	8,173		8,676	8,676		0,001	0,001		0,122	0,122	
Mopeds	2007	6,692	6,692		7,053	7,053		7,593	7,593		0,001	0,001		0,109	0,109	
Motorcycles	1985	2,639	2,014	2,011	3,494	2,239	2,039	20,029	22,185	27,917	0,002	0,002	0,002	0,047	0,047	0,047
Motorcycles	1986	2,639	2,014	2,011	3,502	2,242	2,039	20,029	22,185	27,917	0,002	0,002	0,002	0,047	0,047	0,047
Motorcycles	1987	2,639	2,014	2,011	3,497	2,240	2,039	20,029	22,185	27,917	0,002	0,002	0,002	0,047	0,047	0,047
Motorcycles	1988	2,639	2,014	2,011	3,533	2,250	2,040	20,029	22,185	27,917	0,002	0,002	0,002	0,047	0,047	0,047
Motorcycles	1989	2,639	2,014	2,011	3,554	2,255	2,041	20,029	22,185	27,917	0,002	0,002	0,002	0,047	0,047	0,047
Motorcycles	1990	2,639	2,014	2,011	3,547	2,253	2,041	20,029	22,185	27,917	0,002	0,002	0,002	0,047	0,047	0,047
Motorcycles	1991	2,639	2,014	2,011	3,409	2,276	2,046	20,029	22,185	27,917	0,002	0,002	0,002	0,047	0,047	0,047
Motorcycles	1992	2,639	2,014	2,011	3,538	2,239	2,044	20,029	22,185	27,917	0,002	0,002	0,002	0,047	0,047	0,047
Motorcycles	1993	2,639	2,014	2,011	3,367	2,267	2,048	20,029	22,185	27,917	0,002	0,002	0,002	0,047	0,047	0,047
Motorcycles	1994	2,639	2,014	2,011	3,490	2,242	2,046	20,029	22,185	27,917	0,002	0,002	0,002	0,047	0,047	0,047
Motorcycles	1995	2,639	2,014	2,011	3,544	2,254	2,037	20,029	22,185	27,917	0,002	0,002	0,002	0,047	0,047	0,047
Motorcycles	1996	2,639	2,014	2,011	3,459	2,234	2,045	20,029	22,185	27,917	0,002	0,002	0,002	0,047	0,047	0,047
Motorcycles	1997	2,639	2,014	2,011	3,496	2,244	2,047	20,029	22,185	27,917	0,002	0,002	0,002	0,047	0,047	0,047
Motorcycles	1998	2,639	2,014	2,011	3,467	2,236	2,045	20,029	22,185	27,917	0,002	0,002	0,002	0,047	0,047	0,047
Motorcycles	1999	2,639	2,014	2,011	3,496	2,244	2,046	20,029	22,185	27,917	0,002	0,002	0,002	0,047	0,047	0,047
Motorcycles	2000	2,607	1,998	1,998	3,283	2,179	2,026	19,468	21,623	27,259	0,002	0,002	0,002	0,047	0,047	0,047
Motorcycles	2001	2,568	1,961	1,961	3,233	2,139	1,989	19,445	21,600	27,257	0,002	0,002	0,002	0,046	0,046	0,046
Motorcycles	2002	2,517	1,918	1,919	3,195	2,099	1,947	19,204	21,360	27,001	0,002	0,002	0,002	0,045	0,045	0,045
Motorcycles	2003	2,466	1,875	1,878	3,139	2,055	1,906	18,978	21,134	26,761	0,002	0,002	0,002	0,044	0,044	0,044
Motorcycles	2004	2,414	1,826	1,830	3,097	2,009	1,858	18,614	20,684	26,249	0,002	0,002	0,002	0,043	0,043	0,043
Motorcycles	2005	2,354	1,774	1,780	3,084	1,969	1,810	18,150	20,155	25,645	0,002	0,002	0,002	0,042	0,042	0,042
Motorcycles	2006	2,299	1,725	1,733	3,052	1,926	1,764	17,761	19,704	25,135	0,002	0,002	0,002	0,040	0,040	0,040
Motorcycles	2007	2,231	1,666	1,674	2,972	1,864	1,704	17,321	19,122	24,407	0,002	0,002	0,002	0,039	0,039	0,039

Annex 2B-7: Fuel use (GJ) and emissions (tons) per vehicle category and as totals

Year	Sector	FC (PJ)	SO_2	NO_x	NMVOC	CH_4	CO	CO_2	N_2O	NH_3	TSP
1985	Passenger Cars	64	1208	52255	70537	1843	525856	4647	177	47	1445
1986	Passenger Cars	64	809	53053	70376	1865	504298	4686	180	47	1428
1987	Passenger Cars	65	843	53628	70106	1888	485511	4723	182	48	1423
1988	Passenger Cars	66	871	54803	69860	1923	440335	4788	187	49	1398
1989	Passenger Cars	65	635	54414	68389	1903	412678	4736	185	49	1363
1990	Passenger Cars	68	650	57926	71825	2021	421936	5004	197	52	1392
1991	Passenger Cars	73	669	58348	72370	2045	435764	5315	218	230	1374
1992	Passenger Cars	76	498	58769	71376	2017	425231	5576	238	422	1320
1993	Passenger Cars	78	296	57113	69069	1983	425672	5724	253	604	1270
1994	Passenger Cars	81	303	53865	64626	1871	392516	5920	277	926	1148
1995	Passenger Cars	82	308	50704	59763	1732	369785	5991	287	1170	1057
1996	Passenger Cars	83	313	47345	55266	1611	356896	6055	296	1393	973
1997	Passenger Cars	85	318	43689	48921	1513	303939	6204	303	1820	836
1998	Passenger Cars	87	327	39819	43527	1419	282166	6333	302	2175	751
1999	Passenger Cars	87	273	36142	38192	1313	248692	6370	298	2432	705
2000	Passenger Cars	87	198	33102	31709	1219	226199	6332	291	2587	670
2001	Passenger Cars	86	196	30435	28938	1109	216040	6274	273	2457	655
2002	Passenger Cars	87	199	28248	25657	1014	195347	6350	260	2390	636
2003	Passenger Cars	88	201	26162	23299	934	184534	6417	244	2293	635
2004	Passenger Cars	88	202	24122	19912	842	160535	6451	232	2192	633
2005	Passenger Cars	87	40	21795	18036	756	151967	6396	212	2035	662
2006	Passenger Cars	88	40	19772	15378	661	130602	6450	195	1866	679
2007	Passenger Cars	94	43	19253	13238	592	116622	6869	191	1713	786
1985	Light Duty Vehicles	14	2852	6760	2304	126	16496	1064	5	5	1525
1986	Light Duty Vehicles	16	1942	7457	2425	136	17360	1190	5	6	1710
1987	Light Duty Vehicles	17	1996	7654	2488	140	17864	1222	6	6	1768
1988	Light Duty Vehicles	17	2059	7846	2497	144	17627	1257	6	6	1759
1989	Light Duty Vehicles	18	1436	8056	2479	146	17447	1303	6	6	1813
1990	Light Duty Vehicles	19	1570	8703	2615	157	18462	1416	6	7	1974
1991	Light Duty Vehicles	20	1624	9057	2773	163	19725	1468	6	7	2088
1992	Light Duty Vehicles	20	1042	9052	2852	164	20080	1459	7	7	2035
1993	Light Duty Vehicles	20	418	9386	2984	170	21329	1509	7	7	2147
1994	Light Duty Vehicles	22	456	9959	3099	174	21901	1634	7	8	2326
1995	Light Duty Vehicles	22	448	9665	2950	165	21029	1612	10	15	2175

Continued

Year	Sector	FC (PJ)	SO_2	NO_x	NMVOC	CH_4	CO	CO_2	N_2O	NH_3	TSP
1996	Light Duty Vehicles	22	457	9644	2873	157	20892	1642	13	22	2139
1997	Light Duty Vehicles	23	463	9561	2710	152	19540	1662	16	29	1967
1998	Light Duty Vehicles	23	468	9576	2645	149	19402	1689	20	37	1856
1999	Light Duty Vehicles	23	263	9464	2503	141	18158	1706	23	46	1737
2000	Light Duty Vehicles	24	55	9496	2304	135	17520	1745	27	55	1641
2001	Light Duty Vehicles	24	56	9535	2283	128	17411	1784	32	65	1585
2002	Light Duty Vehicles	25	59	9434	2128	119	16130	1859	37	68	1460
2003	Light Duty Vehicles	28	65	9903	2116	114	15857	2052	43	68	1489
2004	Light Duty Vehicles	30	71	10166	1967	105	14464	2232	51	73	1348
2005	Light Duty Vehicles	34	16	10860	2045	100	14638	2488	60	73	1395
2006	Light Duty Vehicles	37	17	11536	2039	94	14026	2751	70	73	1383
2007	Light Duty Vehicles	38	18	10797	1764	78	11521	2780	73	62	1224
1985	Heavy Duty Vehicles	32	7559	33483	2451	279	7894	2394	92	9	1381
1986	Heavy Duty Vehicles	36	5110	37712	2749	314	8820	2697	103	10	1554
1987	Heavy Duty Vehicles	36	5006	36951	2695	308	8644	2642	101	10	1523
1988	Heavy Duty Vehicles	35	4926	36371	2660	303	8517	2599	99	10	1501
1989	Heavy Duty Vehicles	37	3415	37815	2760	315	8816	2703	103	10	1560
1990	Heavy Duty Vehicles	38	3546	39243	2898	329	9197	2806	108	11	1625
1991	Heavy Duty Vehicles	39	3609	39942	2944	335	9351	2856	110	11	1652
1992	Heavy Duty Vehicles	37	2279	38795	2866	326	9130	2775	107	11	1606
1993	Heavy Duty Vehicles	36	853	37634	2780	318	8888	2700	104	10	1559
1994	Heavy Duty Vehicles	39	909	39441	2846	333	9223	2876	113	11	1622
1995	Heavy Duty Vehicles	40	923	39299	2791	342	9154	2923	116	12	1613
1996	Heavy Duty Vehicles	41	949	39650	2769	356	9185	3005	121	12	1616
1997	Heavy Duty Vehicles	41	962	39596	2595	356	8883	3044	122	12	1548
1998	Heavy Duty Vehicles	42	971	39458	2480	355	8765	3071	123	12	1484
1999	Heavy Duty Vehicles	43	550	40131	2391	361	8729	3162	127	13	1449
2000	Heavy Duty Vehicles	41	96	38169	2205	345	8300	3049	123	12	1328
2001	Heavy Duty Vehicles	42	98	37864	2071	348	8253	3091	124	12	1271
2002	Heavy Duty Vehicles	41	97	36363	1929	340	8051	3063	123	12	1176
2003	Heavy Duty Vehicles	44	103	37557	1941	356	8410	3253	131	13	1174
2004	Heavy Duty Vehicles	45	106	37249	1853	361	8423	3345	136	14	1108
2005	Heavy Duty Vehicles	44	21	35069	1701	345	8067	3239	132	13	1004
2006	Heavy Duty Vehicles	44	21	34538	1621	342	8010	3292	135	14	948
2007	Heavy Duty Vehicles	47	22	34205	1515	328	7695	3444	143	14	885
1985	2-wheelers	1	2	62	5704	131	11021	56	1	1	79

Continued

Year	Sector	FC (PJ)	SO_2	NO_x	NMVOC	CH_4	CO	CO_2	N_2O	NH_3	TSP
1986	2-wheelers	1	2	61	5168	122	10456	52	1	1	72
1987	2-wheelers	1	2	59	4796	115	9928	50	1	1	67
1988	2-wheelers	1	2	59	4577	112	9772	49	1	1	64
1989	2-wheelers	1	1	58	4368	108	9472	47	1	1	61
1990	2-wheelers	1	2	62	4473	112	9946	49	1	1	63
1991	2-wheelers	1	2	61	4610	116	10157	51	1	1	64
1992	2-wheelers	1	2	67	4669	120	10664	53	1	1	66
1993	2-wheelers	1	2	67	4672	122	10901	54	1	1	66
1994	2-wheelers	1	2	74	4683	126	11393	56	1	1	66
1995	2-wheelers	1	2	80	4966	132	12034	59	1	1	70
1996	2-wheelers	1	2	81	5284	140	12615	62	1	1	75
1997	2-wheelers	1	2	89	5796	154	13844	68	1	1	82
1998	2-wheelers	1	2	96	6234	166	14962	73	1	1	88
1999	2-wheelers	1	2	101	5872	164	15182	74	1	1	83
2000	2-wheelers	1	2	115	5360	162	15288	76	1	1	79
2001	2-wheelers	1	2	122	4534	155	15229	75	1	1	69
2002	2-wheelers	1	2	135	4568	161	16032	80	1	1	70
2003	2-wheelers	1	3	147	4491	166	16622	83	2	2	70
2004	2-wheelers	1	3	162	4396	171	17135	87	2	2	68
2005	2-wheelers	1	1	180	4132	172	17315	90	2	2	64
2006	2-wheelers	1	1	202	3934	177	17997	96	2	2	62
2007	2-wheelers	1	1	230	3847	187	19247	105	2	2	62
1985	Total	111	11621	92560	80995	2378	561267	8160	275	62	4431
1986	Total	117	7862	98283	80718	2437	540934	8625	289	64	4764
1987	Total	118	7847	98293	80084	2450	521947	8636	289	64	4781
1988	Total	118	7857	99080	79594	2481	476252	8694	293	66	4722
1989	Total	120	5488	100343	77996	2472	448414	8789	295	66	4796
1990	Total	126	5767	105934	81811	2619	459541	9275	312	70	5053
1991	Total	132	5903	107409	82697	2658	474997	9690	335	248	5179
1992	Total	134	3820	106683	81762	2627	465105	9863	352	441	5026
1993	Total	136	1569	104201	79504	2592	466790	9987	365	623	5041
1994	Total	143	1669	103338	75253	2503	435033	10487	398	946	5161
1995	Total	144	1682	99747	70469	2371	412002	10585	414	1198	4914
1996	Total	147	1721	96719	66193	2264	399588	10764	430	1428	4803
1997	Total	149	1744	92934	60022	2176	346206	10978	443	1862	4432
1998	Total	152	1768	88949	54887	2090	325296	11166	447	2226	4179

Continued

Year	Sector	FC (PJ)	SO_2	NO_x	NMVOC	CH_4	CO	CO_2	N_2O	NH_3	TSP
1999	Total	154	1088	85839	48958	1980	290760	11312	450	2492	3974
2000	Total	153	352	80883	41578	1861	267306	11202	444	2657	3718
2001	Total	153	353	77956	37826	1739	256933	11223	429	2536	3579
2002	Total	155	357	74180	34282	1635	235560	11352	421	2472	3342
2003	Total	161	371	73769	31847	1571	225422	11806	420	2376	3367
2004	Total	165	381	71699	28129	1479	200557	12115	421	2281	3158
2005	Total	166	77	67903	25914	1373	191988	12214	406	2123	3125
2006	Total	171	79	66049	22972	1275	170635	12589	402	1954	3072
2007	Total	180	83	64485	20364	1185	155084	13198	409	1791	2957

Annex 2B-8: COPERT IV:DEA statistics fuel use ratios and mileage adjustment factors

Sales			1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Fuel ratio	Gasoline	DEA:COPERT IV	1,04	1,00	0,97	0,95	0,92	0,97	1,01	1,06	1,09	1,11	1,10	1,08	1,10	1,11	1,09	1,09
	Diesel (fuel ratio)	DEA:COPERT IV	1,22	1,29	1,25	1,25	1,28	1,39	1,43	1,40	1,41	1,52	1,49	1,51	1,51	1,50	1,47	1,42
Mileage factor	Gasoline	DEA:COPERT IV	1,04	1,00	0,97	0,95	0,92	0,97	1,01	1,06	1,09	1,11	1,10	1,08	1,10	1,11	1,09	1,09
	Diesel (mileage factor)	DEA:COPERT IV	1,25	1,32	1,28	1,28	1,32	1,45	1,49	1,45	1,47	1,59	1,57	1,59	1,59	1,57	1,55	1,50
Consumption																		
Fuel ratio	Gasoline	DEA:COPERT IV	1,08	1,08	1,07	1,08	1,07	1,06	1,06	1,07	1,07	1,08	1,09	1,09	1,11	1,11	1,13	1,15
	Diesel (fuel ratio)	DEA:COPERT IV	1,13	1,16	1,13	1,13	1,17	1,27	1,36	1,34	1,35	1,40	1,37	1,38	1,38	1,36	1,34	1,32
Mileage factor	Gasoline	DEA:COPERT IV	1,08	1,08	1,07	1,08	1,07	1,06	1,06	1,07	1,07	1,08	1,09	1,09	1,11	1,11	1,13	1,15
	Diesel (mileage factor)	DEA:COPERT IV	1,15	1,19	1,15	1,15	1,19	1,31	1,41	1,39	1,40	1,46	1,42	1,44	1,44	1,42	1,40	1,38

Continued

Sales			2001	2002	2003	2004	2005	2006	2007
Fuel ratio	Gasoline	DEA:COPERT IV	1,09	1,11	1,11	1,10	1,05	1,01	1,01
	Diesel (fuel ratio)	DEA:COPERT IV	1,38	1,38	1,45	1,47	1,43	1,42	1,42
Mileage factor	Gasoline	DEA:COPERT IV	1,09	1,11	1,11	1,10	1,05	1,01	1,01
	Diesel (mileage factor)	DEA:COPERT IV	1,46	1,47	1,57	1,61	1,56	1,56	1,62
Consumption									
Fuel ratio	Gasoline	DEA:COPERT IV	1,13	1,14	1,13	1,12	1,07	1,02	1,01
	Diesel (fuel ratio)	DEA:COPERT IV	1,29	1,27	1,31	1,32	1,28	1,28	1,30
Mileage factor	Gasoline	DEA:COPERT IV	1,13	1,14	1,13	1,12	1,07	1,02	1,01
	Diesel (mileage factor)	DEA:COPERT IV	1,35	1,34	1,38	1,41	1,37	1,38	1,45

Annex 2B-9: Basis fuel use and emission factors, deterioration factors, transient factors and specific operational data for non road working machinery and equipment, and recreational craft

Basis factors for diesel fuelled non road machinery.

Engine size [P=kW]	Emission Level	NO_x	VOC	CO	N_2O [g pr 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
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 pr 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 pr kWh]	NH_3	TSP	Fuel
2-stroke	SH2	20<=S<50	<1981	1	305	695	0.002	0.01	7	882
2-stroke	SH2	20<=S<50	1981-1990	1	300	579	0.002	0.01	5.3	809
2-stroke	SH2	20<=S<50	1991-Stage I	1.1	203	463	0.002	0.01	3.5	735
2-stroke	SH2	20<=S<50	Stage I	1.5	188	379	0.002	0.01	3.5	720
2-stroke	SH2	20<=S<50	Stage II	1.5	44	379	0.002	0.01	3.5	500
2-stroke	SH3	S>=50	<1981	1.1	189	510	0.002	0.01	3.6	665
2-stroke	SH3	S>=50	1981-1990	1.1	158	425	0.002	0.01	2.7	609
2-stroke	SH3	S>=50	1991-Stage I	1.2	126	340	0.002	0.01	1.8	554
2-stroke	SH3	S>=50	Stage I	2	126	340	0.002	0.01	1.8	529
2-stroke	SH3	S>=50	Stage II	1.2	64	340	0.002	0.01	1.8	500
2-stroke	SN1	S<66	<1981	0.5	155	418	0.002	0.01	2.6	652
2-stroke	SN1	S<66	1981-1990	0.5	155	418	0.002	0.01	2.6	652
2-stroke	SN1	S<66	1991-Stage I	0.5	155	418	0.002	0.01	2.6	652
2-stroke	SN1	S<66	Stage I	0.5	155	418	0.002	0.01	2.6	652
2-stroke	SN1	S<66	Stage II	0.5	155	418	0.002	0.01	2.6	652
2-stroke	SN2	66<=S<100	<1981	0.5	155	418	0.002	0.01	2.6	652
2-stroke	SN2	66<=S<100	1981-1990	0.5	155	418	0.002	0.01	2.6	652
2-stroke	SN2	66<=S<100	1991-Stage I	0.5	155	418	0.002	0.01	2.6	652
2-stroke	SN2	66<=S<100	Stage I	0.5	155	418	0.002	0.01	2.6	652
2-stroke	SN2	66<=S<100	Stage II	0.5	155	418	0.002	0.01	2.6	652
2-stroke	SN3	100<=S<225	<1981	0.5	155	418	0.002	0.01	2.6	652
2-stroke	SN3	100<=S<225	1981-1990	0.5	155	418	0.002	0.01	2.6	652
2-stroke	SN3	100<=S<225	1991-Stage I	0.5	155	418	0.002	0.01	2.6	652
2-stroke	SN3	100<=S<225	Stage I	0.5	155	418	0.002	0.01	2.6	652
2-stroke	SN3	100<=S<225	Stage II	0.5	155	418	0.002	0.01	2.6	652
2-stroke	SN4	S>=225	<1981	0.5	155	418	0.002	0.01	2.6	652
2-stroke	SN4	S>=225	1981-1990	0.5	155	418	0.002	0.01	2.6	652
2-stroke	SN4	S>=225	1991-Stage I	0.5	155	418	0.002	0.01	2.6	652
2-stroke	SN4	S>=225	Stage I	0.5	155	418	0.002	0.01	2.6	652
2-stroke	SN4	S>=225	Stage II	0.5	155	418	0.002	0.01	2.6	652

Fuel use and emission factors LPG fork lifts.

NO_x [g pr kWh]	VOC [g pr kWh]	CO [g pr kWh]	NH_3 [g pr kWh]	N_2O [g pr kWh]	TSP [g pr kWh]	FC [g pr kWh]
19	2.2	1.5	0.003	0.05	0.07	311

Fuel use and emission factors for All Terrain Vehicles (ATV's).

ATV type	NO_x [g pr GJ]	VOC [g pr GJ]	CO [g pr GJ]	NH_3 [g pr GJ]	N_2O [g pr GJ]	TSP [g pr GJ]	Fuel [kg pr hour]
Professional	108	1077	16306	2	2	32	1.125
Private	128	1527	22043	2	2	39	0.75

Fuel use and emission factors for recreational craft.

Fuel type	Vessel type	Engine	Engine type	Direktiv	Engine size	CO	VOC	N_2O	NH_3	NO_x	TSP	Fuel
					[kW]	[g pr kWh]						
Gasoline	Other boats (< 20 ft)	Out board	2-stroke	2003/44	8	202.5	45.9	0.01	0.002	2	10	791
Gasoline	Other boats (< 20 ft)	Out board	2-stroke	Konv.	8	427	257.0	0.01	0.002	2	10	791
Gasoline	Other boats (< 20 ft)	Out board	4-stroke	2003/44	8	202.5	24.0	0.03	0.002	7	0.08	426
Gasoline	Other boats (< 20 ft)	Out board	4-stroke	Konv.	8	520	24.0	0.03	0.002	7	0.08	426
Gasoline	Yawls and cabin boats	Out board	2-stroke	2003/44	20	162	36.5	0.01	0.002	3	10	791
Gasoline	Yawls and cabin boats	Out board	2-stroke	Konv.	20	374	172.0	0.01	0.002	3	10	791
Gasoline	Yawls and cabin boats	Out board	4-stroke	2003/44	20	162	14.0	0.03	0.002	10	0.08	426
Gasoline	Yawls and cabin boats	Out board	4-stroke	Konv.	20	390	14.0	0.03	0.002	10	0.08	426
Gasoline	Sailing boats (< 26 ft)	Out board	2-stroke	2003/44	10	189	43.0	0.01	0.002	2	10	791
Gasoline	Sailing boats (< 26 ft)	Out board	2-stroke	Konv.	10	427	257.0	0.01	0.002	2	10	791
Gasoline	Sailing boats (< 26 ft)	Out board	4-stroke	2003/44	10	189	24.0	0.03	0.002	7	0.08	426
Gasoline	Sailing boats (< 26 ft)	Out board	4-stroke	Konv.	10	520	24.0	0.03	0.002	7	0.08	426
Gasoline	Speed boats	In board	4-stroke	2003/44	90	141	10.0	0.03	0.002	12	0.08	426
Gasoline	Speed boats	In board	4-stroke	Konv.	90	346	10.0	0.03	0.002	12	0.08	426
Gasoline	Speed boats	Out board	2-stroke	2003/44	50	145.8	31.8	0.01	0.002	3	10	791
Gasoline	Speed boats	Out board	2-stroke	Konv.	50	374	172.0	0.01	0.002	3	10	791
Gasoline	Speed boats	Out board	4-stroke	2003/44	50	145.8	14.0	0.03	0.002	10	0.08	426
Gasoline	Speed boats	Out board	4-stroke	Konv.	50	390	14.0	0.03	0.002	10	0.08	426
Gasoline	Water scooters	Built in	2-stroke	2003/44	45	147	32.2	0.01	0.002	3	10	791
Gasoline	Water scooters	Built in	2-stroke	Konv.	45	374	172.0	0.01	0.002	3	10	791
Gasoline	Water scooters	Built in	4-stroke	2003/44	45	147	14.0	0.03	0.002	10	0.08	426
Gasoline	Water scooters	Built in	4-stroke	Konv.	45	390	14.0	0.03	0.002	10	0.08	426
Diesel	Motor boats (27-34 ft)	In board		2003/44	150	5	1.7	0.035	0.002	8.6	1	275
Diesel	Motor boats (27-34 ft)	In board		Konv.	150	5.3	2.0	0.035	0.002	8.6	1.2	275
Diesel	Motor boats (> 34 ft)	In board		2003/44	250	5	1.6	0.035	0.002	8.6	1	275
Diesel	Motor boats (> 34 ft)	In board		Konv.	250	5.3	2.0	0.035	0.002	8.6	1.2	275
Diesel	Motor boats (< 27 ft)	In board		2003/44	40	5	1.8	0.035	0.002	9.8	1	281
Diesel	Motor boats (< 27 ft)	In board		Konv.	40	5.5	2.2	0.035	0.002	18	1.4	281
Diesel	Motor sailors	In board		2003/44	30	5	1.9	0.035	0.002	9.8	1	281
Diesel	Motor sailors	In board		Konv.	30	5.5	2.2	0.035	0.002	18	1.4	281
Diesel	Sailing boats (> 26 ft)	In board		2003/44	30	5	1.9	0.035	0.002	9.8	1	281
Diesel	Sailing boats (> 26 ft)	In board		Konv.	30	5.5	2.2	0.035	0.002	18	1.4	281

CH_4 shares of VOC for diesel, gasoline and LPG.

Fuel type	CH_4 share of VOC
Diesel	0.016
Gasoline 4-stroke	0.1
Gasoline 2-stroke	0.009
LPG	0.05

Deterioration factors for diesel machinery.

Emission Level	NO_x	VOC	CO	TSP
<1981	0.024	0.047	0.185	0.473
1981-1990	0.024	0.047	0.185	0.473
1991-Stage I	0.024	0.047	0.185	0.473
Stage I	0.024	0.036	0.101	0.473
Stage II	0.009	0.034	0.101	0.473
Stage IIIA	0.008	0.027	0.151	0.473
Stage IIIB	0.008	0.027	0.151	0.473
Stage IV	0.008	0.027	0.151	0.473

Deterioration factors for gasoline 2-stroke machinery.

Engine	Size code	Size classe	Emission Level	NO_x	VOC	CO	TSP
2-stroke	SH2	20<=S<50	<1981	0	0.2	0.2	0
2-stroke	SH2	20<=S<50	1981-1990	0	0.2	0.2	0
2-stroke	SH2	20<=S<50	1991-Stage I	0	0.2	0.2	0
2-stroke	SH2	20<=S<50	Stage I	0	0.29	0.24	0
2-stroke	SH2	20<=S<50	Stage II	0	0.29	0.24	0
2-stroke	SH3	S>=50	<1981	-0.031	0.2	0.2	0
2-stroke	SH3	S>=50	1981-1990	-0.031	0.2	0.2	0
2-stroke	SH3	S>=50	1991-Stage I	-0.031	0.2	0.2	0
2-stroke	SH3	S>=50	Stage I	0	0.266	0.231	0
2-stroke	SH3	S>=50	Stage II	0	0.266	0.231	0
2-stroke	SN1	S<66	<1981	-0.6	0.201	0.9	1.1
2-stroke	SN1	S<66	1981-1990	-0.6	0.201	0.9	1.1
2-stroke	SN1	S<66	1991-Stage I	-0.6	0.201	0.9	1.1
2-stroke	SN1	S<66	Stage I	-0.33	0.266	1.109	5.103
2-stroke	SN1	S<66	Stage II	-0.33	0	1.109	5.103
2-stroke	SN2	66<=S<100	<1981	-0.6	0.201	0.9	1.1
2-stroke	SN2	66<=S<100	1981-1990	-0.6	0.201	0.9	1.1
2-stroke	SN2	66<=S<100	1991-Stage I	-0.6	0.201	0.9	1.1
2-stroke	SN2	66<=S<100	Stage I	-0.33	0.266	1.109	5.103
2-stroke	SN2	66<=S<100	Stage II	-0.33	0	1.109	5.103
2-stroke	SN3	100<=S<225	<1981	-0.6	0.201	0.9	1.1
2-stroke	SN3	100<=S<225	1981-1990	-0.6	0.201	0.9	1.1
2-stroke	SN3	100<=S<225	1991-Stage I	-0.6	0.201	0.9	1.1
2-stroke	SN3	100<=S<225	Stage I	-0.33	0.266	1.109	5.103
2-stroke	SN3	100<=S<225	Stage II	-0.33	0	1.109	5.103
2-stroke	SN4	S>=225	<1981	-0.6	0.201	0.9	1.1
2-stroke	SN4	S>=225	1981-1990	-0.6	0.201	0.9	1.1
2-stroke	SN4	S>=225	1991-Stage I	-0.6	0.201	0.9	1.1
2-stroke	SN4	S>=225	Stage I	-0.274	0	0.887	1.935
2-stroke	SN4	S>=225	Stage II	-0.274	0	0.887	1.935

Deterioration factors for gasoline 4-stroke machinery.

Engine	Size code	Size classe	Emission Level	NO_x	VOC	CO	TSP
4-stroke	SN1	S<66	<1981	-0.6	1.1	0.9	1.1
4-stroke	SN1	S<66	1981-1990	-0.6	1.1	0.9	1.1
4-stroke	SN1	S<66	1991-Stage I	-0.6	1.1	0.9	1.1
4-stroke	SN1	S<66	Stage I	-0.3	1.753	1.051	1.753
4-stroke	SN1	S<66	Stage II	-0.3	1.753	1.051	1.753
4-stroke	SN2	66<=S<100	<1981	-0.6	1.1	0.9	1.1
4-stroke	SN2	66<=S<100	1981-1990	-0.6	1.1	0.9	1.1
4-stroke	SN2	66<=S<100	1991-Stage I	-0.6	1.1	0.9	1.1
4-stroke	SN2	66<=S<100	Stage I	-0.3	1.753	1.051	1.753
4-stroke	SN2	66<=S<100	Stage II	-0.3	1.753	1.051	1.753
4-stroke	SN3	100<=S<225	<1981	-0.6	1.1	0.9	1.1
4-stroke	SN3	100<=S<225	1981-1990	-0.6	1.1	0.9	1.1
4-stroke	SN3	100<=S<225	1991-Stage I	-0.6	1.1	0.9	1.1
4-stroke	SN3	100<=S<225	Stage I	-0.3	1.753	1.051	1.753
4-stroke	SN3	100<=S<225	Stage II	-0.3	1.753	1.051	1.753
4-stroke	SN4	S>=225	<1981	-0.6	1.1	0.9	1.1
4-stroke	SN4	S>=225	1981-1990	-0.6	1.1	0.9	1.1
4-stroke	SN4	S>=225	1991-Stage I	-0.6	1.1	0.9	1.1
4-stroke	SN4	S>=225	Stage I	-0.599	1.095	1.307	1.095
4-stroke	SN4	S>=225	Stage II	-0.599	1.095	1.307	1.095
4-stroke	SH2	20<=S<50	<1981	0	0	0	0
4-stroke	SH2	20<=S<50	1981-1990	0	0	0	0
4-stroke	SH2	20<=S<50	1991-Stage I	0	0	0	0
4-stroke	SH2	20<=S<50	Stage I	0	0	0	0
4-stroke	SH2	20<=S<50	Stage II	0	0	0	0
4-stroke	SH3	S>=50	<1981	0	0	0	0
4-stroke	SH3	S>=50	1981-1990	0	0	0	0
4-stroke	SH3	S>=50	1991-Stage I	0	0	0	0
4-stroke	SH3	S>=50	Stage I	0	0	0	0
4-stroke	SH3	S>=50	Stage II	0	0	0	0

Transient factors for diesel machinery.

Emission Level	Load	NO_x	VOC	CO	TSP	Fuel
<1981	High	0.95	1.05	1.53	1.23	1.01
1981-1990	High	0.95	1.05	1.53	1.23	1.01
1991-Stage I	High	0.95	1.05	1.53	1.23	1.01
Stage I	High	0.95	1.05	1.53	1.23	1.01
Stage II	High	0.95	1.05	1.53	1.23	1.01
Stage IIIA	High	0.95	1.05	1.53	1.23	1.01
Stage IIIB	High	1	1	1	1	1
Stage IV	High	1	1	1	1	1
<1981	Low	1.1	2.29	2.57	1.97	1.18
1981-1990	Low	1.1	2.29	2.57	1.97	1.18
1991-Stage I	Low	1.1	2.29	2.57	1.97	1.18
Stage I	Low	1.1	2.29	2.57	1.97	1.18
Stage II	Low	1.1	2.29	2.57	1.97	1.18
Stage IIIA	Low	1.1	2.29	2.57	1.97	1.18
Stage IIIB	Low	1	1	1	1	1
Stage IV	Low	1	1	1	1	1

Annual working hours, load factors and lifetimes for agricultural tractors.

Tractor type	Annual working hours	Load factor	Lifetime (yrs)
Diesel	500 (0-7 years) 500-100 (7-16 years) 100 (>16 years)	0.5	30
Gasoline (certified)	100	0.4	37
Gasoline (non certified)	50	0.4	37

Annual working hours, load factors and lifetimes for harvesters.

Annual working hours	Load factor	Lifetime (yrs)
250-100 (linear decrease 0-24 years)	0.8	25

Annual working hours, load factors and lifetime for machine pool machinery.

Tractor type	Hours pr yr	Load factor	Lifetime (yrs)
Tractors	750	0.5	7
Harvesters	100	0.8	11
Self-propelled vehicles	500	0.75	6

Operational data for other machinery types in agriculture.

Machinery type	Fuel type	Load factor	Lifetime (yrs)	Hours	Size (kW)
ATV private	Gasoline	-	6	250	-
ATV professional	Gasoline	-	8	400	-
Bedding machines	Gasoline	0.3	10	50	3
Fodder trucks	Gasoline	0.4	10	200	8
Other (gasoline)	Gasoline	0.4	10	50	5
Scrapers	Gasoline	0.3	10	50	3
Self-propelled vehicles	Diesel	0.75	15	150	60
Sweepers	Gasoline	0.3	10	50	3

Annual working hours, load factors and lifetimes for forestry machinery.

Machinery type	Hours	Load factors	Lifetime
Chippers	1200	0.5	6
Tractors (other)	100 (1990) 400 (2004)	0.5	15
Tractors (silvicultural)	800	0.5	6
Harvesters	1200	0.5	8
Forwarders	1200	0.5	8
Chain saws (forestry)	800	0.4	3

Annual working hours, load factors and lifetime for fork lifts.

Hours pr yr	Load factor	Lifetime (yrs)
1200 (>=50 kW and <=10 years old) 650 (>=50 kW and >10 years old) 650 (<50 kW)	0.27	20

Operational data for construction machinery.

Machinery type	Load factor	Lifetime	Hours	Size
Track type dozers	0.5	10	1100	140
Track type loaders	0.5	10	1100	100 (1990) 150 (2004)
Wheel loaders (0-5 tons)	0.5	10	1200	20
Wheel loaders (> 5,1 tons)	0.5	10	1200	120
Wheel type excavators	0.6	10	1200	100
Track type excavators (0-5 tons)	0.6	10	1100	20
Track type excavators (>5,1 tons)	0.6	10	1100	120
Excavators/Loaders	0.45	10	700	50
Dump trucks	0.4	10	900 (1990) 1200 (2004)	60 (1990) 180 (2004)
Mini loaders	0.5	14	700	30
Telescopic loaders	0.5	14	1000	35

Stock and operational data for other machinery types in industry.

Sector	Fuel type	Machinery type	Size (kW)	No	Load Factor	Hours
Construction machinery	Diesel	Tampers/Land rollers	30	2800	0.45	600
Construction machinery	Diesel	Generators (diesel)	45	5000	0.5	200
Construction machinery	Diesel	Kompressors (diesel)	45	5000	0.5	500
Construction machinery	Diesel	Pumps (diesel)	75	1000	0.5	5
Construction machinery	Diesel	Asphalt pavers	80	300	0.35	700
Construction machinery	Diesel	Motor graders	100	100	0.4	700
Construction machinery	Diesel	Refuse compressors	160	100	0.25	1300
Construction machinery	Gasoline	Generators (gasoline)	2.5	11000	0.4	80
Construction machinery	Gasoline	Pumps (gasoline)	4	10000	0.4	300
Construction machinery	Gasoline	Kompressors (gasoline)	4	500	0.35	15
Industry	Diesel	Refrigerating units (distribution)	8	3000	0.5	1250
Industry	Diesel	Refrigerating units (long distance)	15	3500	0.5	200
Industry	Diesel	Tractors (transport, industry)	50	3000	0.4	500
Airport GSE and other	Diesel	Airport GSE and other (light duty)	100	500	0.5	400
Airport GSE and other	Diesel	Airport GSE and other (medium duty)	125	350	0.5	300
Airport GSE and other	Diesel	Airport GSE and other (Heavy duty)	175	650	0.5	200
Building and construction	Diesel	Vibratory plates	6	3500	0.6	300
Building and construction	Diesel	Aereal lifts (diesel)	30	150	0.4	400
Building and construction	Diesel	Sweepers (diesel)	30	200	0.4	300
Building and construction	Diesel	High pressure cleaners (diesel)	30	50	0.8	500
Building and construction	Gasoline	Rammers	2.5	3000	0.4	80
Building and construction	Gasoline	Drills	3	100	0.4	10
Building and construction	Gasoline	Vibratory plates (gasoline)	4	2500	0.5	200
Building and construction	Gasoline	Cutters	4	800	0.5	50
Building and construction	Gasoline	Other (gasoline)	5	1000	0.5	40
Building and construction	Gasoline	High pressure cleaners (gasoline)	5	500	0.6	200
Building and construction	Gasoline	Sweepers (gasoline)	10	500	0.4	150
Building and construction	Gasoline	Slicers	10	100	0.7	150
Building and construction	Gasoline	Aereal lifts (gasoline)	20	50	0.4	400

Operational data for the most important types of household and gardening machinery.

Machinery type	Engine	Size (kW)	Hours	Load factor	Lifetime (yrs)
Chain saws (private)	2-stroke	2	5	0.3	10
Chain saws (professional)	2-stroke	3	270	0.4	3
Cultivators (private-large)	4-stroke	3.7	5	0.6	5
Cultivators (private-small)	4-stroke	1	5	0.6	15
Cultivators (professional)	4-stroke	7	360	0.6	8
Hedge cutters (private)	2-stroke	0.9	10	0.5	10
Hedge cutters (professional)	2-stroke	2	300	0.5	4
Lawn movers (private)	4-stroke	2.5 (2000) 3.5 (2004)	25	0.4	8
Lawn movers (professional)	4-stroke	2.5 (2000) 3.5 (2004)	250	0.4	4
Riders (private)	4-stroke	11	50	0.5	12
Riders (professional)	4-stroke	13	330	0.5	5
Shrub clearers (private)	2-stroke	1	15	0.6	10
Shrub clearers (professional)	2-stroke	2	300	0.6	4
Trimmers (private)	2-stroke	0.9	20	0.5	10
Trimmers (professional)	2-stroke	0.9	200	0.5	4

Stock and operational data for other machines in household and gardening.

Machinery type	Engine	No.	Size (kW)	Hours	Load factor	Lifetime (yrs)
Chippers	2-stroke	200	10	100	0.7	10
Garden shredders	2-stroke	500	3	20	0.7	10
Other (gasoline)	2-stroke	200	2	20	0.5	10
Suction machines	2-stroke	300	4	80	0.5	10
Wood cutters	4-stroke	100	4	15	0.5	10

Operational data for recreational craft.

Fuel type	Vessel type	Engine type	Stroke	Hours	Lifetime	Load factor
Gasoline	Other boats (<20 ft)	Out board engine	2-stroke	30	10	0.5
Gasoline	Other boats (<20 ft)	Out board engine	4-stroke	30	10	0.5
Gasoline	Yawls and cabin boats	Out board engine	2-stroke	50	10	0.5
Gasoline	Yawls and cabin boats	Out board engine	4-stroke	50	10	0.5
Gasoline	Sailing boats (<26ft)	Out board engine	2-stroke	5	10	0.5
Gasoline	Sailing boats (<26ft)	Out board engine	4-stroke	5	10	0.5
Gasoline	Speed boats	In board engine	4-stroke	75	10	0.5
Gasoline	Speed boats	Out board engine	2-stroke	50	10	0.5
Gasoline	Speed boats	Out board engine	4-stroke	50	10	0.5
Gasoline	Water scooters	Built in	2-stroke	10	10	0.5
Gasoline	Water scooters	Built in	4-stroke	10	10	0.5
Diesel	Motor boats (27-34 ft)	In board engine		150	15	0.5
Diesel	Motor boats (>34 ft)	In board engine		100	15	0.5
Diesel	Motor boats (<27 ft)	In board engine		75	15	0.5
Diesel	Motor sailors	In board engine		75	15	0.5
Diesel	Sailing boats (<26ft)	In board engine		25	15	0.5

Annex 2B-10: Stock data for non-road working machinery and equipment

Stock data for diesel tractors 1985-2007.

Size (kW)	Emission Level	1985	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
37	<1981	3882	3234	3106	2922	2861	2610	2605	2273	2193	1918	1796	1601	1449	1298	1148	993	833	664	504
37	1981-1990	635	879	889	883	915	887	945	883	918	869	888	871	876	882	892	900	906	903	914
37	1991-Stage I			25	107	153	201	278	354	445	496	554	568	572	576	582	587	592	590	597
37	Stage I													33	56	83	84	84	84	85
37	Stage II																23	53	162	324
45	<1981	25988	21650	20796	19563	19154	17475	17441	15219	14684	12840	12025	10715	9700	8690	7685	6646	5577	4447	3376
45	1981-1990	5740	8770	8867	8805	9128	8848	9419	8807	9151	8668	8856	8681	8731	8800	8894	8974	9037	9006	9116
45	1991-Stage I			203	202	209	203	216	202	210	199	203	199	200	202	204	206	207	207	209
49	1991-Stage I				154	281	485	602	618	702	749	765	750	754	760	768	775	780	778	787
52	1991-Stage I											247	358	360	363	367	370	373	372	376
52	Stage I													132	242	377	381	383	382	387
52	Stage II																68	147	241	347
56	1991-Stage I				201	338	428	747	943	1181	1280	1307	1281	1289	1299	1313	1325	1334	1329	1346
60	<1981	54651	45529	43732	41140	40278	36747	36676	32004	30879	27001	25287	22533	20397	18273	16162	13976	11729	9351	7099
60	1981-1990	11751	20542	20770	20624	21380	20725	22063	20628	21434	20304	20744	20333	20451	20612	20834	21019	21167	21096	21353
60	1991-Stage I			863	857	888	861	917	857	891	844	862	845	850	856	866	873	879	876	887
63	1991-Stage I				468	855	1325	2014	2384	2837	3011	3076	3015	3033	3057	3090	3117	3139	3128	3167
67	1991-Stage I											671	1343	1351	1361	1376	1388	1398	1393	1410
67	Stage I													533	835	1113	1123	1131	1127	1141
67	Stage II																375	729	1144	1524
71	1991-Stage I				411	715	1179	1949	2507	3344	3594	3672	3600	3620	3649	3688	3721	3747	3735	3780
78	<1981	14558	12128	11649	10959	10729	9789	9770	8525	8226	7192	6736	6002	5433	4868	4305	3723	3124	2491	1891
78	1981-1990	4592	11323	11448	11368	11785	11424	12162	11371	11815	11192	11434	11208	11273	11361	11484	11586	11668	11628	11770
78	1991-Stage I			1233	1503	1713	1945	2429	2561	2946	2994	3287	3436	3727	3756	3797	3830	3857	3844	3891
78	Stage I														325	329	332	334	333	337
78	Stage II															227	310	400	463	469
78	Stage IIIA																			63
86	1991-Stage I				108	193	333	589	880	1364	1532	1718	1876	2023	2039	2061	2079	2094	2087	2112
86	Stage I														134	136	137	138	137	139
86	Stage II															91	343	530	760	769
86	Stage IIIA																			226
93	1991-Stage I											149	245	325	327	331	334	336	335	339

Continued

Size (kW)	Emission Level	1985	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
93	Stage I														114	115	116	117	116	118
93	Stage II															107	186	313	512	518
93	Stage IIIA																			264
97	1991-Stage I				71	175	443	962	1556	2327	2638	2695	2642	2657	2678	2707	2731	2750	2741	2774
101	<1981	4659	3881	3728	3507	3433	3132	3126	2728	2632	2302	2156	1921	1739	1558	1378	1191	1000	797	605
101	1981-1990	1158	2377	2403	2387	2474	2398	2553	2387	2480	2350	2400	2353	2367	2385	2411	2432	2449	2441	2471
101	1991-Stage I			266	264	274	266	283	264	275	260	696	1116	1567	1579	1596	1611	1622	1616	1636
101	Stage I														232	234	236	238	237	240
101	Stage II															136	357	635	776	785
101	Stage IIIA																			188
112	1991-Stage I				63	114	166	252	422	690	790	978	1265	1626	1639	1656	1671	1683	1677	1698
112	Stage I														465	470	474	478	476	482
112	Stage II															337	732	1170	1763	1785
112	Stage IIIA																			378
127	1991-Stage I				12	36	81	193	279	408	457	590	707	847	854	863	871	877	874	884
127	Stage I														152	154	155	156	156	158
127	Stage II															78	268	453	591	599
127	Stage IIIA																			292
131	<1981	798	665	639	601	588	537	536	467	451	394	369	329	298	267	236	204	171	137	104
131	1981-1990	288	887	897	890	923	895	952	890	925	876	895	878	883	890	899	907	914	911	922
131	1991-Stage I			97	97	100	97	103	97	100	95	97	95	96	96	97	98	99	99	100
157	1981-1990		15	15	15	16	15	16	15	16	15	15	15	15	15	15	16	16	16	16
157	1991-Stage I			9	23	39	102	232	357	545	648	784	900	905	912	922	930	937	934	945
157	Stage I													89	89	90	91	92	91	92
157	Stage II														149	415	695	1089	1085	1098
157	Stage IIIA																		623	1453
186	1991-Stage I											23	53	54	54	55	55	56	55	56
186	Stage I													47	48	48	49	49	49	49
186	Stage II														68	207	320	481	480	486
186	Stage IIIA																		272	685

Stock data for gasoline tractors 1985-2005.

Size (kW)	Emission Level	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Certified	<1981	13176	12541	11906	11270	10635	10000	9053	8148	7285	6465	5687	4951	4258	3607	2998	2432	1908	1427	987	591	236
Non certified	<1981	26352	25082	23811	22541	21270	20000	19042	18041	16998	15913	14785	13616	12403	11149	9852	8512	7131	5707	4240	2732	1180

Stock data for harvesters 1985-2007.

Size Group	Emission Level	1985	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
0<S<=50	<1981	26601	18915	17241	15607	14575	12673	10700	9491	6966	5446	3589	2873	1828	1236	718	251			
0<S<=50	1981-1990	519	591	594	601	635	636	633	683	641	686	672	715	748	754	777	826	840	703	580
50<S<=60	<1981	2703	2828	2847	2876	3040	3044	3029	3271	3068	2930	2235	1999	1549	1222	854	366			
50<S<=60	1981-1990	853	1333	1341	1355	1432	1434	1427	1541	1446	1548	1516	1612	1687	1702	1752	1863	1894	1675	1519
50<S<=60	1991-Stage I			8	8	8	8	8	9	9	9	9	10	10	10	10	11	11	11	11
60<S<=70	<1981	1786	1869	1881	1901	2009	2012	2002	2162	2028	2171	2127	2073	1626	1299	934	451			
60<S<=70	1981-1990	1138	2348	2363	2388	2524	2527	2515	2716	2547	2727	2671	2841	2973	2999	3087	3282	3338	3018	2827
60<S<=70	1991-Stage I			8	16	18	21	22	24	23	24	24	25	26	27	27	29	30	29	29
70<S<=80	<1981	929	972	979	989	1045	1046	1041	1125	1055	1129	1106	1176	1231	1071	699	202			
70<S<=80	1981-1990	383	1493	1502	1518	1604	1606	1598	1726	1619	1733	1698	1806	1890	1906	1963	2086	2122	1953	1886
70<S<=80	1991-Stage I			72	77	83	86	87	96	91	98	96	102	107	108	111	118	120	118	119
70<S<=80	Stage I											1	1	1	1	1	1	1	1	1
80<S<=90	<1981	323	338	340	344	363	364	362	391	367	393	385	409	428	432	445	202			
80<S<=90	1981-1990	383	1466	1475	1491	1575	1577	1570	1695	1590	1702	1667	1773	1856	1872	1927	2049	2083	1916	1848
80<S<=90	1991-Stage I			61	158	181	200	200	217	207	222	217	231	242	244	251	267	272	265	270
80<S<=90	Stage I											1	1	1	1	1	1	1	1	1
90<S<=100	1981-1990	89	670	674	681	720	721	717	775	726	778	762	810	848	855	881	936	952	930	945
90<S<=100	1991-Stage I			180	257	320	329	351	382	367	393	385	410	429	433	445	473	481	471	478
90<S<=100	Stage I											1	1	1	1	1	1	1	1	1
100<S<=120	1981-1990		589	592	599	633	634	630	681	639	684	670	712	745	752	774	823	837	818	830
100<S<=120	1991-Stage I			129	253	316	375	440	567	586	673	660	702	734	740	762	811	824	805	818
100<S<=120	Stage I											2	2	2	2	2	3	3	3	3
120<S<=140	1981-1990		183	184	186	197	197	196	212	199	213	208	222	232	234	241	256	260	255	258
120<S<=140	1991-Stage I			70	148	189	215	319	484	626	804	860	918	964	972	1001	1064	1082	1057	1074
120<S<=140	Stage I											21	26	30	31	32	34	34	33	34
120<S<=140	Stage II																3	3	3	3
120<S<=140	Stage IIIA																		1	1
140<S<=160	1991-Stage I				8	36	69	112	271	354	554	632	715	784	791	814	866	880	860	874
140<S<=160	Stage II														22	38	50	57	56	56
140<S<=160	Stage IIIA																		5	8

Continued

Size Group	Emission Level	1985	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
160<S<=180	1991-Stage I							26	69	200	374	440	533	594	599	617	655	666	651	661
160<S<=180	Stage II														44	76	95	107	105	106
160<S<=180	Stage IIIA																		8	13
180<S<=200	1991-Stage I								20	67	117	193	249	296	299	308	327	333	325	330
180<S<=200	Stage II														66	99	120	132	129	131
180<S<=200	Stage IIIA																		8	13
200<S<=220	1991-Stage I										45	92	142	185	186	192	204	207	203	206
200<S<=220	Stage II														44	76	95	107	105	106
200<S<=220	Stage IIIA																		8	13
220<S<=240	1991-Stage I											3	48	149	150	154	164	167	163	166
220<S<=240	Stage II														78	124	170	220	215	218
220<S<=240	Stage IIIA																		55	113
240<S<=260	1991-Stage I											3	71	140	141	145	154	157	153	156
240<S<=260	Stage II														78	137	207	295	289	293
240<S<=260	Stage IIIA																		102	214
260<S<=280	1991-Stage I											14	61	129	130	134	142	145	141	143
260<S<=280	Stage II														78	137	207	295	289	293
260<S<=280	Stage IIIA																		102	214
280<S<=300	1991-Stage I													33	33	34	36	37	36	36
280<S<=300	Stage II														78	137	207	295	289	293
280<S<=300	Stage IIIA																		102	214
300<S<=320	Stage II															28	61	104	102	103
300<S<=320	Stage IIIA																		51	107

Stock data for fork lifts 1985-2007.

FuelCode	Size (kW)	Emission Level	1985	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
205B	35	<1981	387	260	234	209	183	158	133	107	84	58	30								
205B	35	1981-1990	120	297	297	297	297	297	297	297	297	297	297	297	277	249	232	198	177	135	95
205B	35	1991-Stage I			26	49	65	93	131	168	218	247	275	304	304	304	304	304	304	304	304
205B	35	Stage II													23	53	75	89	117	152	152
205B	35	Stage IIIA																			41
205B	45	<1981	1612	1082	976	870	764	658	552	446	349	243	126								
205B	45	1981-1990	499	1233	1233	1233	1233	1233	1233	1233	1233	1233	1233	1233	1151	1036	964	820	734	559	394
205B	45	1991-Stage I			108	203	270	386	544	699	905	1063	1063	1063	1063	1063	1063	1063	1063	1063	1063
205B	45	Stage I											151	303	422	524	664	664	664	664	664
205B	45	Stage II																104	232	452	612
205B	50	<1981	2173	1459	1316	1174	1031	888	745	602	471	328	170								
205B	50	1981-1990	673	1662	1662	1662	1662	1662	1662	1662	1662	1662	1662	1662	1551	1396	1299	1105	989	753	531
205B	50	1991-Stage I			145	273	363	519	732	940	1217	1469	1469	1469	1469	1469	1469	1469	1469	1469	1469
205B	50	Stage I											240	461	682	897	1135	1135	1135	1135	1135
205B	50	Stage II																187	447	818	1134
205B	75	<1981	497	334	301	269	236	203	170	138	108	75	39								
205B	75	1981-1990	154	382	382	382	382	382	382	382	382	382	382	382	357	321	299	255	228	174	123
205B	75	1991-Stage I			33	63	84	120	169	217	281	354	354	354	354	354	354	354	354	354	354
205B	75	Stage I											70	162	234	311	311	311	311	311	311
205B	75	Stage II															58	129	208	326	326
205B	75	Stage IIIA																			142
205B	120	<1981	111	74	67	60	52	45	38	31	24	17	9								
205B	120	1981-1990	34	85	85	85	85	85	85	85	85	85	85	85	80	72	67	57	51	39	28
205B	120	1991-Stage I			7	14	19	27	38	49	63	97	97	97	97	97	97	97	97	97	97
205B	120	Stage I											32	71	89	118	118	118	118	118	118
205B	120	Stage II															16	38	58	112	112
205B	120	Stage IIIA																			58
3030	33		5420	5215	5156	5068	4947	4863	4835	4792	4732	4765	4712	4718	4677	4655	4595	4494	4345	4220	4154
3030	40		4917	4730	4676	4596	4486	4410	4384	4344	4289	4295	4223	4218	4214	4244	4224	4166	4116	4048	4005
3030	50		2149	2067	2044	2008	1960	1926	1915	1897	1874	1926	1941	1897	1938	2003	2020	2018	2029	2061	2136
3030	78		97	93	92	91	89	88	88	87	86	90	92	88	95	98	99	104	104	114	123
3030	120											1	2	2	2	3	3	3	3	3	3

Stock data for construction machinery 1985-2007.

TechID	EquipmentName (Eng)	Emission Level	1985	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
23	Track type dozers	<1981	125																		
23	Track type dozers	1981-1990	125	250	221	193	166	139	114	89	66	43	21								
23	Track type dozers	1991-Stage I			25	48	71	93	114	134	153	172	189	206	201	177	154	132	128	125	116
23	Track type dozers	Stage II														20	38	56	86	100	116
23	Track type dozers	Stage IIIA																		25	58
24	Track type loaders	<1981	50																		
24	Track type loaders	1981-1990	50	100	89	79	68	58	48	38	28	19	9								
24	Track type loaders	1991-Stage I			10	20	29	39	48	57	66	75	83	91	91	81	71	62	61	71	68
24	Track type loaders	Stage II														9	18	26	40	56	68
24	Track type loaders	Stage IIIA																		14	34
25	Wheel loaders (0-5 tons)	1981-1990			186	331	434	496	517	496	434	331	186								
25	Wheel loaders (0-5 tons)	1991-Stage I			21	83	186	331	517	744	1013	1323	1674	2067	2046	1984	1881	1736	1444	1269	1045
25	Wheel loaders (0-5 tons)	Stage II													227	496	806	1158	1444	1903	2090
25	Wheel loaders (0-5 tons)	Stage IIIA																			348
26	Wheel loaders (> 5,1 tons)	<1981	1250																		
26	Wheel loaders (> 5,1 tons)	1981-1990	1250	2500	2228	1960	1698	1441	1188	941	698	460	228								
26	Wheel loaders (> 5,1 tons)	1991-Stage I			248	490	728	960	1188	1411	1629	1841	1822	1802	1559	1322	1089	861	677	485	273
26	Wheel loaders (> 5,1 tons)	Stage I											228	450	668	881	871	861	902	969	1092
26	Wheel loaders (> 5,1 tons)	Stage II															218	431	677	969	1092
26	Wheel loaders (> 5,1 tons)	Stage IIIA																			273
27	Wheel type excavators	<1981	500																		
27	Wheel type excavators	1981-1990	500	1000	862	732	611	498	394	298	211	132	62								
27	Wheel type excavators	1991-Stage I			96	183	262	332	394	447	491	528	493	459	372	293	223	162	118	74	35
27	Wheel type excavators	Stage I											62	115	160	196	179	162	157	148	142
27	Wheel type excavators	Stage II															45	81	118	148	142
27	Wheel type excavators	Stage IIIA																			35
28	Track type excavators (0-5 tons)	1981-1990			459	816	1071	1224	1275	1224	1071	816	459								
28	Track type excavators (0-5 tons)	1991-Stage I			51	204	459	816	1275	1837	2500	3265	4132	5101	5050	4897	4642	4285	3889	3599	3027
28	Track type excavators (0-5 tons)	Stage II													561	1224	1990	2857	3889	5399	6054
28	Track type excavators (0-5 tons)	Stage IIIA																			1009
29	Track type excavators (>5,1 tons)	<1981	1000																		
29	Track type excavators (>5,1 tons)	1981-1990	1000	2000	1798	1596	1394	1194	993	794	594	396	198								
29	Track type excavators (>5,1 tons)	1991-Stage I			200	399	598	796	993	1190	1387	1583	1581	1579	1380	1181	983	785	683	536	313
29	Track type excavators (>5,1 tons)	Stage I											198	395	591	787	786	785	910	1073	1251
29	Track type excavators (>5,1 tons)	Stage II															197	393	683	1073	1251

Continued

TechID	EquipmentName (Eng)	Emission Level	1985	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
29	Track type excavators (>5,1 tons)	Stage IIIA																			313
30	Excavators/Loaders	<1981	2100																		
30	Excavators/Loaders	1981-1990	2100	4200	3807	3408	3003	2592	2175	1752	1323	888	447								
30	Excavators/Loaders	1991-Stage I			423	852	1287	1728	2175	2628	3087	3552	3575	3599	3170	2735	2295	1848	1370	938	481
30	Excavators/Loaders	Stage I											447	900	1359	1824	2295	2310	2283	2344	2403
30	Excavators/Loaders	Stage II																462	913	1406	1922
31	Dump trucks	<1981	250																		
31	Dump trucks	1981-1990	250	500	489	469	441	404	358	304	241	169	89								
31	Dump trucks	1991-Stage I			54	117	189	269	358	455	561	676	711	745	682	611	530	442	385	301	176
31	Dump trucks	Stage I											89	186	292	407	530	552	642	752	880
31	Dump trucks	Stage II																110	257	451	704
32	Mini loaders	<1981	1800	800	635	447	235														
32	Mini loaders	1981-1990	1000	2000	2118	2237	2355	2473	2332	2168	1980	1768	1532	1273	990	684	354				
32	Mini loaders	1991-Stage I			212	447	706	989	1296	1626	1980	2357	2758	3183	3301	3419	3537	3656	2756	2294	1077
32	Mini loaders	Stage II													330	684	1061	1462	1531	1720	923
32	Mini loaders	Stage IIIA																			154
33	Telescopic loaders	1981-1990							149	265	348	398	414	398	348	265	149				
33	Telescopic loaders	1991-Stage I							83	199	348	530	746	994	1160	1326	1491	1657	1740	1837	1846
33	Telescopic loaders	Stage II													116	265	447	663	966	1378	1582
33	Telescopic loaders	Stage IIIA																			264

Stock data for machine pools 1985-2006.

EquipmentName (Eng)	Emission Level	1985	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Tractors (machine pools)	<1981	1236																	
Tractors (machine pools)	1981-1990	3091	4100	3643	2808	2368	1786	1214	604										
Tractors (machine pools)	1991-Stage I			607	1123	1776	2382	3035	3624	4324	4210	4336	3956	4069	3323	2566	2066	1421	947
Tractors (machine pools)	Stage I														554	513	517	474	474
Tractors (machine pools)	Stage II															513	1033	1421	1895
Harvesters (machine pools)	<1981	969	139																
Harvesters (machine pools)	1981-1990	807	1385	1385	1197	927	794	712	512	421	282	162	78						
Harvesters (machine pools)	1991-Stage I			139	266	348	454	593	615	737	751	729	778	779	651	531	472	300	257
Harvesters (machine pools)	Stage II														65	118	177	171	171
Harvesters (machine pools)	Stage IIIA																		43
Self-propelled vehicles (machine pools)	1981-1990					72	61	38											
Self-propelled vehicles (machine pools)	1991-Stage I					72	122	190	263	278	277	295	289	314	237	203	153	99	50
Self-propelled vehicles (machine pools)	Stage II														47	102	153	199	199
Self-propelled vehicles (machine pools)	Stage IIIA																		50

Stock data for household and gardening 1985-2006.

EquipmentName (Eng)	Emission Level	1985	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Lawn movers (private)	<1981	253125																	
Lawn movers (private)	1981-1990	421875	675000	590625	506250	421875	337500	253125	168750	84375									
Lawn movers (private)	1991-Stage I			84375	168750	253125	337500	421875	506250	590625	675000	675000	675000	675000	675000	675000	675000	595000	513750
Lawn movers (private)	Stage I																	85000	171250
Lawn movers (professional)	1981-1990	25000	25000	18750	12500	6250													
Lawn movers (professional)	1991-Stage I			6250	12500	18750	25000	25000	25000	25000	25000	25000	25000	25000	25000	25000	25000	18750	12500
Lawn movers (professional)	Stage I																	6250	12500
Cultivators (private-large)	<1981	73333	36667	29333	22000	14667	7333												
Cultivators (private-large)	1981-1990	36667	73333	73333	73333	73333	73333	73333	66000	58667	51333	44000	36667	29333	22000	14667	7333		
Cultivators (private-large)	1991-Stage I			7333	14667	22000	29333	36667	44000	51333	58667	66000	73333	80667	88000	95333	102667	102667	95333
Cultivators (private-large)	Stage II																	7333	14667
Cultivators (private-small)	1981-1990	10000	10000	8000	6000	4000	2000												
Cultivators (private-small)	1991-Stage I			2000	4000	6000	8000	10000	10000	10000	10000	10000	10000	10000	10000	10000	10000	8000	6000
Cultivators (private-small)	Stage II																	2000	4000
Cultivators (professional)	<1981	3750																	
Cultivators (professional)	1981-1990	6250	10000	8750	7500	6250	5000	3750	2500	1250									
Cultivators (professional)	1991-Stage I			1250	2500	3750	5000	6250	7500	8750	10000	10000	10000	10000	10000	10000	10000	8750	7500
Cultivators (professional)	Stage I																	1250	2500
Chain saws (private)	<1981	125000																	
Chain saws (private)	1981-1990	125000	250000	227250	204000	180250	156000	131250	106000	80250	54000	27250							
Chain saws (private)	1991-Stage I			25250	51000	77250	104000	131250	159000	187250	216000	245250	275000	280750	286500	292250	298000	268200	238400
Chain saws (private)	Stage I																	29800	59600
Chain saws (professional)	1981-1990	10000	10000	7333	4000														
Chain saws (professional)	1991-Stage I			3667	8000	13000	14000	15000	16000	17000	18000	19000	20000	27500	35000	42500	50000	33333	16667
Chain saws (professional)	Stage I																	16667	33333
Chain saws (forestry)	1981-1990	8000	8000	5048	2381														
Chain saws (forestry)	1991-Stage I			2524	4762	6714	6286	5857	5429	5000	4571	4143	3714	3286	2857	2429	2000	1333	667
Chain saws (forestry)	Stage I																	667	1333
Riders (private)	<1981	40950	11700	5880															
Riders (private)	1981-1990	29250	58500	58796	59388	54248	49167	44056	38828	33392	27660	21544	14954	7910					
Riders (private)	1991-Stage I			5880	11878	18083	24583	31469	38828	46748	55320	64631	74771	87015	101775	109920	119360	117741	114313
Riders (private)	Stage I																	10704	22863
Riders (professional)	1981-1990	4800	4800	3878	2966	2035	1056												
Riders (professional)	1991-Stage I			970	1978	3053	4224	5520	5760	6000	6240	6480	6720	7802	9726	12492	16100	15728	13398
Riders (professional)	Stage I																	3932	8932

Continued

EquipmentName (Eng)	Emission Level	1985	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Shrub clearers (private)	<1981	24000																	
Shrub clearers (private)	1981-1990	24000	48000	47520	46080	43680	40320	36000	30720	24480	17280	9120							
Shrub clearers (private)	1991-Stage I			5280	11520	18720	26880	36000	46080	57120	69120	82080	96000	107000	118000	129000	140000	126000	112000
Shrub clearers (private)	Stage I																	14000	28000
Shrub clearers (professio-nal)	1981-1990	2000	2000	1650	1200	650													
Shrub clearers (professio-nal)	1991-Stage I			550	1200	1950	2800	3000	3200	3400	3600	3800	4000	5500	7000	8500	10000	7500	5000
Shrub clearers (professio-nal)	Stage I																	2500	5000
Hedge cutters (private)	<1981	6850																	
Hedge cutters (private)	1981-1990	6850	13700	15237	16128	16373	15972	14925	13232	10893	7908	4277							
Hedge cutters (private)	1991-Stage I			1693	4032	7017	10648	14925	19848	25417	31632	38493	46000	52900	59800	66700	73600	66240	58880
Hedge cutters (private)	Stage I																	7360	14720
Hedge cutters (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 1985-2007.

Motortype	Boat type	1985	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Diesel	Motor boats (27-34 ft)	1550	2228	2397	2567	2736	2906	3075	3244	3414	3583	3753	3922	4092	4261	4431	4600	4600	4600	4600
Diesel	Motor boats (> 34 ft)	450	661	714	767	819	872	925	978	1031	1083	1136	1189	1242	1294	1347	1400	1400	1400	1400
Diesel	Motor boats <(27 ft)	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000
Diesel	Motor sailors	3500	3833	3917	4000	4083	4167	4250	4333	4417	4500	4583	4667	4750	4833	4917	5000	5000	5000	5000
Diesel	Sailing boats (> 26 ft)	7500	9167	9583	10000	10417	10833	11250	11667	12083	12500	12917	13333	13750	14167	14583	15000	15000	15000	15000
2-takt	Other boats (< 20 ft)	4000	4222	4278	4333	4389	4444	4500	4556	4565	4527	4439	4300	4108	3862	3560	3200	2750	2250	1800
2-takt	Yawls and cabin boats	4000	4222	4278	4333	4389	4444	4500	4556	4565	4527	4439	4300	4108	3862	3560	3200	2750	2250	1800
2-takt	Sailing boats (< 26 ft)	19000	18111	17889	17667	17444	17222	17000	16778	16390	15843	15144	14300	13317	12201	10960	9600	8250	6750	5400
2-takt	Speed boats	3000	3000	3000	3000	3000	3000	3000	3000	2970	2910	2820	2700	2550	2370	2160	1920	1650	1350	1080
2-takt	Water scooters	1000	1000	1000	1000	1000	1000	1000	1000	990	970	940	900	850	790	720	640	550	450	360
4-takt	Other boats (< 20 ft)									46	140	283	478	725	1027	1384	1800	2250	2750	3200
4-takt	Yawls and cabin boats									46	140	283	478	725	1027	1384	1800	2250	2750	3200
4-takt	Sailing boats (< 26 ft)									166	490	967	1589	2350	3243	4262	5400	6750	8250	9600
4-takt	Speed boats (in board eng.)	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000
4-takt	Speed boats (out board eng.)									30	90	180	300	450	630	840	1080	1350	1650	1920
4-takt	Water scooters									10	30	60	100	150	210	280	360	450	550	640

Engine sizes (kW) for recreational craft 1985-2007.

Motor type	Boat type	1985	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
2-takt	Other boats (< 20 ft)	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
2-takt	Yawls and cabin boats	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20
2-takt	Sailing boats (< 26 ft)	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
2-takt	Speed boats	25	31	32	33	35	36	38	39	40	42	43	44	46	47	49	50	50	50	50
2-takt	Water scooters	45	45	45	45	45	45	45	45	45	45	45	45	45	45	45	45	45	45	45
4-takt	Other boats (< 20 ft)									8	8	8	8	8	8	8	8	8	8	8
4-takt	Yawls and cabin boats									20	20	20	20	20	20	20	20	20	20	20
4-takt	Sailing boats (< 26 ft)									10	10	10	10	10	10	10	10	10	10	10
4-takt	Speed boats (in board eng.)	45	55	58	60	63	65	68	70	73	75	78	80	83	85	88	90	90	90	90
4-takt	Speed boats (out board eng.)									40	42	43	44	46	47	49	50	50	50	50
4-takt	Water scooters									45	45	45	45	45	45	45	45	45	45	45
Diesel	Motor boats (27-34 ft)	70	88	92	97	101	106	110	114	119	123	128	132	137	141	146	150	150	150	150
Diesel	Motor boats (> 34 ft)	120	149	156	163	171	178	185	192	199	207	214	221	228	236	243	250	250	250	250
Diesel	Motor boats <(27 ft)	20	24	26	27	28	29	30	31	32	33	34	36	37	38	39	40	40	40	40
Diesel	Motor sailors	20	22	23	23	24	24	25	26	26	27	27	28	28	29	29	30	30	30	30
Diesel	Sailing boats (> 26 ft)	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30

Annex 3B-11: Traffic data and different technical and operational data for Danish domestic ferries

Annual traffic data for ferries (no. of round trips) for Danish domestic ferries.

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Korsør-Nyborg, DSB	9305	9167	9237	8959	8813	8789	8746	3258	0	0	0	0	0	0	0	0	0	0
Korsør-Nyborg, Vogn-mandsruten	7512	7363	7468	7496	7502	7828	7917	8302	3576	0	0	0	0	0	0	0	0	0
Halsskov-Knudshoved	10601	10582	11701	11767	12420	12970	13539	13612	5732	0	0	0	0	0	0	0	0	0
Kalundborg-Juelsminde	0	1326	1733	1542	1541	1508	856	0	0	0	0	0	0	0	0	0	0	0
Kalundborg-Århus	1907	2400	3162	2921	2913	3540	4962	4888	4483	1454	1870	1804	2037	1800	1750	1725	1724	1695
Sjællands Odde-Ebeltoft	3908	3978	4008	3988	4325	4569	5712	8153	7851	7720	4775	4226	3597	3191	2906	2889	2690	2670
Sjællands Odde-Århus	0	0	0	0	0	0	0	0	0	2339	1799	1817	1825	2359	2863	2795	2853	2810
Hundested-Grenaa	1026	1025	1032	1030	718	602	67	0	0	0	0	0	0	0	0	0	0	0
København-Rønne	558	545	484	412	427	426	437	465	458	506	491	430	413	397	293	0	0	0
Køge-Rønne	0	0	0	0	0	0	0	0	0	0	0	0	0	0	154	488	436	399
Kalundborg-Samsø	873	873	860	881	826	811	813	823	824	850	828	817	833	831	841	867	862	887
Tårs-Spodsbjerg	7656	8835	9488	9535	9402	9562	9000	9129	7052	6442	6477	6498	6468	6516	6497	6494	6460	6493
Local ferries	176891	179850	181834	178419	202445	209129	182750	197489	200027	202054	201833	200130	208396	208501	206297	205564	203413	205260

Ferry data: Service, name, engine year, main engine MCR (kW), engine type, specific fuel consumption (sfc), aux. engine (kW).

Ferry service	Ferry name	Engine year	Main engine MCR (kW)	Engine type	Sfc (g pr kWh)	Aux engine (kW)
Halsskov-Knudshoved	ARVEPRINS KNUD	1963	8238	Slow speed (2-stroke)	220	1666
Halsskov-Knudshoved	DRONNING MARGRETHE II	1973	8826	Medium speed (4-stroke)	230	1692
Halsskov-Knudshoved	HEIMDAL	1983	8309	Medium speed (4-stroke)	220	740
Halsskov-Knudshoved	KNUDSHOVED	1961	6400	Slow speed (2-stroke)	220	1840
Halsskov-Knudshoved	KONG FREDERIK IX	1954	6767	Slow speed (2-stroke)	225	1426
Halsskov-Knudshoved	KRAKA	1982	8309	Medium speed (4-stroke)	220	740
Halsskov-Knudshoved	LODBROG	1982	8309	Medium speed (4-stroke)	220	740
Halsskov-Knudshoved	PRINSESSE ANNE-MARIE	1960	8238	Slow speed (2-stroke)	220	1360
Halsskov-Knudshoved	PRINSESSE ELISABETH	1964	8238	Slow speed (2-stroke)	220	1360
Halsskov-Knudshoved	ROMSØ	1973	8826	Medium speed (4-stroke)	230	1728
Halsskov-Knudshoved	SPROGØ	1962	6400	Slow speed (2-stroke)	220	1840
Hundested-Grenaa	DJURSLAND	1974	9856	Medium speed (4-stroke)	230	900
Hundested-Grenaa	KATTEGAT	1995	23200	High speed (4-stroke)	205	1223
Hundested-Grenaa	KONG FREDERIK IX	1954	6767	Slow speed (2-stroke)	235	1375
Hundested-Grenaa	PRINSESSE ANNE-MARIE	1960	8238	Slow speed (2-stroke)	220	1360
Kalundborg-Juelsminde	Mercandia I	1989	2950	High speed (4-stroke)	220	0
Kalundborg-Juelsminde	Mercandia II	1989	2950	High speed (4-stroke)	220	0
Kalundborg-Juelsminde	Mercandia III	1989	2950	High speed (4-stroke)	220	0
Kalundborg-Juelsminde	Mercandia IV	1989	2950	High speed (4-stroke)	220	0
Kalundborg-Samsø	HOLGER DANSKE	1976	2354	High speed (4-stroke)	225	600
Kalundborg-Samsø	KALUNDBORG	1952	3825	Slow speed (2-stroke)	235	570
Kalundborg-Samsø	KYHOLM	1998	2940	High speed (4-stroke)	195	864
Kalundborg-Samsø	VESBORG	1995	1770	High speed (4-stroke)	200	494
Kalundborg-Århus	ASK	1984	8826	Medium speed (4-stroke)	215	2220
Kalundborg-Århus	ASK	1984	8826	Medium speed (4-stroke)	215	3000
Kalundborg-Århus	ASK	1984	9840	Medium speed (4-stroke)	215	3000
Kalundborg-Århus	CAT-LINK I	1995	17280	High speed (4-stroke)	205	1160
Kalundborg-Århus	CAT-LINK II	1995	17280	High speed (4-stroke)	205	1160
Kalundborg-Århus	CAT-LINK III	1995	22000	High speed (4-stroke)	205	800
Kalundborg-Århus	CAT-LINK III	1995	22000	High speed (4-stroke)	205	801
Kalundborg-Århus	CAT-LINK III	1995	22000	High speed (4-stroke)	205	802
Kalundborg-Århus	CAT-LINK IV	1998	28320	High speed (4-stroke)	205	920
Kalundborg-Århus	CAT-LINK V	1998	28320	High speed (4-stroke)	205	920
Kalundborg-Århus	KATTEGAT SYD	1979	7650	Medium speed (4-stroke)	225	1366
Kalundborg-Århus	KNUDSHOVED	1961	6400	Slow speed (2-stroke)	220	1840
Kalundborg-Århus	KONG FREDERIK IX	1954	6767	Slow speed (2-stroke)	225	1426

Continued

Ferry service	Ferry name	Engine year	Main engine MCR (kW)	Engine type	Sfc (g pr 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
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	

Continued

Ferry service	Ferry name	Engine year	Main engine MCR (kW)	Engine type	Sfc (g pr kWh)	Aux engine (kW)
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

Continued

Ferry service	Ferry name	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
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						

Continued

Ferry service	Ferry name	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
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														
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

Continued

Ferry service	Ferry name	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
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, Vognmands-ruten	Superflex Alfa	33.0	33.0	33.0	33.0	33.0	33.0	33.0	33.0	33.0							
Korsør-Nyborg, Vognmands-ruten	Superflex Bravo	33.0	33.0	33.0	33.0	33.0	33.0	33.0	33.0	33.0							
Korsør-Nyborg, Vognmands-ruten	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

Continued

Ferry service	Ferry name	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Tårs-Spodsbjerg	SPODSBJERG	4.0	2.0	8.0	8.0	9.0	8.0	8.0	19.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0
Tårs-Spodsbjerg	THOR SYDFYEN	14.0	18.0	14.0	16.0	19.0	20.0	20.0	17.0	14.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Annex 2B-12 Fuel use and emission factors, engine specific (NO_x, CO, VOC (NMVOC and CH_4)), and fuel type specific (S-%, SO_2, PM) for ship engines

Specific fuel consumption and NO_x emission factors (g pr kWh) per engine year for diesel ship engines.

Year	High speed 4-stroke sfc (g pr kWh)	Medium speed 4-stroke sfc (g pr kWh)	Slow speed 2-stroke sfc (g pr kWh)	High speed 4-stroke NO_X (g pr kWh)	Medium speed 4-stroke NO_X (g pr kWh)	Slow speed 2-stroke NO_X (g pr kWh)
1949	265.5	255.5	235.5	7.3	8.0	14.5
1950	265.0	255.0	235.0	7.3	8.0	14.5
1951	264.5	254.5	234.5	7.3	8.0	14.5
1952	264.0	254.0	234.0	7.3	8.0	14.5
1953	263.5	253.5	233.5	7.3	8.0	14.5
1954	263.0	253.0	233.0	7.3	8.0	14.5
1955	262.4	252.4	232.4	7.3	8.0	14.5
1956	261.9	251.9	231.9	7.4	8.1	14.6
1957	261.3	251.3	231.3	7.5	8.2	14.7
1958	260.7	250.7	230.7	7.6	8.3	14.8
1959	260.1	250.1	230.1	7.7	8.4	14.9
1960	259.5	249.5	229.5	7.8	8.5	15.0
1961	258.9	248.9	228.9	7.9	8.6	15.1
1962	258.2	248.2	228.2	8.0	8.7	15.1
1963	257.6	247.6	227.6	8.1	8.8	15.2
1964	256.9	246.9	226.9	8.2	8.9	15.3
1965	256.1	246.1	226.1	8.3	9.0	15.4
1966	255.4	245.4	225.4	8.3	9.1	15.5
1967	254.6	244.6	224.6	8.4	9.2	15.6
1968	253.8	243.8	223.8	8.5	9.3	15.7
1969	253.0	243.0	223.0	8.6	9.4	15.8
1970	252.1	242.1	222.1	8.7	9.5	15.9
1971	251.2	241.2	221.2	8.8	9.6	16.0
1972	250.3	240.3	220.3	8.9	9.7	16.1
1973	249.3	239.3	219.3	9.0	9.8	16.2
1974	248.3	238.3	218.3	9.1	9.9	16.3
1975	247.3	237.3	217.3	9.2	10.0	16.4
1976	246.2	236.2	216.2	9.3	10.1	16.4
1977	245.0	235.0	215.0	9.3	10.2	16.5
1978	243.8	233.8	213.8	9.4	10.3	16.6
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

Continued						
Year	High speed 4-stroke sfc (g pr kWh)	Medium speed 4-stroke sfc (g pr kWh)	Slow speed 2-stroke sfc (g pr kWh)	High speed 4-stroke NO_X (g pr kWh)	Medium speed 4-stroke NO_X (g pr kWh)	Slow speed 2-stroke NO_X (g pr kWh)
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
1983	6.75	7.05	7.73	2.11	2.20	2.42
1984	6.79	7.10	7.79	2.12	2.22	2.43
1985	6.84	7.15	7.85	2.14	2.23	2.45
1986	6.89	7.20	7.91	2.15	2.25	2.47
1987	6.94	7.26	7.98	2.17	2.27	2.49
1988	7.00	7.32	8.05	2.19	2.29	2.52
1989	7.06	7.38	8.13	2.21	2.31	2.54
1990	7.12	7.45	8.22	2.22	2.33	2.57
1991	7.18	7.52	8.30	2.25	2.35	2.59
1992	7.25	7.60	8.40	2.27	2.37	2.62
1993	7.33	7.68	8.50	2.29	2.40	2.66
1994	7.41	7.77	8.60	2.31	2.43	2.69
1995	7.49	7.86	8.72	2.34	2.46	2.72
1996	7.58	7.96	8.84	2.37	2.49	2.76
1997	7.68	8.06	8.97	2.40	2.52	2.80
1998	7.78	8.18	9.11	2.43	2.56	2.85
1999	7.89	8.30	9.26	2.46	2.59	2.89
2000	8.00	8.43	9.42	2.50	2.63	2.94

	High speed 4-stroke NMVOC	Medium speed 4-stroke NMVOC	Slow speed 2-stroke NMVOC	High speed 4-stroke CH_4	Medium speed 4-stroke CH_4	Slow speed 2-stroke CH_4
1949	1.83	1.90	2.06	0.06	0.06	0.06
1950	1.83	1.90	2.06	0.06	0.06	0.06
1951	1.83	1.91	2.07	0.06	0.06	0.06
1952	1.84	1.91	2.07	0.06	0.06	0.06
1953	1.84	1.91	2.08	0.06	0.06	0.06
1954	1.84	1.92	2.08	0.06	0.06	0.06
1955	1.85	1.92	2.09	0.06	0.06	0.06
1956	1.85	1.93	2.09	0.06	0.06	0.06
1957	1.86	1.93	2.10	0.06	0.06	0.06
1958	1.86	1.93	2.10	0.06	0.06	0.07
1959	1.86	1.94	2.11	0.06	0.06	0.07
1960	1.87	1.94	2.11	0.06	0.06	0.07
1961	1.87	1.95	2.12	0.06	0.06	0.07
1962	1.88	1.95	2.13	0.06	0.06	0.07
1963	1.88	1.96	2.13	0.06	0.06	0.07
1964	1.89	1.96	2.14	0.06	0.06	0.07
1965	1.89	1.97	2.14	0.06	0.06	0.07
1966	1.90	1.98	2.15	0.06	0.06	0.07
1967	1.90	1.98	2.16	0.06	0.06	0.07
1968	1.91	1.99	2.17	0.06	0.06	0.07
1969	1.92	2.00	2.17	0.06	0.06	0.07
1970	1.92	2.00	2.18	0.06	0.06	0.07
1971	1.93	2.01	2.19	0.06	0.06	0.07
1972	1.94	2.02	2.20	0.06	0.06	0.07
1973	1.95	2.03	2.21	0.06	0.06	0.07
1974	1.95	2.04	2.22	0.06	0.06	0.07
1975	1.96	2.04	2.23	0.06	0.06	0.07
1976	1.97	2.05	2.24	0.06	0.06	0.07
1977	1.98	2.06	2.26	0.06	0.06	0.07
1978	1.99	2.07	2.27	0.06	0.06	0.07
1979	2.00	2.09	2.28	0.06	0.06	0.07
1980	2.01	2.10	2.30	0.06	0.06	0.07
1981	2.02	2.11	2.31	0.06	0.07	0.07
1982	2.03	2.12	2.33	0.06	0.07	0.07
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	2.64	52.8	6.1	6.0	6.0	1291.0	149.2	147.8	147.0
Fuel	National sea	1991	2.35	47	4.9	4.9	4.8	1149.1	120.2	119.0	118.4
Fuel	National sea	1992	1.8	36	3.3	3.2	3.2	880.2	79.8	79.0	78.6
Fuel	National sea	1993	2.39	47.8	5.1	5.0	5.0	1168.7	123.9	122.6	122.0
Fuel	National sea	1994	2.62	52.4	6.0	6.0	5.9	1281.2	147.0	145.6	144.8
Fuel	National sea	1995	2.95	59	7.7	7.6	7.6	1442.5	188.0	186.1	185.2
Fuel	National sea	1996	2.57	51.4	5.8	5.7	5.7	1256.7	141.7	140.2	139.5
Fuel	National sea	1997	2.74	54.8	6.6	6.5	6.5	1339.9	160.8	159.2	158.4
Fuel	National sea	1998	1.97	39.4	3.7	3.7	3.6	963.3	90.6	89.7	89.2
Fuel	National sea	1999	1.97	39.4	3.7	3.7	3.6	963.3	90.6	89.7	89.2
Fuel	National sea	2000	1.81	36.2	3.3	3.3	3.2	885.1	80.4	79.6	79.2
Fuel	National sea	2001	1.7	34	3.0	3.0	3.0	831.3	74.1	73.4	73.0
Fuel	National sea	2002	1.51	30.2	2.6	2.6	2.6	738.4	64.3	63.7	63.3
Fuel	National sea	2003	1.62	32.4	2.9	2.8	2.8	792.2	69.8	69.1	68.8
Fuel	National sea	2004	1.98	39.6	3.7	3.7	3.7	968.2	91.3	90.4	89.9
Fuel	National sea	2005	2	40	3.8	3.8	3.7	978.0	92.6	91.7	91.3
Fuel	National sea	2006	1.94	38.8	3.6	3.6	3.6	948.7	88.6	87.7	87.3
Fuel	National sea	2007	1.2	24	2.1	2.1	2.1	586.8	51.0	50.5	50.3
Fuel	National sea	2008	1.2	24	2.1	2.1	2.1	586.8	51.0	50.5	50.3
Fuel	International sea	1990	2.96	59.2	7.7	7.7	7.6	1447.4	189.4	187.5	186.6
Fuel	International sea	1991	2.89	57.8	7.4	7.3	7.2	1413.2	179.8	178.0	177.1
Fuel	International sea	1992	2.88	57.6	7.3	7.2	7.2	1408.3	178.5	176.7	175.8
Fuel	International sea	1993	3.2	64	9.3	9.2	9.1	1564.8	226.5	224.2	223.1
Fuel	International sea	1994	3.03	60.6	8.2	8.1	8.0	1481.7	199.6	197.6	196.6
Fuel	International sea	1995	3.3	66	10.0	9.9	9.8	1613.7	244.0	241.6	240.4
Fuel	International sea	1996	3.42	68.4	10.9	10.8	10.8	1672.4	266.9	264.2	262.9
Fuel	International sea	1997	3.45	69	11.2	11.0	11.0	1687.0	272.9	270.2	268.8
Fuel	International sea	1998	3.42	68.4	10.9	10.8	10.8	1672.4	266.9	264.2	262.9
Fuel	International sea	1999	3.45	69	11.2	11.0	11.0	1687.0	272.9	270.2	268.8
Fuel	International sea	2000	3.36	67.2	10.4	10.3	10.3	1643.0	255.2	252.6	251.4
Fuel	International sea	2001	3.42	68.4	10.9	10.8	10.8	1672.4	266.9	264.2	262.9
Fuel	International sea	2002	3.44	68.8	11.1	11.0	10.9	1682.2	270.9	268.2	266.8
Fuel	International sea	2003	3.11	62.2	8.7	8.6	8.5	1520.8	211.8	209.7	208.6
Fuel	International sea	2004	3.2	64	9.3	9.2	9.1	1564.8	226.5	224.2	223.1
Fuel	International sea	2005	3.5	70	11.6	11.5	11.4	1711.5	283.2	280.4	279.0
Fuel	International sea	2006	3.35	67	10.4	10.3	10.2	1638.1	253.3	250.8	249.5
Fuel	International sea	2007	1.5	30	2.6	2.6	2.6	733.5	63.8	63.2	62.9
Fuel	International sea	2008	1.5	30	2.6	2.6	2.6	733.5	63.8	63.2	62.9
Diesel	-	1990	0.2	4.0	1.0	1.0	1.0	93.7	23.2	23.0	22.9
Diesel	-	1991	0.2	4.0	1.0	1.0	1.0	93.7	23.2	23.0	22.9
Diesel	-	1992	0.2	4.0	1.0	1.0	1.0	93.7	23.2	23.0	22.9
Diesel	-	1993	0.2	4.0	1.0	1.0	1.0	93.7	23.2	23.0	22.9
Diesel	-	1994	0.2	4.0	1.0	1.0	1.0	93.7	23.2	23.0	22.9
Diesel	-	1995	0.2	4.0	1.0	1.0	1.0	93.7	23.2	23.0	22.9
Diesel	-	1996	0.2	4.0	1.0	1.0	1.0	93.7	23.2	23.0	22.9
Diesel	-	1997	0.2	4.0	1.0	1.0	1.0	93.7	23.2	23.0	22.9
Diesel	-	1998	0.2	4.0	1.0	1.0	1.0	93.7	23.2	23.0	22.9
Diesel	-	1999	0.2	4.0	1.0	1.0	1.0	93.7	23.2	23.0	22.9
Diesel	-	2000	0.2	4.0	1.0	1.0	1.0	93.7	23.2	23.0	22.9
Diesel	-	2001	0.2	4.0	1.0	1.0	1.0	93.7	23.2	23.0	22.9
Diesel	-	2002	0.2	4.0	1.0	1.0	1.0	93.7	23.2	23.0	22.9
Diesel	-	2003	0.2	4.0	1.0	1.0	1.0	93.7	23.2	23.0	22.9
Diesel	-	2004	0.2	4.0	1.0	1.0	1.0	93.7	23.2	23.0	22.9
Diesel	-	2005	0.2	4.0	1.0	1.0	1.0	93.7	23.2	23.0	22.9

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)
Diesel	-	2006	0.2	4.0	1.0	1.0	1.0	93.7	23.2	23.0	22.9
Diesel	-	2007	0.2	4.0	1.0	1.0	1.0	93.7	23.2	23.0	22.9
Diesel	-	2008	0.1	2.0	0.9	0.9	0.9	46.8	21.5	21.3	21.2

Annex 2B-13: Fuel sales figures from DEA, and further processed fuel consumption data suited for the Danish inventory

Enhed: TJ	1985	1990	1995	2000	2001	2002	2003	2004	2005	2006	2007
Agriculture and forestry, DEA statistics											
- LPG	88	438	204	179	190	159	153	138	121	116	110
- gasoline	425	274	161	38	39	28	42	51	52	20	21
- gas/diesel oil	9 199	10 528	11 585	13 689	13 437	13 706	13 463	12 934	12 464	13 047	11 791
Gartneri, DEA statistics											
- LPG	8	50	23	19	20	17	16	14	12	12	11
- gasoline	10	10	18	4	4	3	5	6	6	2	2
- gas/diesel oil	1 705	1 409	1 138	698	581	529	556	488	407	391	353
Fishery, DEA statistics											
- LPG	-	42	16	13	19	21	20	18	20	20	18
- gasoline	-	9	8	67	3	3	0	0	0	1	1
- kerosene	7	26	4	25	1	1	1	1	1	0	0
- gas/diesel oil	9 152	10 422	8 277	9 347	8 908	8 888	8 428	7 337	7 340	7 362	6 854
- fuel oil	27	285	19	-	-	4	84	35	126	86	13
Manufacturing industry, DEA statistics											
- LPG	2 860	2 032	2 234	1 819	1 526	1 405	1 472	1 488	1 478	1 482	1 216
- gasoline	262	177	110	97	69	42	26	30	21	32	16
- gas/diesel oil	15 576	12 259	10 401	8 635	10 099	9 155	9 964	10 515	10 022	9 132	8 883
- fuel oil	29 465	15 989	14 000	8 221	7 395	7 818	6 916	6 940	6 055	8 527	7 642
Building and construction, DEA statistics											
- LPG	305	500	501	165	179	236	226	228	224	248	222
- gasoline	19	34	25	33	24	26	27	27	27	27	28
- gas/diesel oil	5 313	3 548	5 317	5 950	6 356	6 226	6 226	6 227	6 338	6 187	6 410
Housing, DEA statistics											
- gasoline	1 006	1 131	1 233	1 355	1 317	1 313	1 303	1 288	1 250	1 216	1 193
Road transport, DEA statistics											
- gasoline	66 037	74 326	80 998	88 975	86 474	86 247	85 611	84 629	82 118	79 822	78 328
- gas/diesel oil	45 609	54 746	58 561	64 282	66 254	66 814	70 875	75 422	79 476	86 256	95 156
- bioethanol	-	-	-	-	-	-	-	-	-	151	252
Non-road, DEA statistics											
- LPG	2 955	2 520	2 461	2 018	1 736	1 581	1 641	1 640	1 612	1 610	1 337
- gasoline	1 722	1 626	1 547	1 525	1 453	1 412	1 404	1 402	1 356	1 296	1 260
- gas/diesel oil	31 793	27 744	28 441	28 972	30 473	29 616	30 209	30 164	29 232	28 757	27 438

Continued

Enhed: TJ	1985	1990	1995	2000	2001	2002	2003	2004	2005	2006	2007
Non-road, NERI model											
- LPG	1232	1185	1099	1071	1073	1084	1079	1065	1049	1038	1040
- gasoline	2998	2770	2521	2458	2622	2833	3090	3391	3604	3807	3795
- gas/diesel oil	26357	26800	25798	24630	24893	25053	25233	25558	26199	27495	29161
Recreational craft, NERI model											
- gasoline	270	309	358	396	400	403	404	404	393	382	371
- gas/diesel oil	219	343	537	777	831	886	944	1002	1002	1002	1002
Non-road, added 0203 and 0301											
- gas/diesel oil	5436	944	2642	4342	5580	4563	4976	4606	3033	1263	-1724
- LPG	1724	1335	1362	947	662	497	563	575	562	572	298
Non-road, added 0203											
- gas/diesel oil	1864	406	1182	2156	2567	2193	2309	2050	1335	590	-763
- LPG	56	259	125	93	80	55	58	53	46	46	27
Non-road, added 0301											
- gas/diesel oil	3572	538	1460	2186	3013	2370	2667	2557	1697	673	-961
- LPG	1668	1076	1237	854	582	442	505	522	516	526	271
Non-road, added road transport											
- gasoline	-1276	-1145	-975	-932	-1169	-1421	-1686	-1990	-2248	-2511	-2536
Fisheries, added national sea transport											
- fuel oil	27	285	19	0	0	4	84	35	126	86	13
Fisheries, consumed by recreational craft											
- gasoline	0	9	8	67	3	3	0	0	0	1	1
National sea transport, input NERI model											
- LPG	3	2	2	0	-	-	0	0	0	0	0
- kerosene	5	0	1	1	1	1	1	1	1	0	-
- gas/diesel oil	3 074	2 782	6 049	3 367	3 240	3 780	3 828	3 463	4 358	3 699	3 411
- fuel oil	2 541	3 845	1 592	1 509	1 513	2 068	1 907	1 704	1 506	1 367	1 110
Fisheries, input NERI model											
- LPG	-	42	16	13	19	21	20	18	20	20	18
- gasoline	-	-	-	-	-	-	-	-	-	-	-
- kerosene	7	26	4	25	1	1	1	1	1	0	0
- gas/diesel oil	8 932	10 080	7 740	8 570	8 077	8 001	7 484	6 335	6 338	6 360	5 852
National sea transport, output NERI model											
- gas/diesel oil	4942	4942	6655	4515	4301	4192	4199	4308	4260	4180	4119
- fuel oil	3843	3843	2653	715	671	659	647	673	679	633	610

Continued

Enhed: TJ	1985	1990	1995	2000	2001	2002	2003	2004	2005	2006	2007
- kerosene	5	0	1	1	1	1	1	1	1	0	0
- LPG	3	2	2	0	0	0	0	0	0	0	0
Fisheries, output NERI model											
- gas/diesel oil	7064	7920	7134	7422	7016	7590	7113	5490	6437	5879	5144
- kerosene	7	26	4	25	1	1	1	1	1	0	0
- LPG	0	42	16	13	19	21	20	18	20	20	18
National sea transport, added 0301											
- fuel oil	-1 302	3	-1 061	794	842	1 409	1 260	1 032	826	734	500
Road transport, NERI excl. traded fuels											
- gasoline	64 492	72 882	79 674	87 713	84 907	84 426	83 521	82 235	79 477	76 930	75 423
- gas/diesel oil	45 609	54 746	58 561	64 282	66 254	66 814	70 875	75 422	79 476	86 256	95 156
- bioethanol	-	-	-	-	-	-	-	-	-	151	252
Road transport, input NERI model incl. traded fuels											
- gasoline	62 077	66 279	80 101	83 312	81 852	81 963	81 878	80 593	77 835	76 109	75 423
- gas/diesel oil	49 016	59 947	64 013	69 196	70 916	72 552	78 766	84 209	88 264	95 043	103 944
- bioethanol	-	-	-	-	-	-	-	-	-	151	252

Annex 2B-14: Emission factors and total emissions in CollectER format

1990 emission factors for CO_2, CH_4 and N_2O.

Year	SNAP ID	Category	Fuel type	Mode	Fuel [GJ]	CH_4 [g pr GJ]	CO_2 [kg pr GJ]	N_2O [g pr GJ]
1990	070101	Passenger cars	Diesel	Highway driving	666655	3,74	74	0,00
1990	070101	Passenger cars	Gasoline 2-stroke	Highway driving	29026	10,03	73	2,61
1990	070101	Passenger cars	Gasoline conventional	Highway driving	7515158	11,09	73	2,77
1990	070101	Passenger cars	LPG	Highway driving	1527	10,06	65	0,00
1990	070102	Passenger cars	Diesel	Rural driving	1898541	6,82	74	0,00
1990	070102	Passenger cars	Gasoline 2-stroke	Rural driving	116542	13,84	73	2,25
1990	070102	Passenger cars	Gasoline conventional	Rural driving	23176807	13,92	73	3,11
1990	070102	Passenger cars	LPG	Rural driving	4406	16,91	65	0,00
1990	070103	Passenger cars	Diesel	Urban driving	2836128	8,78	74	0,00
1990	070103	Passenger cars	Gasoline 2-stroke	Urban driving	222806	30,02	73	1,69
1990	070103	Passenger cars	Gasoline conventional	Urban driving	31997478	48,94	73	3,24
1990	070103	Passenger cars	LPG	Urban driving	6537	24,31	65	0,00
1990	070201	Light duty vehicles	Diesel	Highway driving	1906443	2,60	74	0,00
1990	070201	Light duty vehicles	Gasoline conventional	Highway driving	220436	10,11	73	2,63
1990	070202	Light duty vehicles	Diesel	Rural driving	6824381	4,26	74	0,00
1990	070202	Light duty vehicles	Gasoline conventional	Rural driving	915549	15,25	73	2,48
1990	070203	Light duty vehicles	Diesel	Urban driving	7966383	6,54	74	0,00
1990	070203	Light duty vehicles	Gasoline conventional	Urban driving	1336101	40,67	73	2,28
1990	070301	Heavy duty vehicles	Diesel	Highway driving	8665327	6,07	74	2,91
1990	070301	Heavy duty vehicles	Gasoline	Highway driving	10264	9,69	73	0,83
1990	070302	Heavy duty vehicles	Diesel	Rural driving	15837441	6,79	74	3,09
1990	070302	Heavy duty vehicles	Gasoline	Rural driving	29859	16,74	73	0,91
1990	070303	Heavy duty vehicles	Diesel	Urban driving	13345616	12,56	74	2,51
1990	070303	Heavy duty vehicles	Gasoline	Urban driving	34524	14,21	73	0,61
1990	0704	Mopeds	Gasoline	Mopeds and Motorcycles < 50 cm3	286683	200,00	73	0,91
1990	070501	Motorcycles	Gasoline	Highway driving	76549	122,02	73	1,27
1990	070502	Motorcycles	Gasoline	Rural driving	142895	146,11	73	1,52
1990	070503	Motorcycles	Gasoline	Urban driving	167965	147,20	73	1,53
1990	0801	Military	Diesel		146162	7,58	74	1,80
1990	0801	Military	Jet fuel	< 3000 ft	149678	2,65	72	2,30
1990	0801	Military	Jet fuel	> 3000 ft	1347105	2,65	72	2,30
1990	0801	Military	Gasoline		986	32,66	73	3,08

Continued

Year	SNAP ID	Category	Fuel type	Mode	Fuel [GJ]	CH_4 [g pr GJ]	CO_2 [kg pr GJ]	N_2O [g pr GJ]
1990	0801	Military	Aviation gasoline		4913	21,90	73	2,00
1990	0802	Railways	Diesel		4010007	3,07	74	2,04
1990	0802	Railways	Kerosene		70	7,00	72	2,00
1990	0802	Railways	Gasoline		0	33,78	73	2,24
1990	0803	Inland waterways	Diesel		342623	2,79	74	2,96
1990	0803	Inland waterways	Gasoline		309136	50,38	73	0,78
1990	080402	Maritime activities	Residual oil		3842534	1,65	78	4,89
1990	080402	Maritime activities	Diesel		4942218	1,57	74	4,68
1990	080402	Maritime activities	Kerosene		452	7,00	72	0,00
1990	080402	Maritime activities	LPG		1794	20,26	65	0,00
1990	080403	Maritime activities	Residual oil		0	1,76	78	4,89
1990	080403	Maritime activities	Diesel		7919928	1,52	74	4,68
1990	080403	Maritime activities	Kerosene		25787	7,00	72	0,00
1990	080403	Maritime activities	Gasoline		0	108,10	73	0,52
1990	080403	Maritime activities	LPG		42320	20,26	65	0,00
1990	080404	Maritime activities	Residual oil		28543368	1,67	78	4,89
1990	080404	Maritime activities	Diesel		11632674	1,53	74	4,68
1990	080501	Air traffic	Jet fuel	Dom. < 3000 ft	422173	1,59	72	5,70
1990	080501	Air traffic	Aviation gasoline		104947	21,90	73	2,00
1990	080502	Air traffic	Jet fuel	Int. < 3000 ft	132339	1,75	72	7,10
1990	080502	Air traffic	Aviation gasoline		30660	21,90	73	2,00
1990	080503	Air traffic	Jet fuel	Dom. > 3000 ft	1026021	1,31	72	2,30
1990	080504	Air traffic	Jet fuel	Int. > 3000 ft	1611915	0,69	72	2,30
1990	0806	Agriculture	Diesel		16496273	2,55	74	2,93
1990	0806	Agriculture	Gasoline		708864	88,42	73	1,28
1990	0807	Forestry	Diesel		145346	2,54	74	2,97
1990	0807	Forestry	Gasoline		341430	60,42	73	0,37
1990	0808	Industry	Diesel		10158406	2,90	74	2,94
1990	0808	Industry	Gasoline		175227	120,61	73	1,33
1990	0808	Industry	LPG		1184856	7,69	65	3,50
1990	0809	Household and gardening	Gasoline		1544959	96,95	73	1,11
1990	80501,00	Air traffic, Copenhagen airport	Jet fuel	Dom. < 3000 ft	502153	2,20	72	4,58
1990	80501,00	Air traffic, Copenhagen airport	Aviation gasoline		8642	21,90	73	2,00
1990	80502,00	Air traffic, Copenhagen airport	Jet fuel	Int. < 3000 ft	2001204	3,64	72	3,79
1990	80502,00	Air traffic, Copenhagen airport	Aviation gasoline		5612	21,90	73	2,00

Continued

Year	SNAP ID	Category	Fuel type	Mode	Fuel [GJ]	CH_4 [g pr GJ]	CO_2 [kg pr GJ]	N_2O [g pr GJ]
1990	80503,00	Air traffic, Copenhagen airport	Jet fuel	Dom. > 3000 ft	1305208	1,25	72	2,30
1990	80504,00	Air traffic, Copenhagen airport	Jet fuel	Int. > 3000 ft	20330315	1,07	72	2,30

1990 emission factors for SO_2, NO_x; NMVOC, NH_3 and TSP.

Year	SNAP ID	Category	Fuel type	Mode	Fuel [GJ]	SO_2 [g pr GJ]	NO_x [g pr GJ]	NMVOC [g pr GJ]	CO [g pr GJ]	NH_3 [g pr GJ]	TSP [g pr GJ]
1990	070101	Passenger cars	Diesel	Highway driving	666655	93,68	254,03	25,07	179,70	0,47	79,48
1990	070101	Passenger cars	Gasoline 2-stroke	Highway driving	29026	2,28	288,90	2357,34	3490,86	0,80	48,15
1990	070101	Passenger cars	Gasoline conventional	Highway driving	7515158	2,28	1317,10	364,60	3459,92	0,85	12,09
1990	070101	Passenger cars	LPG	Highway driving	1527	0,00	1151,70	187,09	3914,25	0,00	10,06
1990	070102	Passenger cars	Diesel	Rural driving	1898541	93,68	253,60	42,09	268,08	0,57	75,13
1990	070102	Passenger cars	Gasoline 2-stroke	Rural driving	116542	2,28	352,84	2476,82	2594,44	0,69	41,51
1990	070102	Passenger cars	Gasoline conventional	Rural driving	23176807	2,28	1140,07	483,50	3992,26	0,96	13,93
1990	070102	Passenger cars	LPG	Rural driving	4406	0,00	1248,46	305,18	1146,38	0,00	14,49
1990	070103	Passenger cars	Diesel	Urban driving	2836128	93,68	208,50	79,41	310,69	0,36	117,16
1990	070103	Passenger cars	Gasoline 2-stroke	Urban driving	222806	2,28	53,06	4365,48	7114,48	0,34	20,27
1990	070103	Passenger cars	Gasoline conventional	Urban driving	31997478	2,28	634,09	890,32	9372,17	0,65	13,72
1990	070103	Passenger cars	LPG	Urban driving	6537	0,00	642,80	431,03	1249,98	0,00	12,16
1990	070201	Light duty vehicles	Diesel	Highway driving	1906443	93,68	270,67	30,19	344,14	0,32	104,48
1990	070201	Light duty vehicles	Gasoline conventional	Highway driving	220436	2,28	1369,26	170,29	2987,40	0,81	16,17
1990	070202	Light duty vehicles	Diesel	Rural driving	6824381	93,68	299,25	33,22	358,42	0,36	107,73
1990	070202	Light duty vehicles	Gasoline conventional	Rural driving	915549	2,28	1188,86	262,59	2316,18	0,76	15,25
1990	070203	Light duty vehicles	Diesel	Urban driving	7966383	93,68	489,77	53,27	403,83	0,27	126,74
1990	070203	Light duty vehicles	Gasoline conventional	Urban driving	1336101	2,28	638,11	689,36	7008,46	0,46	9,12
1990	070301	Heavy duty vehicles	Diesel	Highway driving	8665327	93,68	1032,66	47,58	190,41	0,29	38,30
1990	070301	Heavy duty vehicles	Gasoline	Highway driving	10264	2,28	1037,78	474,61	7610,35	0,28	55,35
1990	070302	Heavy duty vehicles	Diesel	Rural driving	15837441	93,68	1055,19	70,91	215,24	0,31	41,02
1990	070302	Heavy duty vehicles	Gasoline	Rural driving	29859	2,28	1141,55	820,40	8371,39	0,30	60,88
1990	070303	Heavy duty vehicles	Diesel	Urban driving	13345616	93,68	1013,26	98,07	267,09	0,25	47,92
1990	070303	Heavy duty vehicles	Gasoline	Urban driving	34524	2,28	456,62	696,09	7102,99	0,20	40,59
1990	0704	Mopeds	Gasoline	Mopeds and Motorcycles < 50 cm3	286683	2,28	18,26	12503,20	12602,74	0,91	171,69
1990	070501	Motorcycles	Gasoline	Highway driving	76549	2,28	215,28	1274,65	17695,34	1,27	29,79
1990	070502	Motorcycles	Gasoline	Rural driving	142895	2,28	173,21	1528,99	16838,71	1,52	35,67
1990	070503	Motorcycles	Gasoline	Urban driving	167965	2,28	93,24	2017,69	15315,93	1,53	35,94

Continued

Year	SNAP ID	Category	Fuel type	Mode	Fuel [GJ]	SO_2 [g pr GJ]	NO_x [g pr GJ]	NMVOC [g pr GJ]	CO [g pr GJ]	NH_3 [g pr GJ]	TSP [g pr GJ]
1990	0801	Military	Diesel		146162	93,68	782,10	64,64	274,45	0,31	68,28
1990	0801	Military	Jet fuel	< 3000 ft	149678	22,99	250,57	24,94	229,89		1,16
1990	0801	Military	Jet fuel	> 3000 ft	1347105	22,99	250,57	24,94	229,89		1,16
1990	0801	Military	Gasoline		986	2,28	890,75	1175,82	6684,91	0,78	14,48
1990	0801	Military	Aviation gasoline		4913	22,83	859,00	1242,60	6972,00	1,60	10,00
1990	0802	Railways	Diesel		4010007	93,68	1225,13	79,94	223,21	0,20	50,26
1990	0802	Railways	Kerosene		70	5,00	50,00	3,00	20,00		121,95
1990	0802	Railways	Gasoline		0	2,28	871,06	1129,29	6687,29	1,63	0,00
1990	0803	Inland waterways	Diesel		342623	93,68	983,64	171,79	453,65	0,17	106,93
1990	0803	Inland waterways	Gasoline		309136	2,28	291,33	3606,55	13853,27	0,08	182,44
1990	080402	Maritime activities	Residual oil		3842534	1290,95	1601,17	53,33	175,95		149,25
1990	080402	Maritime activities	Diesel		4942218	93,68	1100,31	50,67	167,17		23,21
1990	080402	Maritime activities	Kerosene		452	2,30	50,00	3,00	20,00		5,00
1990	080402	Maritime activities	LPG		1794		1249,00	384,94	443,00		0,20
1990	080403	Maritime activities	Residual oil		0	1466,99	1393,64	56,92	180,93		139,40
1990	080403	Maritime activities	Diesel		7919928	93,68	1052,12	49,13	162,08		23,21
1990	080403	Maritime activities	Kerosene		25787	2,30	50,00	3,00	20,00		5,00
1990	080403	Maritime activities	Gasoline		0	2,28	64,34	10809,58	18485,08	0,10	23,25
1990	080403	Maritime activities	LPG		42320		1249,00	384,94	443,00		0,20
1990	080404	Maritime activities	Residual oil		28543368	1447,43	1689,57	53,98	178,09		189,43
1990	080404	Maritime activities	Diesel		11632674	93,68	1208,60	49,46	163,17		23,21
1990	080501	Air traffic	Jet fuel	Dom. < 3000 ft	422173	22,99	314,51	14,93	90,41		1,16
1990	080501	Air traffic	Aviation gasoline		104947	22,83	859,00	1242,60	6972,00	1,60	10,00
1990	080502	Air traffic	Jet fuel	Int. < 3000 ft	132339	22,99	309,25	16,47	168,98		1,16
1990	080502	Air traffic	Aviation gasoline		30660	22,83	859,00	1242,60	6972,00	1,60	10,00
1990	080503	Air traffic	Jet fuel	Dom. > 3000 ft	1026021	22,99	330,11	12,36	90,75		1,16
1990	080504	Air traffic	Jet fuel	Int. > 3000 ft	1611915	22,99	244,20	6,48	54,10		1,16
1990	0806	Agriculture	Diesel		16496273	93,68	758,87	156,85	635,53	0,17	144,45
1990	0806	Agriculture	Gasoline		708864	2,28	31,60	949,55	47524,17	0,09	6,56
1990	0807	Forestry	Diesel		145346	93,68	857,48	156,47	645,65	0,17	149,05
1990	0807	Forestry	Gasoline		341430	2,28	40,39	7206,91	18057,40	0,07	101,22
1990	0808	Industry	Diesel		10158406	93,68	933,58	178,23	655,80	0,17	154,50
1990	0808	Industry	Gasoline		175227	2,28	136,27	1610,77	14797,46	0,09	12,40
1990	0808	Industry	LPG		1184856	0,00	1328,11	146,09	104,85	0,21	4,89
1990	0809	Household and gardening	Gasoline		1544959	2,28	67,15	2656,60	30931,24	0,08	22,88

Continued

Year	SNAP ID	Category	Fuel type	Mode	Fuel [GJ]	SO_2 [g pr GJ]	NO_x [g pr GJ]	NMVOC [g pr GJ]	CO [g pr GJ]	NH_3 [g pr GJ]	TSP [g pr GJ]
1990	80501,00	Air traffic, Copenhagen airport	Jet fuel	Dom. < 3000 ft	502153	22,99	283,87	20,73	129,70		1,16
1990	80501,00	Air traffic, Copenhagen airport	Aviation gasoline		8642	22,83	859,00	1242,60	6972,00	1,60	10,00
1990	80502,00	Air traffic, Copenhagen airport	Jet fuel	Int. < 3000 ft	2001204	22,99	324,87	34,25	157,15		1,16
1990	80502,00	Air traffic, Copenhagen airport	Aviation gasoline		5612	22,83	859,00	1242,60	6972,00	1,60	10,00
1990	80503,00	Air traffic, Copenhagen airport	Jet fuel	Dom. > 3000 ft	1305208	22,99	314,86	11,78	84,05		1,16
1990	80504,00	Air traffic, Copenhagen airport	Jet fuel	Int. > 3000 ft	20330315	22,99	290,20	10,08	37,65		1,16

2007 emission factors for CO_2, CH_4 and N_2O.

Year	SNAP ID	Category	Fuel type	Mode	Fuel [GJ]	CH_4 [g pr GJ]	CO_2 [kg pr GJ]	N_2O [g pr GJ]
2007	70101	Passenger cars	Diesel	Highway driving	4239149	0,76	74,00	2,01
2007	70101	Passenger cars	Gasoline 2-stroke	Highway driving	0	10,03	73,00	2,01
2007	70101	Passenger cars	Gasoline conventional	Highway driving	961877	11,53	72,76	2,88
2007	70101	Passenger cars	Gasoline catalyst	Highway driving	11094084	3,09	72,76	0,70
2007	70101	Passenger cars	LPG	Highway driving	44	10,06	65,00	0,00
2007	70102	Passenger cars	Diesel	Rural driving	9387821	1,58	74,00	2,20
2007	70102	Passenger cars	Gasoline 2-stroke	Rural driving	2113477	13,84	73,00	1,73
2007	70102	Passenger cars	Gasoline conventional	Rural driving	25543136	14,22	72,76	3,18
2007	70102	Passenger cars	Gasoline catalyst	Rural driving	0	3,45	72,76	1,37
2007	70102	Passenger cars	LPG	Rural driving	89	16,91	65,00	0,00
2007	70103	Passenger cars	Diesel	Urban driving	9636862	2,66	74,00	3,01
2007	70103	Passenger cars	Gasoline 2-stroke	Urban driving	0	43,97	73,00	0,82
2007	70103	Passenger cars	Gasoline conventional	Urban driving	2466010	51,98	72,76	3,19
2007	70103	Passenger cars	Gasoline catalyst	Urban driving	28568228	8,98	72,76	2,54
2007	70103	Passenger cars	LPG	Urban driving	112	23,50	65,00	0,00
2007	70201	Light duty vehicles	Diesel	Highway driving	4882419	0,66	74,00	1,43
2007	70201	Light duty vehicles	Gasoline conventional	Highway driving	351803	10,11	72,76	2,63
2007	70201	Light duty vehicles	Gasoline catalyst	Highway driving	36252	2,47	72,76	1,57
2007	70202	Light duty vehicles	Diesel	Rural driving	14874951	1,41	74,00	1,57
2007	70202	Light duty vehicles	Gasoline conventional	Rural driving	128141	15,25	72,76	2,48
2007	70202	Light duty vehicles	Gasoline catalyst	Rural driving	1242164	2,37	72,76	2,52
2007	70203	Light duty vehicles	Diesel	Urban driving	14454320	2,28	74,00	2,18
2007	70203	Light duty vehicles	Gasoline conventional	Urban driving	154585	40,55	72,76	2,21
2007	70203	Light duty vehicles	Gasoline catalyst	Urban driving	1494595	5,26	72,76	4,38
2007	70301	Heavy duty vehicles	Diesel	Highway driving	13114006	5,77	74,00	3,21
2007	70301	Heavy duty vehicles	Gasoline	Highway driving	15491	9,69	72,76	0,83
2007	70302	Heavy duty vehicles	Diesel	Rural driving	19682352	6,34	74,00	3,25
2007	70302	Heavy duty vehicles	Gasoline	Rural driving	31518	16,74	72,76	0,91
2007	70303	Heavy duty vehicles	Diesel	Urban driving	13672121	9,24	74,00	2,67
2007	70303	Heavy duty vehicles	Gasoline	Urban driving	32188	14,21	72,76	0,61
2007	704	Mopeds	Gasoline		188922	135,18	72,76	1,26
2007	70501	Motorcycles	Gasoline	Highway driving	213387	106,14	72,76	1,20
2007	70502	Motorcycles	Gasoline	Rural driving	473994	132,33	72,76	1,51
2007	70503	Motorcycles	Gasoline	Urban driving	565148	135,37	72,76	1,53
2007	801	Military	Diesel		678945	4,12	74,00	2,53

Continued

Year	SNAP ID	Category	Fuel type	Mode	Fuel [GJ]	CH_4 [g pr GJ]	CO_2 [kg pr GJ]	N_2O [g pr GJ]
2007	801	Military	Jet fuel	< 3000 ft	171808	2,65	72,00	2,30
2007	801	Military	Jet fuel	> 3000 ft	1546268	2,65	72,00	2,30
2007	801	Military	Gasoline		6373	10,00	72,76	1,93
2007	801	Military	Aviation gasoline		6313	21,90	73,00	2,00
2007	802	Railways	Diesel		3075538	2,88	74,00	2,04
2007	803	Inland waterways	Diesel		1002148	2,70	74,00	2,97
2007	803	Inland waterways	Gasoline		370806	58,91	73,00	1,28
2007	80402	National sea traffic	Residual oil		609869	1,91	78,00	4,89
2007	80402	National sea traffic	Diesel		4118801	1,48	74,00	4,68
2007	80402	National sea traffic	Kerosene		0			
2007	80402	National sea traffic	LPG		0			
2007	80403	Fishing	Residual oil		0	1,76	78,00	4,90
2007	80403	Fishing	Diesel		5143684	1,75	74,00	4,68
2007	80403	Fishing	Kerosene		278	7,00	72,00	0,00
2007	80403	Fishing	Gasoline		0	108,10	73,00	0,52
2007	80403	Fishing	LPG		18216	20,26	65,00	0,00
2007	80404	International sea traffic	Residual oil		35243144	1,89	78,00	4,89
2007	80404	International sea traffic	Diesel		10946734	1,72	74,00	4,68
2007	80501	Air traffic, other airports	Jet fuel	Dom. < 3000 ft	218081	2,46	72,00	12,63
2007	80501	Air traffic, other airports	Aviation gasoline		97612	21,90	73,00	2,00
2007	80502	Air traffic, other airports	Jet fuel	Int. < 3000 ft	292943	4,64	72,00	8,18
2007	80502	Air traffic, other airports	Aviation gasoline		651	21,90	73,00	2,00
2007	80503	Air traffic, other airports	Jet fuel	Dom. > 3000 ft	546082	2,04	72,00	2,30
2007	80504	Air traffic, other airports	Jet fuel	Int. > 3000 ft	3352561	1,01	72,00	2,30
2007	806	Agriculture	Diesel		15378079	1,22	74,00	3,15
2007	806	Agriculture	Gasoline		382327	152,40	73,00	1,68
2007	807	Forestry	Diesel		159065	0,72	74,00	3,21
2007	807	Forestry	Gasoline		74145	57,62	73,00	0,43
2007	808	Industry	Diesel		13624003	1,32	74,00	3,09
2007	808	Industry	Gasoline		161029	106,02	73,00	1,44
2007	808	Industry	LPG		1039571	7,69	65,00	3,50
2007	809	Household and gardening	Gasoline		3177713	74,06	73,00	1,13
2007	80501	Air traffic, Copenhagen airport	Jet fuel	Dom. < 3000 ft	208725	3,42	72,00	8,42
2007	80501	Air traffic, Copenhagen airport	Aviation gasoline		782	21,90	73,00	2,00
2007	80502	Air traffic, Copenhagen airport	Jet fuel	Int. < 3000 ft	2789582	4,64	72,00	3,94

Continued

Year	SNAP ID	Category	Fuel type	Mode	Fuel [GJ]	CH_4 [g pr GJ]	CO_2 [kg pr GJ]	N_2O [g pr GJ]
2007	80502	Air traffic, Copenhagen airport	Aviation gasoline		95	21,90	73,00	2,00
2007	80503	Air traffic, Copenhagen airport	Jet fuel	Dom. > 3000 ft	409239	2,21	72,00	2,30
2007	80504	Air traffic, Copenhagen airport	Jet fuel	Int. > 3000 ft	31083722	1,19	72,00	2,30

2007 emission factors for SO_2, NO_x; NMVOC, NH_3 and TSP.

Year	SNAP ID	Category	Fuel type	Mode	Fuel [GJ]	SO_2 [g pr GJ]	NO_x [g pr GJ]	NMVOC [g pr GJ]	CO [g pr GJ]	NH_3 [g pr GJ]	TSP [g pr GJ]
2007	70101	Passenger cars	Diesel	Highway driving	4239149	0,47	320,46	7,84	36,63	0,48	29,60
2007	70101	Passenger cars	Gasoline 2-stroke	Highway driving	0	2,28	288,90	2357,34	3490,86	0,80	48,15
2007	70101	Passenger cars	Gasoline conventional	Highway driving	961877	0,46	1332,24	331,15	2773,37	0,89	10,46
2007	70101	Passenger cars	Gasoline catalyst	Highway driving	11094084	0,46	114,52	24,84	691,33	32,04	0,67
2007	70101	Passenger cars	LPG	Highway driving	44	0,00	1151,70	187,09	3914,25	0,00	10,06
2007	70102	Passenger cars	Diesel	Rural driving	9387821	0,47	295,69	11,03	61,01	0,52	22,91
2007	70102	Passenger cars	Gasoline 2-stroke	Rural driving	2113477	2,28	352,84	2476,82	2594,44	0,69	41,51
2007	70102	Passenger cars	Gasoline conventional	Rural driving	25543136	0,46	1156,70	453,39	3162,05	0,98	11,73
2007	70102	Passenger cars	Gasoline catalyst	Rural driving	0	0,46	91,66	26,18	515,08	37,49	0,60
2007	70102	Passenger cars	LPG	Rural driving	89	0,00	1248,46	305,18	1146,38	0,00	14,49
2007	70103	Passenger cars	Diesel	Urban driving	9636862	0,47	277,45	27,32	136,83	0,39	35,33
2007	70103	Passenger cars	Gasoline 2-stroke	Urban driving	0	2,28	51,89	4470,04	7400,54	0,33	19,72
2007	70103	Passenger cars	Gasoline conventional	Urban driving	2466010	0,46	634,50	858,71	7875,97	0,64	11,30
2007	70103	Passenger cars	Gasoline catalyst	Urban driving	28568228	0,46	123,99	198,46	2274,41	13,46	0,68
2007	70103	Passenger cars	LPG	Urban driving	112	0,00	616,11	440,44	1327,53	0,00	11,75
2007	70201	Light duty vehicles	Diesel	Highway driving	4882419	0,47	283,52	27,45	161,76	0,36	35,30
2007	70201	Light duty vehicles	Gasoline conventional	Highway driving	351803	0,46	1369,26	170,29	2987,40	0,81	16,17
2007	70201	Light duty vehicles	Gasoline catalyst	Highway driving	36252	0,46	95,07	10,67	425,55	24,36	0,51
2007	70202	Light duty vehicles	Diesel	Rural driving	14874951	0,47	297,95	30,72	145,27	0,40	31,07
2007	70202	Light duty vehicles	Gasoline conventional	Rural driving	128141	0,46	1188,86	262,59	2316,18	0,76	15,25
2007	70202	Light duty vehicles	Gasoline catalyst	Rural driving	1242164	0,46	83,64	15,05	318,58	24,89	0,41
2007	70203	Light duty vehicles	Diesel	Urban driving	14454320	0,47	304,39	50,61	173,30	0,29	40,43
2007	70203	Light duty vehicles	Gasoline conventional	Urban driving	154585	0,46	624,19	717,35	7390,65	0,44	8,85
2007	70203	Light duty vehicles	Gasoline catalyst	Urban driving	1494595	0,46	97,04	113,84	2657,70	7,00	0,40
2007	70301	Heavy duty vehicles	Diesel	Highway driving	13114006	0,47	715,05	22,66	139,68	0,32	17,42
2007	70301	Heavy duty vehicles	Gasoline	Highway driving	15491	0,46	1037,78	474,61	7610,35	0,28	55,35
2007	70302	Heavy duty vehicles	Diesel	Rural driving	19682352	0,47	740,33	30,25	146,23	0,33	17,95

Continued

Year	SNAP ID	Category	Fuel type	Mode	Fuel [GJ]	SO_2 [g pr GJ]	NO_x [g pr GJ]	NMVOC [g pr GJ]	CO [g pr GJ]	NH_3 [g pr GJ]	TSP [g pr GJ]
2007	70302	Heavy duty vehicles	Gasoline	Rural driving	31518	0,46	1141,55	820,40	8371,39	0,30	60,88
2007	70303	Heavy duty vehicles	Diesel	Urban driving	13672121	0,47	745,30	41,47	173,67	0,27	21,89
2007	70303	Heavy duty vehicles	Gasoline	Urban driving	32188	0,46	456,62	696,09	7102,99	0,20	40,59
2007	704	Mopeds	Gasoline		188922	0,46	112,42	8440,75	9577,73	1,26	137,39
2007	70501	Motorcycles	Gasoline	Highway driving	213387	0,46	249,42	1006,99	14684,49	1,20	23,58
2007	70502	Motorcycles	Gasoline	Rural driving	473994	0,46	195,74	1257,04	14427,72	1,51	29,57
2007	70503	Motorcycles	Gasoline	Urban driving	565148	0,46	110,37	1701,44	13209,28	1,53	29,89
2007	801	Military	Diesel		678945	0,47	492,21	30,61	140,33	0,35	26,76
2007	801	Military	Jet fuel	< 3000 ft	171808	22,99	250,57	24,94	229,89	0,00	1,16
2007	801	Military	Jet fuel	> 3000 ft	1546268	22,99	250,57	24,94	229,89	0,00	1,16
2007	801	Military	Gasoline		6373	0,46	176,04	227,05	1856,59	23,18	2,33
2007	801	Military	Aviation gasoline		6313	22,99	859,00	1242,60	6972,00	1,60	10,00
2007	802	Railways	Diesel		3075538	0,47	1155,92	74,96	204,41	0,20	39,02
2007	803	Inland waterways	Diesel		1002148	93,68	859,98	166,16	448,87	0,17	102,24
2007	803	Inland waterways	Gasoline		370806	0,46	471,95	1805,80	15316,45	0,09	75,54
2007	80402	National sea traffic	Residual oil		609869	586,80	1853,36	61,68	203,47		51,05
2007	80402	National sea traffic	Diesel		4118801	93,68	913,41	51,67	77,70	0,00	23,21
2007	80402	National sea traffic	Kerosene		0						
2007	80402	National sea traffic	LPG		0						
2007	80403	Fishing	Residual oil		0	1101,71	1393,60	56,90	180,90		139,40
2007	80403	Fishing	Diesel		5143684	93,68	1361,84	56,69	187,03	0,00	23,21
2007	80403	Fishing	Kerosene		278	2,30	50,00	3,00	20,00		5,00
2007	80403	Fishing	Gasoline		0	2,28	64,34	10809,60	18485,10	0,10	23,25
2007	80403	Fishing	LPG		18216	0,00	1249,00	384,94	443,00	0,00	0,20
2007	80404	International sea traffic	Residual oil		35243144	733,50	2069,79	61,20	201,91		63,83
2007	80404	International sea traffic	Diesel		10946734	93,68	1532,37	55,75	183,92		23,21
2007	80501	Air traffic, other airports	Jet fuel	Dom. < 3000 ft	218081	22,99	293,55	23,12	141,74		1,16
2007	80501	Air traffic, other airports	Aviation gasoline		97612	22,83	859,00	1242,60	6972,00	1,60	10,00
2007	80502	Air traffic, other airports	Jet fuel	Int. < 3000 ft	292943	22,99	291,92	43,72	198,15		1,16
2007	80502	Air traffic, other airports	Aviation gasoline		651	22,83	859,00	1242,60	6972,00	1,60	10,00
2007	80503	Air traffic, other airports	Jet fuel	Dom. > 3000 ft	546082	22,99	291,19	19,21	129,09		1,16
2007	80504	Air traffic, other airports	Jet fuel	Int. > 3000 ft	3352561	22,99	237,35	9,52	58,63		1,16
2007	806	Agriculture	Diesel		15378079	2,34	716,23	74,95	391,81	0,18	56,80
2007	806	Agriculture	Gasoline		382327	0,46	107,62	1143,27	21924,54	1,41	29,26
2007	807	Forestry	Diesel		159065	2,34	566,80	44,17	275,21	0,18	30,98

Continued

Year	SNAP ID	Category	Fuel type	Mode	Fuel [GJ]	SO_2 [g pr GJ]	NO_x [g pr GJ]	NMVOC [g pr GJ]	CO [g pr GJ]	NH_3 [g pr GJ]	TSP [g pr GJ]
2007	807	Forestry	Gasoline		74145	0,46	86,32	6899,22	16933,82	0,09	77,69
2007	808	Industry	Diesel		13624003	2,34	678,30	80,88	376,58	0,18	68,25
2007	808	Industry	Gasoline		161029	0,46	200,51	1509,22	13278,13	0,10	14,57
2007	808	Industry	LPG		1039571	0,00	1328,11	146,09	104,85	0,21	4,89
2007	809	Household and gardening	Gasoline		3177713	0,46	90,65	2549,32	28132,76	0,09	25,05
2007	80501	Air traffic, Copenhagen airport	Jet fuel	Dom. < 3000 ft	208725	22,99	280,40	32,20	176,61		1,16
2007	80501	Air traffic, Copenhagen airport	Aviation gasoline		782	22,83	859,00	1242,60	6972,00	1,60	10,00
2007	80502	Air traffic, Copenhagen airport	Jet fuel	Int. < 3000 ft	2789582	22,99	342,69	43,65	229,09	0,00	1,16
2007	80502	Air traffic, Copenhagen airport	Aviation gasoline		95	22,83	859,00	1242,60	6972,00	1,60	10,00
2007	80503	Air traffic, Copenhagen airport	Jet fuel	Dom. > 3000 ft	409239	22,99	321,59	20,83	112,70	0,00	1,16
2007	80504	Air traffic, Copenhagen airport	Jet fuel	Int. > 3000 ft	31083722	22,99	314,27	11,22	34,26	0,00	1,16

1990 emissions for CO_2, CH_4, N_2O, SO_2, NO_x; NMVOC, NH_3 and TSP.

	Category	Mode		SO_2 [tonnes]	NO_x [tonnes]	NMVOC [tonnes]	CH_4 [tonnes]	CO [tonnes]	CO_2 [ktonnes]	N_2O [tonnes]	NH_3 [tonnes]	TSP [tonnes]
1990	Passenger cars	Highway driving	70101	80	10078	2825	86	26229	600	21	7	145
1990	Passenger cars	Rural driving	70102	231	26952	11576	337	93345	1841	72	23	470
1990	Passenger cars	Urban driving	70103	339	20897	29689	1598	302362	2562	104	22	776
1990	Light duty vehicles	Highway driving	70201	179	818	95	7	1315	157	1	1	203
1990	Light duty vehicles	Rural driving	70202	641	3131	467	43	4567	572	2	3	749
1990	Light duty vehicles	Urban driving	70203	749	4754	1345	106	12581	687	3	3	1022
1990	Heavy duty vehicles	Highway driving	70301	812	8959	417	53	1728	642	25	3	332
1990	Heavy duty vehicles	Rural driving	70302	1484	16746	1148	108	3659	1174	49	5	651
1990	Heavy duty vehicles	Urban driving	70303	1250	13538	1333	168	3810	990	34	3	641
1990	Mopeds		704	1	5	3584	57	3613	21	0	0	49
1990	Motorcycles	Highway driving	70501	0	16	98	9	1355	6	0	0	2
1990	Motorcycles	Rural driving	70502	0	25	218	21	2406	10	0	0	5
1990	Motorcycles	Urban driving	70503	0	16	339	25	2573	12	0	0	6
1990	Evaporation		706			28676						
1990	Tyre and brake wear		707									1104
1990	Road abrasion		708									773
1990	Military		801	48	494	54	5	425	119	4	0	12
1990	Railways		802	376	4913	321	12	895	297	8	1	202
1990	Inland waterways		803	33	427	1174	17	4438	48	1	0	93
1990	National sea traffic		80402	5424	11593	456	14	1503	666	42		688
1990	Fishing		80403	742	8387	405	13	1303	591	37	0	184
1990	International sea traffic		80404	42404	62285	2116	65	6981	3087	194		5677
1990	Air traffic, Dom. < 3000 ft.		80501	24	373	158	4	895	75	5	0	2
1990	Air traffic, Int. < 3000 ft.		80502	50	722	116	8	590	156	9	0	3
1990	Air traffic, Dom. > 3000 ft.		80503	54	750	28	3	203	168	5		3
1990	Air traffic, Int. > 3000 ft.		80504	504	6293	215	23	853	1580	50		25
1990	Agriculture		806	1547	12541	3260	105	44172	1272	49	3	2388
1990	Forestry		807	14	138	2483	21	6259	36	1	0	56
1990	Industry		808	952	11081	2266	60	9379	842	34	2	1577
1990	Household and gardening		809	4	104	4104	150	47787	113	2	0	35

2007 emissions for CO_2, CH_4, N_2O, SO_2, NO_x; NMVOC, NH_3 and TSP.

	Category	Mode			SO_2 [tonnes]	NO_x [tonnes]	NMVOC [tonnes]	CH_4 [tonnes]	CO [tonnes]	CO_2 [ktonnes]	N_2O [tonnes]	NH_3 [tonnes]	TSP [tonnes]
2007	Passenger cars	Highway driving	70101	070101	7	3910	627	49	10493	1191	19	358	143
2007	Passenger cars	Rural driving	70102	070102	17	7562	1730	133	20413	2707	62	964	255
2007	Passenger cars	Urban driving	70103	070103	19	7781	8051	410	85717	2971	110	390	388
2007	Light duty vehicles	Highway driving	70201	070201	2	1467	144	4	1048	390	8	10	173
2007	Light duty vehicles	Rural driving	70202	070202	8	4688	509	26	2853	1200	27	37	465
2007	Light duty vehicles	Urban driving	70203	070203	8	4641	1013	47	7620	1190	38	15	586
2007	Heavy duty vehicles	Highway driving	70301	070301	6	9393	305	76	1950	972	42	4	229
2007	Heavy duty vehicles	Rural driving	70302	070302	9	14607	621	125	3142	1459	64	6	355
2007	Heavy duty vehicles	Urban driving	70303	070303	6	10205	589	127	2603	1014	37	4	301
2007	Mopeds		704	070400	0	21	1595	26	1809	14	0	0	26
2007	Motorcycles	Highway driving	70501	070501	0	53	215	23	3133	16	0	0	5
2007	Motorcycles	Rural driving	70502	070502	0	93	596	63	6839	34	1	1	14
2007	Motorcycles	Urban driving	70503	070503	0	62	962	77	7465	41	1	1	17
2007	Evaporation		706	070600			3408						
2007	Tyre and brake wear		707	070700									1661
2007	Road abrasion		708	070800									1144
2007	Military		801	080100	40	771	73	8	546	175	6	0	20
2007	Railways		802	080200	1	3555	231	9	629	228	6	1	120
2007	Inland waterways		803	080300	94	1037	836	25	6129	101	3	0	130
2007	National sea traffic		80402	080402	744	4892	250	7	444	352	22	0	127
2007	Fishing		80403	080403	482	7028	299	9	970	382	24	0	119
2007	International sea traffic		80404	080404	26876	89720	2767	86	9129	3559	224		2504
2007	Air traffic, Dom. < 3000 ft.		80501	080501	12	207	134	3	754	38	5	0	1
2007	Air traffic, Int. < 3000 ft.		80502	080502	71	1042	136	14	702	222	13	0	4
2007	Air traffic, Dom. > 3000 ft.		80503	080503	22	291	19	2	117	69	2	0	1
2007	Air traffic, Int. > 3000 ft.		80504	080504	792	10564	381	40	1261	2479	79	0	40
2007	Agriculture		806	080600	36	11055	1590	77	14408	1166	49	3	885
2007	Forestry		807	080700	0	97	519	4	1299	17	1	0	11
2007	Industry		808	080800	32	10654	1497	43	7378	1088	46	3	937
2007	Household and gardening		809	080900	1	288	8101	235	89398	232	4	0	80

Non-exhaust emission factors, activity data and total non-exhaust emissions of TSP, PM_{10} and $PM_{2.5}$ in 2007.

Year	Source	Category	Mileage [kmkveh]	TSP [mg pr km]	PM_{10} [mg pr km]	$PM_{2.5}$ [mg pr km]	TSP [tonnes]	PM_{10} [tonnes]	$PM_{2.5}$ [tonnes]
2007	Brake wear	1	38975465	7.6	7.5	3.0	297	291	116
2007	Brake wear	2	12707725	13.7	13.4	5.3	174	171	68
2007	Brake wear	3	3788995	34.8	34.1	13.6	132	129	51
2007	Brake wear	4	975262	47.4	46.4	18.5	46	45	18
2007	Brake wear	5	238308	6.2	6.1	2.4	1	1	1
2007	Brake wear	6	917018	4.2	4.2	1.7	4	4	2
2007	Road abrasion	1	38975465	15.0	7.5	4.1	585	292	158
2007	Road abrasion	2	12707725	15.0	7.5	4.1	191	95	51
2007	Road abrasion	3	3788995	76.0	38.0	20.5	288	144	78
2007	Road abrasion	4	975262	76.0	38.0	20.5	74	37	20
2007	Road abrasion	5	238308	6.0	3.0	1.6	1	1	0
2007	Road abrasion	6	917018	6.0	3.0	1.6	6	3	1
2007	Tyre wear	1	38975465	12.4	7.5	5.2	485	291	204
2007	Tyre wear	2	12707725	20.5	12.3	8.6	260	156	109
2007	Tyre wear	3	3788995	59.8	35.9	25.1	226	136	95
2007	Tyre wear	4	975262	29.4	17.7	12.4	29	17	12
2007	Tyre wear	5	238308	6.4	3.8	2.7	2	1	1
2007	Tyre wear	6	917018	5.6	3.3	2.3	5	3	2
2007	Total	1	38975465	35.1	22.4	12.2	1367	874	477
2007	Total	2	12707725	49.1	33.2	18.0	625	422	228
2007	Total	3	3788995	170.5	107.9	59.2	646	409	224
2007	Total	4	975262	152.8	102.1	51.4	149	100	50
2007	Total	5	238308	18.6	12.9	6.7	4	3	2
2007	Total	6	917018	15.8	10.5	5.6	14	10	5

Heavy metal emission factors and total emissions for 1990 and 2007 in CollectER format.

SNAP ID	Category	Fuel type	Mode	Arsenic [g pr GJ]	Cadmium [g pr GJ]	Chromium [g pr GJ]	Copper [g pr GJ]	Mercury [g pr GJ]	Nickel [g pr GJ]	Lead [g pr GJ]	Selenium [g pr GJ]	Zinc [g pr GJ]
070101	Passenger cars	Diesel	Highway driving		0,000234	0,001171	0,039812		0,001639	0,000000	0,000234	0,023419
070101	Passenger cars	Gasoline 2-stroke	Highway driving		0,000228	0,001141	0,038813		0,001598	0,000685	0,000228	0,022831
070101	Passenger cars	Gasoline conventional	Highway driving		0,000228	0,001141	0,038813		0,001598	0,000685	0,000228	0,022831
070101	Passenger cars	Gasoline catalyst	Highway driving		0,000228	0,001141	0,038813		0,001598	0,000685	0,000228	0,022831
070101	Passenger cars	LPG	Highway driving		0,000000	0,000000	0,000000		0,000000	0,000000	0,000000	0,000000
070102	Passenger cars	Diesel	Rural driving		0,000234	0,001171	0,039812		0,001639	0,000000	0,000234	0,023419
070102	Passenger cars	Gasoline 2-stroke	Rural driving		0,000228	0,001141	0,038813		0,001598	0,000685	0,000228	0,022831
070102	Passenger cars	Gasoline conventional	Rural driving		0,000228	0,001141	0,038813		0,001598	0,000685	0,000228	0,022831
070102	Passenger cars	Gasoline catalyst	Rural driving		0,000228	0,001141	0,038813		0,001598	0,000685	0,000228	0,022831
070102	Passenger cars	LPG	Rural driving		0,000000	0,000000	0,000000		0,000000	0,000000	0,000000	0,000000
070103	Passenger cars	Diesel	Urban driving		0,000234	0,001171	0,039812		0,001639	0,000000	0,000234	0,023419
070103	Passenger cars	Gasoline 2-stroke	Urban driving		0,000228	0,001141	0,038813		0,001598	0,000685	0,000228	0,022831
070103	Passenger cars	Gasoline conventional	Urban driving		0,000228	0,001141	0,038813		0,001598	0,000685	0,000228	0,022831
070103	Passenger cars	Gasoline catalyst	Urban driving		0,000228	0,001141	0,038813		0,001598	0,000685	0,000228	0,022831
070103	Passenger cars	LPG	Urban driving		0,000000	0,000000	0,000000		0,000000	0,000000	0,000000	0,000000
070201	Light duty vehicles	Diesel	Highway driving		0,000234	0,001171	0,039812		0,001639	0,000000	0,000234	0,023419
070201	Light duty vehicles	Gasoline conventional	Highway driving		0,000228	0,001141	0,038813		0,001598	0,000685	0,000228	0,022831
070201	Light duty vehicles	Gasoline catalyst	Highway driving		0,000228	0,001141	0,038813		0,001598	0,000685	0,000228	0,022831
070202	Light duty vehicles	Diesel	Rural driving		0,000234	0,001171	0,039812		0,001639	0,000000	0,000234	0,023419
070202	Light duty vehicles	Gasoline conventional	Rural driving		0,000228	0,001141	0,038813		0,001598	0,000685	0,000228	0,022831
070202	Light duty vehicles	Gasoline catalyst	Rural driving		0,000228	0,001141	0,038813		0,001598	0,000685	0,000228	0,022831
070203	Light duty vehicles	Diesel	Urban driving		0,000234	0,001171	0,039812		0,001639	0,000000	0,000234	0,023419
070203	Light duty vehicles	Gasoline conventional	Urban driving		0,000228	0,001141	0,038813		0,001598	0,000685	0,000228	0,022831
070203	Light duty vehicles	Gasoline catalyst	Urban driving		0,000228	0,001141	0,038813		0,001598	0,000685	0,000228	0,022831
070301	Heavy duty vehicles	Diesel	Highway driving		0,000234	0,001171	0,039812		0,001639	0,000000	0,000234	0,023419
070301	Heavy duty vehicles	Gasoline	Highway driving		0,000228	0,001141	0,038813		0,001598	0,000685	0,000228	0,022831
070302	Heavy duty vehicles	Diesel	Rural driving		0,000234	0,001171	0,039812		0,001639	0,000000	0,000234	0,023419
070302	Heavy duty vehicles	Gasoline	Rural driving		0,000228	0,001141	0,038813		0,001598	0,000685	0,000228	0,022831
070303	Heavy duty vehicles	Diesel	Urban driving		0,000234	0,001171	0,039812		0,001639	0,000000	0,000234	0,023419
070303	Heavy duty vehicles	Gasoline	Urban driving		0,000228	0,001141	0,038813		0,001598	0,000685	0,000228	0,022831
0704	Mopeds	Gasoline			0,000228	0,001141	0,038813		0,001598	0,000685	0,000228	0,022831
070501	Motorcycles	Gasoline	Highway driving		0,000228	0,001141	0,038813		0,001598	0,000685	0,000228	0,022831
070502	Motorcycles	Gasoline	Rural driving		0,000228	0,001141	0,038813		0,001598	0,000685	0,000228	0,022831
070503	Motorcycles	Gasoline	Urban driving		0,000228	0,001141	0,038813		0,001598	0,000685	0,000228	0,022831

SNAP ID	Category	Fuel type	Mode	Arsenic [mg pr GJ]	Cadmium [mg pr GJ]	Chromium [mg pr GJ]	Copper [mg pr GJ]	Mercury [mg pr GJ]	Nickel [mg pr GJ]	Lead [mg pr GJ]	Selenium [mg pr GJ]	Zinc [mg pr GJ]
0801	Military	Diesel			0,23	1,17	39,81		1,64		0,23	23,42
0801	Military	Jet fuel	< 3000 ft	0,00	0,23	1,14	38,81	0,00	1,60	0,00	0,23	22,83
0801	Military	Jet fuel	> 3000 ft	0,00	0,23	1,14	38,81	0,00	1,60	0,00	0,23	22,83
0801	Military	Gasoline			0,23	1,14	38,81		1,60	0,68	0,23	22,83
0801	Military	Aviation gasoline		0,00	0,23	1,14	38,81	0,00	1,60	12785,39	0,23	22,83
0802	Railways	Diesel			0,23	1,17	39,81		1,64		0,23	23,42
0802	Railways	Kerosene										
0802	Railways	Gasoline			0,23	1,14	38,81		1,60	0,68	0,23	22,83
0803	Inland waterways	Diesel			0,23	1,17	39,81		1,64		0,23	23,42
0803	Inland waterways	Gasoline			0,23	1,14	38,81		1,60	0,68	0,23	22,83
080402	National sea traffic	Residual oil		12,22	0,73	4,89	12,22	0,49	733,50	4,89	9,78	22,00
080402	National sea traffic	Diesel		1,17	0,23	0,94	1,17	1,17	1,64	2,34	4,68	11,71
080402	National sea traffic	Kerosene										
080402	National sea traffic	LPG										
080403	Fishing	Residual oil		12,22	0,73	4,89	12,22	0,49	733,50	4,89	9,78	22,00
080403	Fishing	Diesel		1,17	0,23	0,94	1,17	1,17	1,64	2,34	4,68	11,71
080403	Fishing	Kerosene										
080403	Fishing	Gasoline			0,23	1,14	38,81		1,60	0,68	0,23	22,83
080403	Fishing	LPG										
080404	International sea traffic	Residual oil		12,22	0,73	4,89	12,22	0,49	733,50	4,89	9,78	22,00
080404	International sea traffic	Diesel		1,17	0,23	0,94	1,17	1,17	1,64	2,34	4,68	11,71
080501	Air traffic, other airports	Jet fuel	Dom. < 3000 ft		0,23	1,14	38,81		1,60	0,00	0,23	22,83
080501	Air traffic, other airports	Aviation gasoline			0,23	1,14	38,81		1,60	13505,69	0,23	22,83
080502	Air traffic, other airports	Jet fuel	Int. < 3000 ft		0,23	1,14	38,81		1,60	0,00	0,23	22,83
080502	Air traffic, other airports	Aviation gasoline			0,23	1,14	38,81		1,60	13505,69	0,23	22,83
080503	Air traffic, other airports	Jet fuel	Dom. > 3000 ft		0,23	1,14	38,81		1,60	0,00	0,23	22,83
080504	Air traffic, other airports	Jet fuel	Int. > 3000 ft		0,23	1,14	38,81		1,60	0,00	0,23	22,83
0806	Agriculture	Diesel			0,23	1,17	39,81		1,64		0,23	23,42
0806	Agriculture	Gasoline			0,23	1,14	38,81		1,60	0,68	0,23	22,83
0807	Forestry	Diesel			0,23	1,17	39,81		1,64		0,23	23,42
0807	Forestry	Gasoline			0,23	1,14	38,81		1,60	0,68	0,23	22,83
0808	Industry	Diesel			0,23	1,17	39,81		1,64		0,23	23,42
0808	Industry	Gasoline			0,23	1,14	38,81		1,60	0,68	0,23	22,83
0808	Industry	LPG										
0809	Household and gardening	Gasoline			0,23	1,14	38,81		1,60	0,68	0,23	22,83
080501	Air traffic, CPH. airport	Jet fuel	Dom. < 3000 ft		0,23	1,14	38,81		1,60		0,23	22,83
080501	Air traffic, CPH. airport	Aviation gasoline			0,23	1,14	38,81		1,60	13505,69	0,23	22,83
080502	Air traffic, CPH. airport	Jet fuel	Int. < 3000 ft	0,00	0,23	1,14	38,81	0,00	1,60	0,00	0,23	22,83
080502	Air traffic, CPH. airport	Aviation gasoline		0,00	0,23	1,14	38,81	0,00	1,60	13505,69	0,23	22,83
080503	Air traffic, CPH. airport	Jet fuel	Dom. > 3000 ft	0,00	0,23	1,14	38,81	0,00	1,60	0,00	0,23	22,83
080504	Air traffic, CPH. airport	Jet fuel	Int. > 3000 ft	0,00	0,23	1,14	38,81	0,00	1,60	0,00	0,23	22,83

Year	Category	Mode	SNAP ID	Arsenic [kg]	Cadmium [kg]	Chromium [kg]	Copper [kg]	Mercury [kg]	Nickel [kg]	Lead [kg]	Selenium [kg]	Zinc [kg]
1990	Passenger cars	Highway driving	70101		2	9	315		13	11099	2	185
1990	Passenger cars	Rural driving	70102		6	28	966		40	34269	6	568
1990	Passenger cars	Urban driving	70103		8	40	1350		56	47403	8	794
1990	Light duty vehicles	Highway driving	70201		1	3	87		4	324	1	51
1990	Light duty vehicles	Rural driving	70202		2	9	318		13	1347	2	187
1990	Light duty vehicles	Urban driving	70203		2	11	385		16	1966	2	226
1990	Heavy duty vehicles	Highway driving	70301		2	10	346		14	15	2	203
1990	Heavy duty vehicles	Rural driving	70302		4	19	632		26	44	4	372
1990	Heavy duty vehicles	Urban driving	70303		3	16	533		22	51	3	314
1990	Mopeds		704		0	0	14		1	422	0	9
1990	Motorcycles	Highway driving	70501		0	0	4		0	113	0	2
1990	Motorcycles	Rural driving	70502		0	0	7		0	210	0	4
1990	Motorcycles	Urban driving	70503		0	0	8		0	247	0	5
1990	Evaporation		706									
1990	Military		801		0	2	64		3	64	0	38
1990	Railways		802		1	5	160		7	0	1	94
1990	Inland waterways		803		0	1	26		1	455	0	15
1990	National sea traffic		80402	53	4	23	53	8	2827	30	61	142
1990	Fishing		80403	9	2	7	9	9	13	19	37	93
1990	International sea traffic		80404	363	24	150	363	28	20956	167	334	764
1990	Air traffic, Dom. < 3000 ft.		80501		0	1	40		2	1534	0	24
1990	Air traffic, Int. < 3000 ft.		80502		0	2	84		3	490	0	50
1990	Air traffic, Dom. > 3000 ft.		80503		1	3	90		4		1	53
1990	Air traffic, Int. > 3000 ft.		80504		5	25	852		35		5	501
1990	Agriculture		806		4	20	684		28	1043	4	403
1990	Forestry		807		0	1	19		1	502	0	11
1990	Industry		808		2	12	411		17	258	2	242
1990	Household and gardening		809		0	2	60		2	2273	0	35

Year	Category	Mode	SNAP ID	Arsenic [kg]	Cadmium [kg]	Chromium [kg]	Copper [kg]	Mercury [kg]	Nickel [kg]	Lead [kg]	Selenium [kg]	Zinc [kg]
2007	Passenger cars	Rural driving	70101		4	19	637		26	8	4	375
2007	Passenger cars	Urban driving	70102		9	43	1447		60	19	9	851
2007	Light duty vehicles	Highway driving	70103		9	47	1588		65	21	9	934
2007	Light duty vehicles	Rural driving	70201		1	6	209		9	0	1	123
2007	Light duty vehicles	Urban driving	70202		4	19	645		27	1	4	380
2007	Heavy duty vehicles	Highway driving	70203		4	19	639		26	1	4	376
2007	Heavy duty vehicles	Rural driving	70301		3	15	523		22	0	3	307
2007	Heavy duty vehicles	Urban driving	70302		5	23	785		32	0	5	462
2007	Mopeds		70303		3	16	546		22	0	3	321
2007	Motorcycles	Highway driving	704		0	0	7		0	0	0	4
2007	Motorcycles	Rural driving	70501		0	0	8		0	0	0	5
2007	Motorcycles	Urban driving	70502		0	1	18		1	0	0	11
2007	Evaporation		70503		0	1	22		1	0	0	13
2007	Military		706									
2007	Railways		801	0	1	3	94	0	4	81	1	55
2007	Inland waterways		802		1	4	122		5		1	72
2007	National sea traffic		803		0	2	54		2	0	0	32
2007	Fishing		80402	12	1	7	12	5	454	13	25	62
2007	International sea traffic		80403	6	1	5	6	6	8	12	24	60
2007	Air traffic, Dom. < 3000 ft.		80404	443	28	183	443	30	25869	198	396	904
2007	Air traffic, Int. < 3000 ft.		80501		0	1	20		1	1329	0	12
2007	Air traffic, Dom. > 3000 ft.		80502	0	1	4	120	0	5	10	1	70
2007	Air traffic, Int. > 3000 ft.		80503	0	0	1	37	0	2	0	0	22
2007	Agriculture		80504	0	8	39	1336	0	55	0	8	786
2007	Forestry		806		4	18	627		26	0	4	369
2007	Industry		807		0	0	9		0	0	0	5
2007	Household and gardening		808		3	16	549		23	0	3	323
2007	Passenger cars	Rural driving	809		1	4	123		5	2	1	73

PAH emission factors for 1990 and 2007 in CollectER format.

Year	SNAP ID	Category	Fuel type	Mode	Dioxins/ Furans [g pr GJ]	Flouranthene [g pr GJ]	Benzo(b) flouranthene [g pr GJ]	Benzo(k) flouranthene [g pr GJ]	Benzo(a) pyrene [g pr GJ]	Benzo(g,h,i) perylene [g pr GJ]	indeno(1,2,3-c,d) pyrene [g pr GJ]
1990	070101	Passenger cars	Diesel	Highway driving	2,34E-04	2,34E-02	7,01E-10	1,22E-02	7,48E-04	6,78E-04	8,18E-04
1990	070101	Passenger cars	Gasoline 2-stroke	Highway driving	2,97E-04	2,97E-02					
1990	070101	Passenger cars	Gasoline conventional	Highway driving	2,25E-04	2,25E-02	1,34E-08	8,54E-03	5,55E-04	4,27E-04	4,69E-04
1990	070101	Passenger cars	Gasoline catalyst	Highway driving	0,00E+00	0,00E+00					
1990	070101	Passenger cars	LPG	Highway driving	2,34E-04	2,34E-02	8,52E-10	1,49E-02	9,09E-04	8,24E-04	9,94E-04
1990	070102	Passenger cars	Diesel	Rural driving	2,97E-04	2,97E-02					
1990	070102	Passenger cars	Gasoline 2-stroke	Rural driving	2,24E-04	2,24E-02	1,51E-08	9,58E-03	6,23E-04	4,79E-04	5,27E-04
1990	070102	Passenger cars	Gasoline conventional	Rural driving	0,00E+00	0,00E+00					
1990	070102	Passenger cars	Gasoline catalyst	Rural driving	2,34E-04	2,34E-02	5,33E-10	9,30E-03	5,68E-04	5,15E-04	6,21E-04
1990	070102	Passenger cars	LPG	Rural driving	2,97E-04	2,97E-02					
1990	070103	Passenger cars	Diesel	Urban driving	2,25E-04	2,25E-02	1,02E-08	6,47E-03	4,20E-04	3,23E-04	3,56E-04
1990	070103	Passenger cars	Gasoline 2-stroke	Urban driving	0,00E+00	0,00E+00					
1990	070103	Passenger cars	Gasoline conventional	Urban driving	2,34E-04	2,34E-02	4,87E-10	8,51E-03	5,19E-04	4,70E-04	5,68E-04
1990	070103	Passenger cars	Gasoline catalyst	Urban driving	2,97E-04	2,97E-02	1,27E-08	8,09E-03	5,26E-04	4,04E-04	4,45E-04
1990	070103	Passenger cars	LPG	Urban driving	2,34E-04	2,34E-02	5,33E-10	9,31E-03	5,68E-04	5,15E-04	6,22E-04
1990	070201	Light duty vehicles	Diesel	Highway driving	2,97E-04	2,97E-02	1,20E-08	7,63E-03	4,95E-04	3,81E-04	4,19E-04
1990	070201	Light duty vehicles	Gasoline conventional	Highway driving	2,34E-04	2,34E-02	3,98E-10	6,95E-03	4,25E-04	3,85E-04	4,64E-04
1990	070201	Light duty vehicles	Gasoline catalyst	Highway driving	2,97E-04	2,97E-02	7,18E-09	4,56E-03	2,96E-04	2,28E-04	2,51E-04
1990	070202	Light duty vehicles	Diesel	Rural driving	2,34E-04	2,34E-02	1,06E-09	2,09E-03	5,26E-04	7,80E-04	9,74E-05
1990	070202	Light duty vehicles	Gasoline conventional	Rural driving	2,97E-04	2,97E-02					
1990	070202	Light duty vehicles	Gasoline catalyst	Rural driving	2,34E-04	2,34E-02	1,12E-09	2,21E-03	5,57E-04	8,25E-04	1,03E-04
1990	070203	Light duty vehicles	Diesel	Urban driving	2,97E-04	2,97E-02					
1990	070203	Light duty vehicles	Gasoline conventional	Urban driving	2,34E-04	2,34E-02	9,11E-10	1,79E-03	4,51E-04	6,68E-04	8,34E-05
1990	070203	Light duty vehicles	Gasoline catalyst	Urban driving	2,97E-04	2,97E-02					
1990	070301	Heavy duty vehicles	Diesel	Highway driving	2,97E-04	2,97E-02					
1990	070301	Heavy duty vehicles	Gasoline	Highway driving	2,97E-04	2,97E-02	2,00E-08	1,27E-02	8,24E-04	6,34E-04	6,97E-04
1990	070302	Heavy duty vehicles	Diesel	Rural driving	2,97E-04	2,97E-02	2,39E-08	1,52E-02	9,86E-04	7,59E-04	8,34E-04
1990	070302	Heavy duty vehicles	Gasoline	Rural driving	2,97E-04	2,97E-02	2,41E-08	1,53E-02	9,94E-04	7,65E-04	8,41E-04
1990	070303	Heavy duty vehicles	Diesel	Urban driving	2,34E-04	2,34E-02	7,01E-10	1,22E-02	7,48E-04	6,78E-04	8,18E-04
1990	070303	Heavy duty vehicles	Gasoline	Urban driving	2,97E-04	2,97E-02					
1990	0704	Mopeds	Gasoline		2,25E-04	2,25E-02	1,34E-08	8,54E-03	5,55E-04	4,27E-04	4,69E-04
1990	070501	Motorcycles	Gasoline	Highway driving	0,00E+00	0,00E+00					
1990	070502	Motorcycles	Gasoline	Rural driving	2,34E-04	2,34E-02	8,52E-10	1,49E-02	9,09E-04	8,24E-04	9,94E-04
1990	070503	Motorcycles	Gasoline	Urban driving	2,97E-04	2,97E-02					

Continued

Year	SNAP ID	Category	Fuel type	Mode	Dioxins/ Furans [g pr GJ]	Flouranthene [g prGJ]	Benzo(b) flouranthene [g prGJ]	Benzo(k) flouranthene [g prGJ]	Benzo(a) pyrene [g pr GJ]	Benzo(g,h,i) perylene [g prGJ]	indeno(1,2,3-c,d) pyrene [g pr GJ]
2007	070101	Passenger cars	Diesel	Highway driving	0,00E+00	1,28E-02	7,82E-04	7,09E-04	8,56E-04	1,66E-03	8,07E-04
2007	070101	Passenger cars	Gasoline 2-stroke	Highway driving							
2007	070101	Passenger cars	Gasoline conventional	Highway driving	1,39E-08	8,82E-03	5,73E-04	4,41E-04	4,85E-04	1,15E-03	4,41E-04
2007	070101	Passenger cars	Gasoline catalyst	Highway driving	0,00E+00	8,84E-04	1,96E-04	2,45E-04	1,96E-04	3,93E-04	2,95E-04
2007	070101	Passenger cars	LPG	Highway driving							
2007	070102	Passenger cars	Diesel	Rural driving	8,35E-10	1,46E-02	8,91E-04	8,07E-04	9,75E-04	1,89E-03	9,19E-04
2007	070102	Passenger cars	Gasoline 2-stroke	Rural driving							
2007	070102	Passenger cars	Gasoline conventional	Rural driving	1,53E-08	9,74E-03	6,33E-04	4,87E-04	5,36E-04	1,27E-03	4,87E-04
2007	070102	Passenger cars	Gasoline catalyst	Rural driving	0,00E+00	9,87E-04	2,19E-04	2,74E-04	2,19E-04	4,39E-04	3,29E-04
2007	070102	Passenger cars	LPG	Rural driving							
2007	070103	Passenger cars	Diesel	Urban driving	5,54E-10	9,68E-03	5,91E-04	5,36E-04	6,47E-04	1,26E-03	6,10E-04
2007	070103	Passenger cars	Gasoline 2-stroke	Urban driving							
2007	070103	Passenger cars	Gasoline conventional	Urban driving	9,99E-09	6,34E-03	4,12E-04	3,17E-04	3,49E-04	8,25E-04	3,17E-04
2007	070103	Passenger cars	Gasoline catalyst	Urban driving	0,00E+00	5,38E-04	1,19E-04	1,49E-04	1,19E-04	2,39E-04	1,79E-04
2007	070103	Passenger cars	LPG	Urban driving							
2007	070201	Light duty vehicles	Diesel	Highway driving	5,29E-10	9,23E-03	5,64E-04	5,11E-04	6,17E-04	1,20E-03	5,81E-04
2007	070201	Light duty vehicles	Gasoline conventional	Highway driving	1,27E-08	8,09E-03	5,26E-04	4,04E-04	4,45E-04	1,05E-03	4,04E-04
2007	070201	Light duty vehicles	Gasoline catalyst	Highway driving	0,00E+00	6,18E-04	1,37E-04	1,72E-04	1,37E-04	2,75E-04	2,06E-04
2007	070202	Light duty vehicles	Diesel	Rural driving	5,78E-10	1,01E-02	6,17E-04	5,59E-04	6,75E-04	1,31E-03	6,36E-04
2007	070202	Light duty vehicles	Gasoline conventional	Rural driving	1,20E-08	7,63E-03	4,95E-04	3,81E-04	4,19E-04	9,91E-04	3,81E-04
2007	070202	Light duty vehicles	Gasoline catalyst	Rural driving	0,00E+00	5,84E-04	1,30E-04	1,62E-04	1,30E-04	2,59E-04	1,95E-04
2007	070203	Light duty vehicles	Diesel	Urban driving	4,16E-10	7,26E-03	4,43E-04	4,02E-04	4,85E-04	9,42E-04	4,57E-04
2007	070203	Light duty vehicles	Gasoline conventional	Urban driving	6,92E-09	4,39E-03	2,85E-04	2,20E-04	2,42E-04	5,71E-04	2,20E-04
2007	070203	Light duty vehicles	Gasoline catalyst	Urban driving	0,00E+00	3,37E-04	7,49E-05	9,36E-05	7,49E-05	1,50E-04	1,12E-04
2007	070301	Heavy duty vehicles	Diesel	Highway driving	1,03E-09	2,03E-03	5,12E-04	7,59E-04	9,48E-05	7,59E-05	1,33E-04
2007	070301	Heavy duty vehicles	Gasoline	Highway driving							
2007	070302	Heavy duty vehicles	Diesel	Rural driving	1,05E-09	2,07E-03	5,21E-04	7,72E-04	9,65E-05	7,70E-05	1,35E-04
2007	070302	Heavy duty vehicles	Gasoline	Rural driving							
2007	070303	Heavy duty vehicles	Diesel	Urban driving	8,54E-10	1,68E-03	4,23E-04	6,26E-04	7,82E-05	6,25E-05	1,10E-04
2007	070303	Heavy duty vehicles	Gasoline	Urban driving							
2007	0704	Mopeds	Gasoline								
2007	070501	Motorcycles	Gasoline	Highway driving	2,02E-08	1,28E-02	8,32E-04	6,40E-04	7,04E-04	1,66E-03	6,40E-04
2007	070502	Motorcycles	Gasoline	Rural driving	2,41E-08	1,53E-02	9,96E-04	7,66E-04	8,43E-04	1,99E-03	7,66E-04
2007	070503	Motorcycles	Gasoline	Urban driving	2,44E-08	1,55E-02	1,01E-03	7,75E-04	8,52E-04	2,01E-03	7,75E-04

Continued

Year	SNAP ID	Category	Fuel type	Mode	Dioxins/ Furans [ng/GJ]	Flouranthene [microg/GJ]	Benzo(b) flouranthene [microg/GJ]	Benzo(k) flouranthene [microg/GJ]	Benzo(a) pyrene [microg/GJ]	Benzo(g,h,i) perylene [microg/GJ]	indeno(1,2,3-c,d) pyrene [microg/GJ]
1990	0801	Military	Diesel		0.23	23.42	0.71	4391.42	570.64	568.31	289.75
1990	0801	Military	Jet fuel	< 3000 ft	0.23	22.83	0.00	0.00	0.00	0.00	0.00
1990	0801	Military	Jet fuel	> 3000 ft	0.23	22.83	0.00	0.00	0.00	0.00	0.00
1990	0801	Military	Gasoline		0.23	22.83	6.27	5257.47	277.33	116.39	141.99
1990	0801	Military	Aviation gasoline		0.23	22.83	5.11	4328.53	209.06	71.27	114.03
1990	0802	Railways	Diesel		0.23	23.42	0.70	1365.92	348.03	388.90	57.47
1990	0802	Railways	Kerosene								
1990	0802	Railways	Gasoline		0.23	22.83	6.27	5257.47	277.33	116.39	141.99
1990	0803	Inland waterways	Diesel		0.23	23.42	0.71	4391.42	570.64	568.31	289.75
1990	0803	Inland waterways	Gasoline		0.23	22.83	5.11	4328.53	209.06	71.27	114.03
1990	080402	National sea traffic	Residual oil		9.78	22.00	13.42	5190.00	270.00	50.00	20.00
1990	080402	National sea traffic	Diesel		4.68	11.71	12.01	7420.00	640.00	300.00	150.00
1990	080402	National sea traffic	Kerosene								
1990	080402	National sea traffic	LPG								
1990	080403	Fishing	Residual oil		9.78	22.00	13.42	5190.00	270.00	50.00	20.00
1990	080403	Fishing	Diesel		4.68	11.71	12.01	7420.00	640.00	300.00	150.00
1990	080403	Fishing	Kerosene								
1990	080403	Fishing	Gasoline		0.23	22.83	11.42	3420.09	342.47	146.12	244.29
1990	080403	Fishing	LPG								
1990	080404	International sea traffic	Residual oil		9.78	22.00	13.42	4120.00	200.00	90.00	70.00
1990	080404	International sea traffic	Diesel		4.68	11.71	12.01	7420.00	640.00	300.00	150.00
1990	080501	Air traffic. other airports	Jet fuel	Dom. < 3000 ft	0.23	22.83	0.00	0.00	0.00	0.00	0.00
1990	080501	Air traffic. other airports	Aviation gasoline		0.23	22.83	5.11	4328.53	209.06	71.27	114.03
1990	080502	Air traffic. other airports	Jet fuel	Int. < 3000 ft	0.23	22.83	0.00	0.00	0.00	0.00	0.00
1990	080502	Air traffic. other airports	Aviation gasoline		0.23	22.83	5.11	4328.53	209.06	71.27	114.03
1990	080503	Air traffic. other airports	Jet fuel	Dom. > 3000 ft	0.23	22.83	0.00	0.00	0.00	0.00	0.00
1990	080504	Air traffic. other airports	Jet fuel	Int. > 3000 ft	0.23	22.83	0.00	0.00	0.00	0.00	0.00
1990	0806	Agriculture	Diesel		0.23	23.42	0.71	4391.42	570.64	568.31	289.75
1990	0806	Agriculture	Gasoline		0.23	22.83	5.11	4328.53	209.06	71.27	114.03
1990	0807	Forestry	Diesel		0.23	23.42	0.71	4391.42	570.64	568.31	289.75
1990	0807	Forestry	Gasoline		0.23	22.83	5.11	4328.53	209.06	71.27	114.03
1990	0808	Industry	Diesel		0.23	23.42	0.71	4391.42	570.64	568.31	289.75
1990	0808	Industry	Gasoline		0.23	22.83	5.11	4328.53	209.06	71.27	114.03
1990	0808	Industry	LPG								
1990	0809	Household and gardening	Gasoline		0.23	22.83	5.11	4328.53	209.06	71.27	114.03
1990	080501	Air traffic. CPH. airport	Jet fuel	Dom. < 3000 ft	0.23	22.83	0.00	0.00	0.00	0.00	0.00
1990	080501	Air traffic. Copenhagen airport	Aviation gasoline		0.23	22.83	5.11	4328.53	209.06	71.27	114.03
1990	080502	Air traffic. Copenhagen airport	Jet fuel	Int. < 3000 ft	0.23	22.83	0.00	0.00	0.00	0.00	0.00
1990	080502	Air traffic. Copenhagen airport	Aviation gasoline		0.23	22.83	5.11	4328.53	209.06	71.27	114.03
1990	080503	Air traffic. Copenhagen airport	Jet fuel	Dom. > 3000 ft	0.23	22.83	0.00	0.00	0.00	0.00	0.00
1990	080504	Air traffic. Copenhagen airport	Jet fuel	Int. > 3000 ft	0.23	22.83	0.00	0.00	0.00	0.00	0.00

Continued

Year	SNAP ID	Category	Fuel type	Mode	Dioxins/ Furans [g/GJ]	Flouranthene [g/GJ]	Benzo(b) flouranthene [g/GJ]	Benzo(k) flouranthene [g/GJ]	Benzo(a) pyrene [g/GJ]	Benzo(g,h,i) perylene [g/GJ]	indeno(1,2,3-c,d) pyrene [g/GJ]
2007	801	Military	Diesel		0.71	4349.86	510.47	495.91	255.72	464.46	264.30
2007	801	Military	Jet fuel	< 3000 ft	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2007	801	Military	Jet fuel	> 3000 ft	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2007	801	Military	Gasoline		6.89	2151.74	179.80	115.04	118.07	357.51	178.80
2007	801	Military	Aviation gasoline		5.11	4328.53	209.06	71.27	114.03	688.95	244.70
2007	802	Railways	Diesel		0.72	1411.28	359.58	401.81	59.38	50.80	92.37
2007	803	Inland waterways	Diesel		0.71	4349.86	510.47	495.91	255.72	464.46	264.30
2007	803	Inland waterways	Gasoline		5.11	4328.53	209.06	71.27	114.03	688.95	244.70
2007	80402	National sea traffic	Residual oil		13.42	5190.00	270.00	50.00	20.00	70.00	30.00
2007	80402	National sea traffic	Diesel		12.01	7420.00	640.00	300.00	150.00	1430.00	1180.00
2007	80402	National sea traffic	Kerosene								
2007	80402	National sea traffic	LPG								
2007	80403	Fishing	Residual oil		13.42	5190.00	270.00	50.00	20.00	70.00	30.00
2007	80403	Fishing	Diesel		12.01	7420.00	640.00	300.00	150.00	1430.00	1180.00
2007	80403	Fishing	Kerosene								
2007	80403	Fishing	Gasoline		11.42	3420.00	342.00	146.00	244.00	489.00	244.00
2007	80403	Fishing	LPG								
2007	80404	International sea traffic	Residual oil		13.42	4120.00	200.00	90.00	70.00	260.00	200.00
2007	80404	International sea traffic	Diesel		12.01	7420.00	640.00	300.00	150.00	1430.00	1180.00
2007	80501	Air traffic. other airports	Jet fuel	Dom. < 3000 ft	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2007	80501	Air traffic. other airports	Aviation gasoline		5.11	4328.53	209.06	71.27	114.03	688.95	244.70
2007	80502	Air traffic. other airports	Jet fuel	Int. < 3000 ft	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2007	80502	Air traffic. other airports	Aviation gasoline		5.11	4328.53	209.06	71.27	114.03	688.95	244.70
2007	80503	Air traffic. other airports	Jet fuel	Dom. > 3000 ft	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2007	80504	Air traffic. other airports	Jet fuel	Int. > 3000 ft	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2007	806	Agriculture	Diesel		0.71	4349.86	510.47	495.91	255.72	464.46	264.30
2007	806	Agriculture	Gasoline		5.11	4328.53	209.06	71.27	114.03	688.95	244.70
2007	807	Forestry	Diesel		0.71	4349.86	510.47	495.91	255.72	464.46	264.30
2007	807	Forestry	Gasoline		5.11	4328.53	209.06	71.27	114.03	688.95	244.70
2007	808	Industry	Diesel		0.71	4349.86	510.47	495.91	255.72	464.46	264.30
2007	808	Industry	Gasoline		5.11	4328.53	209.06	71.27	114.03	688.95	244.70
2007	808	Industry	LPG								

Continued

Year	SNAP ID	Category	Fuel type	Mode	Dioxins/ Furans [g/GJ]	Flouranthene [g/GJ]	Benzo(b) flouranthene [g/GJ]	Benzo(k) flouranthene [g/GJ]	Benzo(a) pyrene [g/GJ]	Benzo(g,h,i) perylene [g/GJ]	indeno(1,2,3-c,d) pyrene [g/GJ]
2007	809	Household and gardening	Gasoline		5.11	4328.53	209.06	71.27	114.03	688.95	244.70
2007	80501	Air traffic. Copenhagen airport	Jet fuel	Dom. < 3000 ft	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2007	80501	Air traffic. Copenhagen airport	Aviation gasoline		5.11	4328.53	209.06	71.27	114.03	688.95	244.70
2007	80502	Air traffic. Copenhagen airport	Jet fuel	Int. < 3000 ft	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2007	80502	Air traffic. Copenhagen airport	Aviation gasoline		5.11	4328.53	209.06	71.27	114.03	688.95	244.70
2007	80503	Air traffic. Copenhagen airport	Jet fuel	Dom. > 3000 ft	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2007	80504	Air traffic. Copenhagen airport	Jet fuel	Int. > 3000 ft	0.00	0.00	0.00	0.00	0.00	0.00	0.00

PAH total emissions for 1990 and 2007 in CollectER format.

Year	Category	Mode	SNAP ID	Dioxins/ Furans [kg]	Flouranthene [kg]	Benzo(b) flouranthene [kg]	Benzo(k) flouranthene [kg]	Benzo(a) pyrene [kg]	Benzo(g,h,i) perylene [kg]	indeno(1,2,3-c,d) pyrene [kg]
1990	Passenger cars	Highway driving	70101	0.10	72.32	4.67	3.66	4.07	9.40	3.72
1990	Passenger cars	Rural driving	70102	0.35	250.39	16.16	12.67	14.10	32.54	12.88
1990	Passenger cars	Urban driving	70103	0.33	233.33	15.06	11.80	13.14	30.32	12.01
1990	Light duty vehicles	Highway driving	70201	0.00	18.00	1.11	0.99	1.18	2.34	1.11
1990	Light duty vehicles	Rural driving	70202	0.01	70.49	4.33	3.86	4.63	9.15	4.35
1990	Light duty vehicles	Urban driving	70203	0.01	61.49	3.78	3.37	4.03	7.98	3.79
1990	Heavy duty vehicles	Highway driving	70301	0.01	18.07	4.56	6.76	0.84	0.67	1.18
1990	Heavy duty vehicles	Rural driving	70302	0.02	34.97	8.82	13.07	1.63	1.31	2.28
1990	Heavy duty vehicles	Urban driving	70303	0.01	23.86	6.02	8.92	1.11	0.89	1.56
1990	Mopeds		704							
1990	Motorcycles	Highway driving	70501	0.00	0.97	0.06	0.05	0.05	0.13	0.05
1990	Motorcycles	Rural driving	70502	0.00	2.17	0.14	0.11	0.12	0.28	0.11
1990	Motorcycles	Urban driving	70503	0.00	2.57	0.17	0.13	0.14	0.33	0.13
1990	Evaporation		706							
1990	Military		801	0.00	0.67	0.08	0.08	0.04	0.08	0.04
1990	Railways		802	0.00	5.48	1.40	1.56	0.23	0.20	0.36
1990	Inland waterways		803	0.00	2.84	0.26	0.22	0.13	0.40	0.18
1990	National sea traffic		80402	0.11	56.61	4.20	1.67	0.82	7.34	5.95
1990	Fishing		80403	0.10	58.77	5.07	2.38	1.19	11.33	9.35
1990	International sea traffic		80404	0.52	203.91	13.15	6.06	3.74	24.06	19.44
1990	Air traffic. Dom. < 3000 ft.		80501	0.00	0.49	0.02	0.01	0.01	0.08	0.03
1990	Air traffic. Int. < 3000 ft.		80502	0.00	0.16	0.01	0.00	0.00	0.02	0.01
1990	Air traffic. Dom. > 3000 ft.		80503	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1990	Air traffic. Int. > 3000 ft.		80504	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1990	Agriculture		806	0.02	75.51	9.56	9.43	4.86	9.56	4.96
1990	Forestry		807	0.00	2.12	0.15	0.11	0.08	0.32	0.13
1990	Industry		808	0.01	45.37	5.83	5.79	2.96	5.71	2.99
1990	Household and gardening		809	0.01	6.69	0.32	0.11	0.18	1.06	0.38
2007	Passenger cars	Highway driving	70101	0.01	72.61	6.04	6.15	6.27	12.51	7.11
2007	Passenger cars	Rural driving	70102	0.04	182.80	15.30	15.61	15.88	31.66	18.05
2007	Passenger cars	Urban driving	70103	0.03	124.33	10.13	10.21	10.50	20.97	11.78
2007	Light duty vehicles	Highway driving	70201	0.00	45.59	2.82	2.57	3.08	5.98	2.93
2007	Light duty vehicles	Rural driving	70202	0.01	151.98	9.40	8.57	10.25	19.95	9.75
2007	Light duty vehicles	Urban driving	70203	0.01	106.14	6.56	5.98	7.16	13.93	6.81
2007	Heavy duty vehicles	Highway driving	70301	0.01	26.63	6.72	9.95	1.24	1.00	1.74

Continued

Year	Category	Mode	SNAP ID	Dioxins/ Furans [kg]	Flouranthene [kg]	Benzo(b) flouranthene [kg]	Benzo(k) flouranthene [kg]	Benzo(a) pyrene [kg]	Benzo(g,h,i) perylene [kg]	indeno(1,2,3-c,d) pyrene [kg]
2007	Heavy duty vehicles	Rural driving	70302	0.02	40.66	10.26	15.20	1.90	1.52	2.66
2007	Heavy duty vehicles	Urban driving	70303	0.01	22.91	5.78	8.56	1.07	0.85	1.50
2007	Mopeds		704							
2007	Motorcycles	Highway driving	70501	0.00	2.73	0.18	0.14	0.15	0.36	0.14
2007	Motorcycles	Rural driving	70502	0.01	7.27	0.47	0.36	0.40	0.94	0.36
2007	Motorcycles	Urban driving	70503	0.01	8.76	0.57	0.44	0.48	1.14	0.44
2007	Evaporation		706							
2007	Military		801	0.00	2.99	0.35	0.34	0.18	0.32	0.18
2007	Railways		802	0.00	4.34	1.11	1.24	0.18	0.16	0.28
2007	Inland waterways		803	0.00	5.96	0.59	0.52	0.30	0.72	0.36
2007	National sea traffic		80402	0.06	33.73	2.80	1.27	0.63	5.93	4.88
2007	Fishing		80403	0.06	38.17	3.29	1.54	0.77	7.36	6.07
2007	International sea traffic		80404	0.60	226.43	14.05	6.46	4.11	24.82	19.97
2007	Air traffic. Dom. < 3000 ft.		80501	0.00	0.43	0.02	0.01	0.01	0.07	0.02
2007	Air traffic. Int. < 3000 ft.		80502	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2007	Air traffic. Dom. > 3000 ft.		80503	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2007	Air traffic. Int. > 3000 ft.		80504	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2007	Agriculture		806	0.01	68.55	7.93	7.65	3.98	7.41	4.16
2007	Forestry		807	0.00	1.01	0.10	0.08	0.05	0.12	0.06
2007	Industry		808	0.01	59.96	6.99	6.77	3.50	6.44	3.64
2007	Household and gardening		809	0.02	13.75	0.66	0.23	0.36	2.19	0.78

Annex 2B-15: Fuel use and emissions in CRF format

Fuel

IPCC ID	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Industry-Other (1A2f)	11.7	11.7	11.6	11.6	11.6	11.5	11.5	11.5	11.5	11.5	11.6	11.7	11.7	11.9	11.9	12.0	12.1	12.3	12.4	12.5	13.0	13.9	14.8
Civil Aviation (1A3a)	3.6	3.3	3.7	3.8	3.6	3.4	2.8	2.7	2.6	2.7	2.8	2.8	2.9	2.7	2.4	2.1	2.2	1.9	1.9	1.8	1.9	2.0	1.5
Road (1A3b)	111.1	117.4	117.6	118.3	119.6	126.2	131.9	134.3	136.0	142.8	144.1	146.6	149.5	152.0	154.0	152.5	152.8	154.5	160.6	164.8	166.1	171.3	179.6
Railways (1A3c)	4.9	4.9	4.4	4.6	4.2	4.0	4.1	4.3	4.5	4.1	4.1	4.1	4.0	3.3	3.1	3.1	2.9	2.8	3.0	2.9	3.1	3.1	3.1
Navigation (1A3d)	9.3	9.3	9.3	9.4	9.4	9.4	9.5	9.7	9.6	9.7	10.2	11.2	11.0	9.0	7.4	6.4	6.2	6.1	6.2	6.4	6.3	6.2	6.1
Residential (1A4b)	1.6	1.6	1.6	1.5	1.5	1.5	1.6	1.6	1.6	1.6	1.6	1.6	1.7	1.7	1.7	1.8	2.0	2.2	2.5	2.8	3.0	3.2	3.2
Ag./for./fish. (1A4c)	24.4	26.0	23.8	25.5	25.3	25.7	25.7	24.3	23.8	22.9	23.4	22.2	21.0	20.4	21.1	21.8	21.5	22.1	21.7	20.3	21.3	21.1	21.2
Military (1A5)	5.5	4.3	5.0	2.7	2.3	1.6	3.9	1.9	3.3	3.5	3.4	2.4	2.3	2.8	2.5	1.5	1.3	1.2	1.3	3.3	3.7	1.7	2.4
Navigation int. (1A3d)	17.3	20.1	29.4	37.3	38.2	40.2	36.1	37.9	56.1	63.1	66.3	63.0	57.8	58.2	54.6	56.0	47.3	39.1	41.2	33.5	34.5	44.7	46.2
Civil Aviation int. (1A3a)	19.3	20.9	22.4	24.0	25.1	24.1	22.7	23.5	23.0	25.2	25.9	27.4	27.9	30.0	31.8	32.6	33.1	28.6	29.8	34.0	35.8	35.9	37.5

Emissions

pol_name	IPCC ID	Unit	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
SO_2	Industry-Other (1A2f)	[tons]	2402	1441	1440	1438	956	952	955	957	957	959	968	244	246	249	251	253
SO_2	Civil Aviation (1A3a)	[tons]	82	77	85	86	83	77	64	62	61	63	63	65	68	62	56	49
SO_2	Road (1A3b)	[tons]	11621	7862	7847	7857	5488	5767	5903	3820	1569	1669	1682	1721	1744	1768	1088	352
SO_2	Railways (1A3c)	[tons]	1152	695	618	641	393	376	382	263	105	95	96	95	93	78	40	7
SO_2	Navigation (1A3d)	[tons]	6363	6363	6367	6127	6130	5456	4232	2822	3522	4005	4502	3458	2647	1555	1292	1129
SO_2	Residential (1A4b)	[tons]	4	4	4	4	4	4	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	2120	978	853	856	931	1021
SO_2	Military (1A5)	[tons]	408	260	193	72	70	48	206	82	76	80	80	56	54	65	47	27
SO_2	Navigation int. (1A3d)	[tons]	18333	22047	36943	48034	48337	42404	34348	31152	59669	60081	66260	62320	57078	48000	50568	56634
SO_2	Civil Aviation int. (1A3a)	[tons]	444	480	515	551	578	554	521	541	530	580	596	629	642	689	731	750
NO_x	Industry-Other (1A2f)	[tons]	10903	10964	11011	11044	11065	11081	11282	11440	11558	11677	11882	12080	12248	12425	12262	12096
NO_x	Civil Aviation (1A3a)	[tons]	1203	1132	1237	1252	1208	1123	920	902	900	940	958	971	998	911	815	723
NO_x	Road (1A3b)	[tons]	92560	98283	98293	99080	100343	105934	107409	106683	104201	103338	99747	96719	92934	88949	85839	80883
NO_x	Railways (1A3c)	[tons]	6025	6063	5391	5589	5145	4913	4995	5284	5485	4971	5015	4977	4846	4089	3730	3727
NO_x	Navigation (1A3d)	[tons]	11778	11798	11852	11902	11962	12020	11433	11104	11007	11236	11898	13043	11805	9411	6608	5830
NO_x	Residential (1A4b)	[tons]	96	99	101	103	103	104	111	118	125	130	136	140	144	149	151	153
NO_x	Ag./for./fish. (1A4c)	[tons]	18159	19915	18153	20143	20342	21066	21722	20824	20763	20524	21442	21138	20176	20119	21495	22807
NO_x	Military (1A5)	[tons]	2340	2020	1625	980	873	494	1861	1011	1291	1272	1760	963	1217	1413	1095	550
NO_x	Navigation int. (1A3d)	[tons]	23987	28474	43643	56580	58561	62285	55731	57636	89632	101094	106928	102221	94977	94125	91400	96911
NO_x	Civil Aviation int. (1A3a)	[tons]	5663	6129	6569	7035	7313	7016	6586	6846	6702	7317	7517	7904	8058	8662	9204	9446
NMVOC	Industry-Other (1A2f)	[tons]	2422	2395	2368	2339	2304	2266	2231	2191	2147	2107	2088	2095	2083	2074	1997	1926
NMVOC	Civil Aviation (1A3a)	[tons]	216	213	190	198	193	186	168	164	161	191	206	194	186	169	162	156
NMVOC	Road (1A3b)	[tons]	80995	80718	80084	79594	77996	81811	82697	81762	79504	75253	70469	66193	60022	54887	48958	41578
NMVOC	Railways (1A3c)	[tons]	393	396	352	365	336	321	326	345	358	324	327	325	316	267	276	253
NMVOC	Navigation (1A3d)	[tons]	1505	1505	1536	1566	1598	1630	1658	1699	1727	1761	1819	1920	1913	1817	1704	1652
NMVOC	Residential (1A4b)	[tons]	4191	4166	4139	4112	4108	4104	4111	4094	4054	4070	4147	4231	4314	4395	4499	4602
NMVOC	Ag./for./fish. (1A4c)	[tons]	6357	6417	6216	6284	6207	6149	5777	5298	4944	4638	4516	4208	3966	3691	3563	3414
NMVOC	Military (1A5)	[tons]	601	469	175	490	315	54	172	94	128	124	159	95	109	122	111	58
NMVOC	Navigation int. (1A3d)	[tons]	880	1029	1527	1948	2003	2116	1900	1990	2993	3378	3560	3398	3138	3158	3003	3126
NMVOC	Civil Aviation int. (1A3a)	[tons]	261	288	313	342	361	331	309	316	309	308	343	360	365	386	395	407
CH_4	Industry-Other (1A2f)	[tons]	63	63	62	61	61	60	58	57	56	54	53	53	53	53	51	50
CH_4	Civil Aviation (1A3a)	[tons]	8	8	8	8	8	7	6	6	6	7	7	7	7	7	6	5
CH_4	Road (1A3b)	[tons]	2378	2437	2450	2481	2472	2619	2658	2627	2592	2503	2371	2264	2176	2090	1980	1861
CH_4	Railways (1A3c)	[tons]	15	15	14	14	13	12	13	13	14	12	13	12	12	10	11	10
CH_4	Navigation (1A3d)	[tons]	28	28	29	29	30	31	31	32	33	33	35	37	36	33	31	30
CH_4	Residential (1A4b)	[tons]	158	156	153	150	150	150	147	144	140	138	136	135	134	134	135	137
CH_4	Ag./for./fish. (1A4c)	[tons]	155	154	147	146	142	139	132	123	116	110	106	100	94	89	88	88
CH_4	Military (1A5)	[tons]	31	26	17	18	14	5	19	10	13	13	18	10	12	14	11	6
CH_4	Navigation int. (1A3d)	[tons]	27	32	47	60	62	65	59	62	93	104	110	105	97	98	93	97
CH_4	Civil Aviation int. (1A3a)	[tons]	25	27	30	32	33	31	29	30	29	31	35	37	38	40	41	42
CO	Industry-Other (1A2f)	[tons]	9863	9784	9702	9611	9502	9379	9294	9188	9070	8956	8910	8963	8939	8907	8647	8395

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pol_name	IPCC ID	Unit	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
CO	Civil Aviation (1A3a)	[tons]	1256	1241	1118	1167	1140	1098	989	955	930	1098	1180	1117	1085	973	932	895
CO	Road (1A3b)	[tons]	561267	540934	521947	476252	448414	459541	474997	465105	466790	435033	412002	399588	346206	325296	290760	267306
CO	Railways (1A3c)	[tons]	1098	1105	982	1018	937	895	910	963	999	906	914	907	883	745	717	694
CO	Navigation (1A3d)	[tons]	5291	5291	5453	5613	5777	5941	6095	6287	6428	6610	6861	7065	6967	6799	6541	6572
CO	Residential (1A4b)	[tons]	50434	49697	48935	48149	47970	47787	46848	45867	45027	44365	43997	44112	44229	44347	45103	45873
CO	Ag./for./fish. (1A4c)	[tons]	61165	59707	57256	55768	53717	51734	48771	45427	42608	39735	37673	34858	32455	29823	27820	25842
CO	Military (1A5)	[tons]	4168	3098	1315	3127	1948	425	1028	525	859	880	905	627	617	704	705	407
CO	Navigation int. (1A3d)	[tons]	2903	3396	5038	6427	6608	6981	6268	6566	9873	11143	11745	11211	10351	10417	9905	10313
CO	Civil Aviation int. (1A3a)	[tons]	1103	1207	1289	1416	1564	1442	1357	1399	1388	1342	1421	1502	1564	1662	1743	1790
CO_2	Industry-Other (1A2f)	[ktons]	852	852	851	849	845	842	843	843	842	841	848	853	860	867	873	879
CO_2	Civil Aviation (1A3a)	[ktons]	256	241	268	271	262	243	199	193	190	196	199	205	212	194	174	154
CO_2	Road (1A3b)	[ktons]	8160	8625	8636	8694	8789	9275	9690	9863	9987	10487	10585	10764	10978	11166	11312	11202
CO_2	Railways (1A3c)	[ktons]	364	366	326	338	311	297	302	319	331	300	303	301	293	247	232	228
CO_2	Navigation (1A3d)	[ktons]	702	701	705	707	710	714	713	727	717	729	766	840	820	668	553	476
CO_2	Residential (1A4b)	[ktons]	114	114	113	113	113	113	113	114	115	116	118	120	122	124	127	129
CO_2	Ag./for./fish. (1A4c)	[ktons]	1806	1922	1758	1887	1874	1899	1903	1794	1760	1695	1728	1642	1554	1510	1564	1615
CO_2	Military (1A5)	[ktons]	402	316	361	196	165	119	287	141	237	252	252	176	171	204	182	111
CO_2	Navigation int. (1A3d)	[ktons]	1320	1537	2261	2869	2936	3087	2762	2887	4300	4829	5061	4803	4403	4414	4155	4279
CO_2	Civil Aviation int. (1A3a)	[ktons]	1391	1503	1613	1725	1809	1736	1632	1693	1659	1818	1867	1971	2010	2159	2290	2350
N_2O	Industry-Other (1A2f)	[tons]	34	34	34	34	34	34	34	35	35	35	35	36	36	36	37	37
N_2O	Civil Aviation (1A3a)	[tons]	10	10	11	11	11	10	9	9	9	9	10	11	11	9	9	8
N_2O	Road (1A3b)	[tons]	275	289	289	293	295	312	335	352	365	398	414	430	443	447	450	444
N_2O	Railways (1A3c)	[tons]	10	10	9	9	9	8	8	9	9	8	8	8	8	7	6	6
N_2O	Navigation (1A3d)	[tons]	43	43	43	43	43	43	43	44	43	44	46	51	49	40	32	27
N_2O	Residential (1A4b)	[tons]	2	2	2	2	2	2	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	81	77	71	70	74	78
N_2O	Military (1A5)	[tons]	12	10	11	6	5	4	8	4	7	8	7	5	5	6	6	3
N_2O	Navigation int. (1A3d)	[tons]	83	97	142	180	185	194	174	182	270	304	318	302	277	278	262	269
N_2O	Civil Aviation int. (1A3a)	[tons]	47	50	54	58	61	59	56	58	57	63	64	69	70	75	80	82
NH_3	Industry-Other (1A2f)	[tons]	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
NH_3	Civil Aviation (1A3a)	[tons]	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NH_3	Road (1A3b)	[tons]	62	64	64	66	66	70	248	441	623	946	1198	1428	1862	2226	2492	2657
NH_3	Railways (1A3c)	[tons]	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
NH_3	Navigation (1A3d)	[tons]	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NH_3	Residential (1A4b)	[tons]	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NH_3	Ag./for./fish. (1A4c)	[tons]	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
NH_3	Military (1A5)	[tons]	1	1	0	0	0	0	1	0	0	0	1	0	0	0	1	0
NH_3	Navigation int. (1A3d)	[tons]		0						0	0							
NH_3	Civil Aviation int. (1A3a)	[tons]	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TSP	Industry-Other (1A2f)	[tons]	1823	1778	1733	1686	1634	1577	1533	1484	1433	1383	1349	1317	1284	1249	1193	1135
TSP	Civil Aviation (1A3a)	[tons]	5	5	5	5	5	5	4	4	4	4	4	4	4	4	4	3
TSP	Road (1A3b)	[tons]	4431	4764	4781	4722	4796	5053	5179	5026	5041	5161	4914	4803	4432	4179	3974	3718

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pol_name	IPCC ID	Unit	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
TSP	Railways (1A3c)	[tons]	247	249	222	229	211	202	205	217	225	204	206	204	199	168	146	141
TSP	Navigation (1A3d)	[tons]	948	948	953	948	953	781	612	451	561	646	773	613	546	378	337	307
TSP	Residential (1A4b)	[tons]	37	36	36	36	36	35	35	34	33	34	35	36	38	39	40	41
TSP	Ag./for./fish. (1A4c)	[tons]	2783	2820	2673	2723	2665	2628	2534	2362	2300	2119	2087	1892	1783	1633	1576	1507
TSP	Military (1A5)	[tons]	103	103	51	18	26	12	116	69	66	57	120	48	77	84	52	19
TSP	Navigation int. (1A3d)	[tons]	3047	3663	6129	8024	8081	5677	4512	4139	8822	8348	10262	10169	9437	7917	8390	8994
TSP	Civil Aviation int. (1A3a)	[tons]	23	24	26	28	30	28	27	28	27	29	30	32	32	35	37	38
PM_{10}	Industry-Other (1A2f)	[tons]	1823	1778	1733	1686	1634	1577	1533	1484	1433	1383	1349	1317	1284	1249	1193	1135
PM_{10}	Civil Aviation (1A3a)	[tons]	5	5	5	5	5	5	4	4	4	4	4	4	4	4	4	3
PM_{10}	Road (1A3b)	[tons]	4431	4764	4781	4722	4796	5053	5179	5026	5041	5161	4914	4803	4432	4179	3974	3718
PM_{10}	Railways (1A3c)	[tons]	247	249	222	229	211	202	205	217	225	204	206	204	199	168	146	141
PM_{10}	Navigation (1A3d)	[tons]	940	939	944	939	944	774	607	447	556	641	767	608	542	376	335	306
PM_{10}	Residential (1A4b)	[tons]	37	36	36	36	36	35	35	34	33	34	35	36	38	39	40	41
PM_{10}	Ag./for./fish. (1A4c)	[tons]	2781	2818	2671	2721	2663	2626	2532	2360	2298	2117	2086	1891	1782	1632	1575	1505
PM_{10}	Military (1A5)	[tons]	103	103	51	18	26	12	116	69	66	57	120	48	77	84	52	19
PM_{10}	Navigation int. (1A3d)	[tons]	3016	3626	6068	7944	8000	5620	4467	4098	8734	8264	10160	10068	9342	7838	8306	8904
PM_{10}	Civil Aviation int. (1A3a)	[tons]	23	24	26	28	30	28	27	28	27	29	30	32	32	35	37	38
$PM_{2.5}$	Industry-Other (1A2f)	[tons]	1823	1778	1733	1686	1634	1577	1533	1484	1433	1383	1349	1317	1284	1249	1193	1135
$PM_{2.5}$	Civil Aviation (1A3a)	[tons]	5	5	5	5	5	5	4	4	4	4	4	4	4	4	4	3
$PM_{2.5}$	Road (1A3b)	[tons]	4431	4764	4781	4722	4796	5053	5179	5026	5041	5161	4914	4803	4432	4179	3974	3718
$PM_{2.5}$	Railways (1A3c)	[tons]	247	249	222	229	211	202	205	217	225	204	206	204	199	168	146	141
$PM_{2.5}$	Navigation (1A3d)	[tons]	935	935	939	935	940	771	604	446	554	638	764	606	540	375	334	305
$PM_{2.5}$	Residential (1A4b)	[tons]	37	36	36	36	36	35	35	34	33	34	35	36	38	39	40	41
$PM_{2.5}$	Ag./for./fish. (1A4c)	[tons]	2780	2817	2670	2720	2662	2625	2531	2359	2297	2116	2085	1890	1781	1631	1574	1504
$PM_{2.5}$	Military (1A5)	[tons]	103	103	51	18	26	12	116	69	66	57	120	48	77	84	52	19
$PM_{2.5}$	Navigation int. (1A3d)	[tons]	3001	3608	6037	7904	7959	5592	4445	4077	8690	8223	10108	10017	9295	7799	8264	8859
$PM_{2.5}$	Civil Aviation int. (1A3a)	[tons]	23	24	26	28	30	28	27	28	27	29	30	32	32	35	37	38
Arsenic	Civil Aviation (1A3a)	[kg]															0	0
Arsenic	Navigation (1A3d)	[kg]						53	46	38	38	39	40	35	26	19	15	14
Arsenic	Ag./for./fish. (1A4c)	[kg]						9	10	9	8	8	8	8	6	7	7	9
Arsenic	Military (1A5)	[kg]										0					0	0
Arsenic	Navigation int. (1A3d)	[kg]						363	302	276	475	505	514	332	426	366	379	432
Arsenic	Civil Aviation int. (1A3a)	[kg]															0	0
Cadmium	Industry-Other (1A2f)	[kg]						2	2	2	2	2	2	2	2	3	2	3
Cadmium	Civil Aviation (1A3a)	[kg]						1	1	1	1	1	1	1	1	1	1	0
Cadmium	Road (1A3b)	[kg]						29	30	31	31	33	33	34	34	35	36	35
Cadmium	Railways (1A3c)	[kg]						1	1	1	1	1	1	1	1	1	1	1
Cadmium	Navigation (1A3d)	[kg]						4	4	4	3	4	4	4	3	3	2	2
Cadmium	Residential (1A4b)	[kg]						0	0	0	0	0	0	0	0	0	0	0
Cadmium	Ag./for./fish. (1A4c)	[kg]						6	6	6	6	5	5	5	5	5	5	5
Cadmium	Military (1A5)	[kg]						0	1	0	1	1	1	1	1	1	1	0
Cadmium	Navigation int. (1A3d)	[kg]						24	20	19	32	34	35	20	30	27	27	29

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pol_name	IPCC ID	Unit	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Cadmium	Civil Aviation int. (1A3a)	[kg]						6	5	5	5	6	6	6	6	7	7	8
Chromium	Industry-Other (1A2f)	[kg]						12	12	12	12	12	12	12	12	13	13	13
Chromium	Civil Aviation (1A3a)	[kg]						4	3	3	3	3	3	3	3	3	3	2
Chromium	Road (1A3b)	[kg]						146	152	155	157	165	166	169	173	176	178	176
Chromium	Railways (1A3c)	[kg]						5	5	5	5	5	5	5	5	4	4	4
Chromium	Navigation (1A3d)	[kg]						24	22	19	19	20	20	19	16	12	10	9
Chromium	Residential (1A4b)	[kg]						2	2	2	2	2	2	2	2	2	2	2
Chromium	Ag./for./fish. (1A4c)	[kg]						28	28	27	26	25	26	24	23	23	23	24
Chromium	Military (1A5)	[kg]						2	5	2	4	4	4	3	3	3	3	2
Chromium	Navigation int. (1A3d)	[kg]						150	127	118	199	213	218	133	182	161	164	184
Chromium	Civil Aviation int. (1A3a)	[kg]						28	26	27	26	29	30	31	32	34	36	37
Copper	Industry-Other (1A2f)	[kg]						411	413	413	413	414	418	421	425	429	432	435
Copper	Civil Aviation (1A3a)	[kg]						131	107	104	102	106	107	110	114	104	94	83
Copper	Road (1A3b)	[kg]						4965	5184	5273	5337	5605	5657	5754	5867	5968	6047	5989
Copper	Railways (1A3c)	[kg]						160	162	172	178	162	163	162	157	133	125	123
Copper	Navigation (1A3d)	[kg]						78	73	67	69	73	76	73	66	61	60	60
Copper	Residential (1A4b)	[kg]						60	60	61	61	62	63	64	65	66	67	69
Copper	Ag./for./fish. (1A4c)	[kg]						713	706	674	672	636	653	623	630	597	594	581
Copper	Military (1A5)	[kg]						64	154	76	128	136	136	95	92	110	98	60
Copper	Navigation int. (1A3d)	[kg]						363	302	276	475	505	514	332	426	366	379	432
Copper	Civil Aviation int. (1A3a)	[kg]						936	880	913	894	980	1006	1063	1084	1164	1234	1267
Mercury	Civil Aviation (1A3a)	[kg]															0	0
Mercury	Navigation (1A3d)	[kg]						8	8	9	9	9	9	11	11	9	7	6
Mercury	Ag./for./fish. (1A4c)	[kg]						9	10	9	8	8	8	8	6	7	7	9
Mercury	Military (1A5)	[kg]										0					0	0
Mercury	Navigation int. (1A3d)	[kg]						28	26	30	40	47	51	14	46	50	44	43
Mercury	Civil Aviation int. (1A3a)	[kg]															0	0
Nickel	Industry-Other (1A2f)	[kg]						17	17	17	17	17	17	17	17	18	18	18
Nickel	Civil Aviation (1A3a)	[kg]						5	4	4	4	4	4	5	5	4	4	3
Nickel	Road (1A3b)	[kg]						204	213	217	220	231	233	237	242	246	249	247
Nickel	Railways (1A3c)	[kg]						7	7	7	7	7	7	7	6	5	5	5
Nickel	Navigation (1A3d)	[kg]						2828	2355	1826	1825	1943	1958	1553	987	645	543	534
Nickel	Residential (1A4b)	[kg]						2	2	2	3	3	3	3	3	3	3	3
Nickel	Ag./for./fish. (1A4c)	[kg]						42	42	40	39	37	38	36	34	33	35	36
Nickel	Military (1A5)	[kg]						3	6	3	5	6	6	4	4	5	4	2
Nickel	Navigation int. (1A3d)	[kg]						20956	17236	15429	27162	28664	29023	19856	23826	19820	20967	24364
Nickel	Civil Aviation int. (1A3a)	[kg]						39	36	38	37	40	41	44	45	48	51	52
Lead	Industry-Other (1A2f)	[kg]						258	187	160	67	12	12	12	0	0	0	0
Lead	Civil Aviation (1A3a)	[kg]						1534	1423	1378	1328	1639	1788	1640	1559	1399	1387	1369
Lead	Road (1A3b)	[kg]						97510	75857	68775	29818	54	55	55	57	58	58	57
Lead	Railways (1A3c)	[kg]						0	0	0	0		0	0	0	0	0	0
Lead	Navigation (1A3d)	[kg]						485	371	331	159	51	53	55	27	21	17	14

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pol_name	IPCC ID	Unit	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Lead	Residential (1A4b)	[kg]						2273	1666	1442	612	109	110	112	1	1	1	1
Lead	Ag./for./fish. (1A4c)	[kg]						1564	1069	859	346	71	67	63	13	13	15	18
Lead	Military (1A5)	[kg]						64	80	62	120	86	102	98	123	116	78	114
Lead	Navigation int. (1A3d)	[kg]						167	144	142	226	247	256	134	218	205	201	216
Lead	Civil Aviation int. (1A3a)	[kg]						490	465	452	456	153	175	126	145	145	124	118
Selenium	Industry-Other (1A2f)	[kg]						2	2	2	2	2	2	2	2	3	2	3
Selenium	Civil Aviation (1A3a)	[kg]						1	1	1	1	1	1	1	1	1	1	0
Selenium	Road (1A3b)	[kg]						29	30	31	31	33	33	34	34	35	36	35
Selenium	Railways (1A3c)	[kg]						1	1	1	1	1	1	1	1	1	1	1
Selenium	Navigation (1A3d)	[kg]						61	58	55	54	55	57	59	54	42	34	28
Selenium	Residential (1A4b)	[kg]						0	0	0	0	0	0	0	0	0	0	0
Selenium	Ag./for./fish. (1A4c)	[kg]						41	42	39	37	37	37	35	29	30	33	38
Selenium	Military (1A5)	[kg]						0	1	0	1	1	1	1	1	1	1	0
Selenium	Navigation int. (1A3d)	[kg]						334	289	284	451	495	512	269	436	410	401	431
Selenium	Civil Aviation int. (1A3a)	[kg]						6	5	5	5	6	6	6	6	7	7	8
Zinc	Industry-Other (1A2f)	[kg]						242	243	243	243	243	246	248	250	252	254	256
Zinc	Civil Aviation (1A3a)	[kg]						77	63	61	60	62	63	65	67	61	55	49
Zinc	Road (1A3b)	[kg]						2921	3050	3102	3140	3297	3328	3384	3451	3511	3557	3523
Zinc	Railways (1A3c)	[kg]						94	95	101	105	95	96	95	93	78	73	72
Zinc	Navigation (1A3d)	[kg]						158	152	147	146	151	157	164	154	126	107	96
Zinc	Residential (1A4b)	[kg]						35	35	36	36	36	37	37	38	39	40	40
Zinc	Ag./for./fish. (1A4c)	[kg]						506	505	479	474	453	463	441	429	412	420	423
Zinc	Military (1A5)	[kg]						38	91	45	75	80	80	56	54	65	58	35
Zinc	Navigation int. (1A3d)	[kg]						764	664	660	1038	1141	1183	607	1010	959	933	997
Zinc	Civil Aviation int. (1A3a)	[kg]						551	518	537	526	576	592	625	638	685	726	745
Dioxins/furans	Industry-Other (1A2f)	[g]						0	0	0	0	0	0	0	0	0	0	0
Dioxins/furans	Civil Aviation (1A3a)	[g]						0	0	0	0	0	0	0	0	0	0	0
Dioxins/furans	Road (1A3b)	[g]						1	1	1	1	1	1	1	1	0	0	0
Dioxins/furans	Railways (1A3c)	[g]						0	0	0	0	0	0	0	0	0	0	0
Dioxins/furans	Navigation (1A3d)	[g]						0	0	0	0	0	0	0	0	0	0	0
Dioxins/furans	Residential (1A4b)	[g]						0	0	0	0	0	0	0	0	0	0	0
Dioxins/furans	Ag./for./fish. (1A4c)	[g]						0	0	0	0	0	0	0	0	0	0	0
Dioxins/furans	Military (1A5)	[g]						0	0	0	0	0	0	0	0	0	0	0
Dioxins/furans	Navigation int. (1A3d)	[g]						1	0	0	1	1	1	1	1	1	1	1
Dioxins/furans	Civil Aviation int. (1A3a)	[g]						0	0	0	0	0	0	0	0	0	0	0
Flouranthene	Industry-Other (1A2f)	[kg]						45	44	45	46	45	46	46	46	46	46	48
Flouranthene	Civil Aviation (1A3a)	[kg]						0	0	0	0	1	1	1	0	0	0	0
Flouranthene	Road (1A3b)	[kg]						789	795	789	772	757	718	683	650	621	599	582
Flouranthene	Railways (1A3c)	[kg]						5	5	6	6	6	6	6	6	5	4	4
Flouranthene	Navigation (1A3d)	[kg]						59	61	64	63	64	67	76	76	61	50	42
Flouranthene	Residential (1A4b)	[kg]						7	7	7	7	7	7	7	7	7	8	8
Flouranthene	Ag./for./fish. (1A4c)	[kg]						136	135	128	127	121	124	117	107	104	110	118

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pol_name	IPCC ID	Unit	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Flouranthene	Military (1A5)	[kg]						1	7	4	4	3	8	3	6	6	4	2
Flouranthene	Navigation int. (1A3d)	[kg]						204	190	212	294	340	361	349	322	343	311	306
Flouranthene	Civil Aviation int. (1A3a)	[kg]						0	0	0	0	0	0	0	0	0	0	0
Benzo(b) flouranthene	Industry-Other (1A2f)	[kg]						6	6	6	6	6	6	6	6	6	6	6
Benzo(b) flouranthene	Civil Aviation (1A3a)	[kg]						0	0	0	0	0	0	0	0	0	0	0
Benzo(b) flouranthene	Road (1A3b)	[kg]						65	66	66	65	66	65	64	62	61	61	59
Benzo(b) flouranthene	Railways (1A3c)	[kg]						1	1	1	2	1	1	1	1	1	1	1
Benzo(b) flouranthene	Navigation (1A3d)	[kg]						4	5	5	5	5	5	6	6	5	4	4
Benzo(b) flouranthene	Residential (1A4b)	[kg]						0	0	0	0	0	0	0	0	0	0	0
Benzo(b) flouranthene	Ag./for./fish. (1A4c)	[kg]						15	15	14	14	13	13	13	12	11	12	12
Benzo(b) flouranthene	Military (1A5)	[kg]						0	1	1	1	0	1	0	1	1	1	0
Benzo(b) flouranthene	Navigation int. (1A3d)	[kg]						13	13	15	20	23	25	25	23	25	22	21
Benzo(b) flouranthene	Civil Aviation int. (1A3a)	[kg]						0	0	0	0	0	0	0	0	0	0	0
Benzo(k) flouranthene	Industry-Other (1A2f)	[kg]						6	6	6	6	6	6	6	6	6	6	6
Benzo(k) flouranthene	Civil Aviation (1A3a)	[kg]						0	0	0	0	0	0	0	0	0	0	0
Benzo(k) flouranthene	Road (1A3b)	[kg]						65	67	67	66	69	69	69	69	69	69	68
Benzo(k) flouranthene	Railways (1A3c)	[kg]						2	2	2	2	2	2	2	2	1	1	1
Benzo(k) flouranthene	Navigation (1A3d)	[kg]						2	2	2	2	2	2	3	3	3	2	2
Benzo(k) flouranthene	Residential (1A4b)	[kg]						0	0	0	0	0	0	0	0	0	0	0
Benzo(k) flouranthene	Ag./for./fish. (1A4c)	[kg]						12	12	11	11	11	11	10	10	9	9	9
Benzo(k) flouranthene	Military (1A5)	[kg]						0	1	1	1	0	1	0	1	1	1	0
Benzo(k) flouranthene	Navigation int. (1A3d)	[kg]						6	6	7	9	11	12	11	11	12	10	10
Benzo(k) flouranthene	Civil Aviation int. (1A3a)	[kg]						0	0	0	0	0	0	0	0	0	0	0
Benzo(a) pyrene	Industry-Other (1A2f)	[kg]						3	3	3	3	3	3	3	3	3	3	3
Benzo(a) pyrene	Civil Aviation (1A3a)	[kg]						0	0	0	0	0	0	0	0	0	0	0
Benzo(a) pyrene	Road (1A3b)	[kg]						45	46	46	46	47	45	44	44	43	43	42
Benzo(a) pyrene	Railways (1A3c)	[kg]						0	0	0	0	0	0	0	0	0	0	0
Benzo(a) pyrene	Navigation (1A3d)	[kg]						1	1	1	1	1	1	1	2	1	1	1
Benzo(a) pyrene	Residential (1A4b)	[kg]						0	0	0	0	0	0	0	0	0	0	0
Benzo(a) pyrene	Ag./for./fish. (1A4c)	[kg]						6	6	6	6	5	5	5	5	5	5	5
Benzo(a) pyrene	Military (1A5)	[kg]						0	0	0	0	0	1	0	0	0	0	0
Benzo(a) pyrene	Navigation int. (1A3d)	[kg]						4	4	4	5	6	7	7	6	7	6	6
Benzo(a) pyrene	Civil Aviation int. (1A3a)	[kg]						0	0	0	0	0	0	0	0	0	0	0
Benzo(g,h,i) perylene	Industry-Other (1A2f)	[kg]						6	6	6	6	5	6	5	5	5	5	5
Benzo(g,h,i) perylene	Civil Aviation (1A3a)	[kg]						0	0	0	0	0	0	0	0	0	0	0
Benzo(g,h,i) perylene	Road (1A3b)	[kg]						95	97	98	97	97	93	90	88	86	84	82
Benzo(g,h,i) perylene	Railways (1A3c)	[kg]						0	0	0	0	0	0	0	0	0	0	0
Benzo(g,h,i) perylene	Navigation (1A3d)	[kg]						8	9	10	10	10	10	12	13	11	9	7
Benzo(g,h,i) perylene	Residential (1A4b)	[kg]						1	1	1	1	1	1	1	1	1	1	1
Benzo(g,h,i) perylene	Ag./for./fish. (1A4c)	[kg]						21	21	20	19	19	19	18	16	15	16	18
Benzo(g,h,i) perylene	Military (1A5)	[kg]						0	1	1	1	0	1	0	1	1	0	0
Benzo(g,h,i) perylene	Navigation int. (1A3d)	[kg]						24	24	30	37	45	49	48	45	52	45	41

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pol_name	IPCC ID	Unit	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Benzo(g,h,i) perylene	Civil Aviation int. (1A3a)	[kg]						0	0	0	0	0	0	0	0	0	0	0
indeno(1,2,3-c,d) pyrene	Industry-Other (1A2f)	[kg]						3	3	3	3	3	3	3	3	3	3	3
indeno(1,2,3-c,d) pyrene	Civil Aviation (1A3a)	[kg]						0	0	0	0	0	0	0	0	0	0	0
indeno(1,2,3-c,d) pyrene	Road (1A3b)	[kg]						43	45	45	46	47	47	46	47	47	47	47
indeno(1,2,3-c,d) pyrene	Railways (1A3c)	[kg]						0	0	0	0	0	0	0	0	0	0	0
indeno(1,2,3-c,d) pyrene	Navigation (1A3d)	[kg]						6	7	8	8	8	8	10	11	9	7	6
indeno(1,2,3-c,d) pyrene	Residential (1A4b)	[kg]						0	0	0	0	0	0	0	0	0	0	0
indeno(1,2,3-c,d) pyrene	Ag./for./fish. (1A4c)	[kg]						14	15	14	13	13	13	12	11	11	11	13
indeno(1,2,3-c,d) pyrene	Military (1A5)	[kg]						0	0	0	0	0	1	0	0	0	0	0
indeno(1,2,3-c,d) pyrene	Navigation int. (1A3d)	[kg]						19	20	24	30	36	39	39	36	42	36	34
indeno(1,2,3-c,d) pyrene	Civil Aviation int. (1A3a)	[kg]						0	0	0	0	0	0	0	0	0	0	0

pol_name	IPCC ID	Unit	2000	2001	2002	2003	2004	2005	2006	2007
SO_2	Industry-Other (1A2f)	[tonnes]	253	256	258	261	263	28	30	32
SO_2	Civil Aviation (1A3a)	[tonnes]	49	52	45	44	40	43	45	34
SO_2	Road (1A3b)	[tonnes]	352	353	357	371	381	77	79	83
SO_2	Railways (1A3c)	[tonnes]	7	7	7	7	7	1	1	1
SO_2	Navigation (1A3d)	[tonnes]	1129	1039	963	995	1150	1157	1086	838
SO_2	Residential (1A4b)	[tonnes]	4	4	5	6	6	1	1	1
SO_2	Ag./for./fish. (1A4c)	[tonnes]	1021	986	1041	997	851	637	585	518
SO_2	Military (1A5)	[tonnes]	27	12	19	17	46	57	26	40
SO_2	Navigation int. (1A3d)	[tonnes]	56634	45358	31538	33060	28581	36544	52936	26876
SO_2	Civil Aviation int. (1A3a)	[tonnes]	750	761	658	684	782	822	825	863
NO_x	Industry-Other (1A2f)	[tonnes]	12096	11869	11617	11214	10744	10664	10807	10654
NO_x	Civil Aviation (1A3a)	[tonnes]	723	747	636	590	546	579	596	498
NO_x	Road (1A3b)	[tonnes]	80883	77956	74180	73769	71699	67903	66049	64485
NO_x	Railways (1A3c)	[tonnes]	3727	3396	3396	3540	3478	3724	3542	3555
NO_x	Navigation (1A3d)	[tonnes]	5830	5741	5900	5827	5939	6026	5997	5929
NO_x	Residential (1A4b)	[tonnes]	153	167	183	202	223	249	275	288
NO_x	Ag./for./fish. (1A4c)	[tonnes]	22807	22699	23269	22322	19933	20776	19532	18180
NO_x	Military (1A5)	[tonnes]	550	712	483	539	1310	1327	613	771
NO_x	Navigation int. (1A3d)	[tonnes]	96911	81585	66095	71376	58906	62825	84716	89720
NO_x	Civil Aviation int. (1A3a)	[tonnes]	9446	9610	8737	9097	10481	11037	11175	11606
NMVOC	Industry-Other (1A2f)	[tonnes]	1926	1873	1815	1754	1676	1620	1583	1497
NMVOC	Civil Aviation (1A3a)	[tonnes]	156	155	151	143	157	165	155	153
NMVOC	Road (1A3b)	[tonnes]	41578	37826	34282	31847	28129	25914	22972	20364
NMVOC	Railways (1A3c)	[tonnes]	253	248	243	223	217	235	230	231
NMVOC	Navigation (1A3d)	[tonnes]	1652	1614	1575	1513	1446	1334	1206	1087
NMVOC	Residential (1A4b)	[tonnes]	4602	5328	6082	6869	7685	7859	8037	8101
NMVOC	Ag./for./fish. (1A4c)	[tonnes]	3414	3246	3079	2858	2586	2568	2513	2407
NMVOC	Military (1A5)	[tonnes]	58	60	48	50	110	115	55	73
NMVOC	Navigation int. (1A3d)	[tonnes]	3126	2651	2190	2334	1914	2005	2643	2767
NMVOC	Civil Aviation int. (1A3a)	[tonnes]	407	406	391	399	451	469	492	516
CH_4	Industry-Other (1A2f)	[tonnes]	50	49	48	47	46	45	44	43
CH_4	Civil Aviation (1A3a)	[tonnes]	5	5	5	5	6	7	6	5
CH_4	Road (1A3b)	[tonnes]	1861	1739	1635	1571	1479	1373	1275	1185
CH_4	Railways (1A3c)	[tonnes]	10	10	9	9	8	9	9	9
CH_4	Navigation (1A3d)	[tonnes]	30	31	31	32	32	32	32	32
CH_4	Residential (1A4b)	[tonnes]	137	149	164	183	204	219	233	235
CH_4	Ag./for./fish. (1A4c)	[tonnes]	88	86	86	85	82	86	93	91
CH_4	Military (1A5)	[tonnes]	6	7	5	5	13	13	6	8
CH_4	Navigation int. (1A3d)	[tonnes]	97	82	68	72	59	62	82	86
CH_4	Civil Aviation int. (1A3a)	[tonnes]	42	42	41	42	47	49	52	55
CO	Industry-Other (1A2f)	[tonnes]	8395	8227	8030	7842	7600	7497	7515	7378

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pol_name	IPCC ID	Unit	2000	2001	2002	2003	2004	2005	2006	2007
CO	Civil Aviation (1A3a)	[tonnes]	895	888	860	832	855	858	838	870
CO	Road (1A3b)	[tonnes]	267306	256933	235560	225422	200557	191988	170635	155084
CO	Railways (1A3c)	[tonnes]	694	637	627	611	599	648	626	629
CO	Navigation (1A3d)	[tonnes]	6572	6742	6934	7116	7312	7339	6955	6573
CO	Residential (1A4b)	[tonnes]	45873	50280	56144	63688	72683	80610	87744	89398
CO	Ag./for./fish. (1A4c)	[tonnes]	25842	24006	22167	20229	18183	17153	16884	16677
CO	Military (1A5)	[tonnes]	407	327	321	315	734	823	390	546
CO	Navigation int. (1A3d)	[tonnes]	10313	8745	7225	7701	6316	6615	8719	9129
CO	Civil Aviation int. (1A3a)	[tonnes]	1790	1797	1610	1670	1845	1914	1871	1964
CO_2	Industry-Other (1A2f)	[ktons]	879	888	897	907	912	950	1021	1088
CO_2	Civil Aviation (1A3a)	[ktonnes]	154	161	140	137	127	133	141	107
CO_2	Road (1A3b)	[ktonnes]	11202	11223	11352	11806	12115	12214	12589	13198
CO_2	Railways (1A3c)	[ktonnes]	228	211	210	218	216	232	227	228
CO_2	Navigation (1A3d)	[ktonnes]	476	461	457	461	475	471	461	454
CO_2	Residential (1A4b)	[ktonnes]	129	143	161	182	205	220	233	232
CO_2	Ag./for./fish. (1A4c)	[ktonnes]	1615	1592	1636	1602	1498	1577	1563	1565
CO_2	Military (1A5)	[ktonnes]	111	97	89	92	239	271	126	175
CO_2	Navigation int. (1A3d)	[ktonnes]	4279	3605	2966	3130	2545	2636	3433	3559
CO_2	Civil Aviation int. (1A3a)	[ktonnes]	2350	2385	2059	2142	2449	2575	2583	2701
N_2O	Industry-Other (1A2f)	[tonnes]	37	38	38	38	39	40	43	46
N_2O	Civil Aviation (1A3a)	[tonnes]	8	8	8	8	8	8	8	7
N_2O	Road (1A3b)	[tonnes]	444	429	421	420	421	406	402	409
N_2O	Railways (1A3c)	[tonnes]	6	6	6	6	6	6	6	6
N_2O	Navigation (1A3d)	[tonnes]	27	26	26	26	27	27	26	26
N_2O	Residential (1A4b)	[tonnes]	2	2	2	3	3	3	4	4
N_2O	Ag./for./fish. (1A4c)	[tonnes]	78	77	80	78	71	76	75	74
N_2O	Military (1A5)	[tonnes]	3	3	3	3	8	9	4	6
N_2O	Navigation int. (1A3d)	[tonnes]	269	227	187	197	160	166	216	224
N_2O	Civil Aviation int. (1A3a)	[tonnes]	82	82	72	75	85	89	89	93
NH_3	Industry-Other (1A2f)	[tonnes]	2	2	2	2	2	2	2	3
NH_3	Civil Aviation (1A3a)	[tonnes]	0	0	0	0	0	0	0	0
NH_3	Road (1A3b)	[tonnes]	2657	2536	2472	2376	2281	2123	1954	1791
NH_3	Railways (1A3c)	[tonnes]	1	1	1	1	1	1	1	1
NH_3	Navigation (1A3d)	[tonnes]	0	0	0	0	0	0	0	0
NH_3	Residential (1A4b)	[tonnes]	0	0	0	0	0	0	0	0
NH_3	Ag./for./fish. (1A4c)	[tonnes]	3	3	3	3	3	3	3	3
NH_3	Military (1A5)	[tonnes]	0	0	0	0	1	1	0	0
NH_3	Navigation int. (1A3d)	[tonnes]								
NH_3	Civil Aviation int. (1A3a)	[tonnes]	0	0	0	0	0	0	0	0
TSP	Industry-Other (1A2f)	[tonnes]	1135	1121	1098	1075	1037	1002	991	937
TSP	Civil Aviation (1A3a)	[tonnes]	3	3	3	3	3	3	3	3
TSP	Road (1A3b)	[tonnes]	3718	3579	3342	3367	3158	3125	3072	2957

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pol_name	IPCC ID	Unit	2000	2001	2002	2003	2004	2005	2006	2007
TSP	Railways (1A3c)	[tonnes]	141	125	124	119	115	124	120	120
TSP	Navigation (1A3d)	[tonnes]	307	298	290	295	315	309	292	257
TSP	Residential (1A4b)	[tonnes]	41	50	58	67	76	78	79	80
TSP	Ag./for./fish. (1A4c)	[tonnes]	1507	1440	1374	1291	1191	1146	1074	1015
TSP	Military (1A5)	[tonnes]	19	41	19	24	51	45	20	20
TSP	Navigation int. (1A3d)	[tonnes]	8994	7414	5254	4816	4293	6155	8300	2504
TSP	Civil Aviation int. (1A3a)	[tonnes]	38	38	33	35	40	42	42	44
PM_{10}	Industry-Other (1A2f)	[tonnes]	1135	1121	1098	1075	1037	1002	991	937
PM_{10}	Civil Aviation (1A3a)	[tonnes]	3	3	3	3	3	3	3	3
PM_{10}	Road (1A3b)	[tonnes]	3718	3579	3342	3367	3158	3125	3072	2957
PM_{10}	Railways (1A3c)	[tonnes]	141	125	124	119	115	124	120	120
PM_{10}	Navigation (1A3d)	[tonnes]	306	296	289	294	314	307	290	256
PM_{10}	Residential (1A4b)	[tonnes]	41	50	58	67	76	78	79	80
PM_{10}	Ag./for./fish. (1A4c)	[tonnes]	1505	1439	1372	1290	1190	1145	1073	1014
PM_{10}	Military (1A5)	[tonnes]	19	41	19	24	51	45	20	20
PM_{10}	Navigation int. (1A3d)	[tonnes]	8904	7340	5201	4767	4250	6094	8217	2479
PM_{10}	Civil Aviation int. (1A3a)	[tonnes]	38	38	33	35	40	42	42	44
$PM_{2.5}$	Industry-Other (1A2f)	[tonnes]	1135	1121	1098	1075	1037	1002	991	937
$PM_{2.5}$	Civil Aviation (1A3a)	[tonnes]	3	3	3	3	3	3	3	3
$PM_{2.5}$	Road (1A3b)	[tonnes]	3718	3579	3342	3367	3158	3125	3072	2957
$PM_{2.5}$	Railways (1A3c)	[tonnes]	141	125	124	119	115	124	120	120
$PM_{2.5}$	Navigation (1A3d)	[tonnes]	305	295	288	293	313	307	289	255
$PM_{2.5}$	Residential (1A4b)	[tonnes]	41	50	58	67	76	78	79	80
$PM_{2.5}$	Ag./for./fish. (1A4c)	[tonnes]	1504	1438	1372	1289	1189	1144	1072	1013
$PM_{2.5}$	Military (1A5)	[tonnes]	19	41	19	24	51	45	20	20
$PM_{2.5}$	Navigation int. (1A3d)	[tonnes]	8859	7303	5175	4743	4229	6063	8175	2466
$PM_{2.5}$	Civil Aviation int. (1A3a)	[tonnes]	38	38	33	35	40	42	42	44
Arsenic	Civil Aviation (1A3a)	[kg]	0	0	0	0	0	0	0	0
Arsenic	Navigation (1A3d)	[kg]	14	13	13	13	13	13	13	12
Arsenic	Ag./for./fish. (1A4c)	[kg]	9	8	9	8	6	8	7	6
Arsenic	Military (1A5)	[kg]	0	0	0	0	0	0	0	0
Arsenic	Navigation int. (1A3d)	[kg]	432	342	240	274	230	268	401	443
Arsenic	Civil Aviation int. (1A3a)	[kg]	0	0	0	0	0	0	0	0
Cadmium	Industry-Other (1A2f)	[kg]	3	3	3	3	3	3	3	3
Cadmium	Civil Aviation (1A3a)	[kg]	0	1	0	0	0	0	0	0
Cadmium	Road (1A3b)	[kg]	35	35	36	37	38	38	40	42
Cadmium	Railways (1A3c)	[kg]	1	1	1	1	1	1	1	1
Cadmium	Navigation (1A3d)	[kg]	2	2	2	2	2	2	2	2
Cadmium	Residential (1A4b)	[kg]	0	0	1	1	1	1	1	1
Cadmium	Ag./for./fish. (1A4c)	[kg]	5	5	5	5	5	5	5	5
Cadmium	Military (1A5)	[kg]	0	0	0	0	1	1	0	1
Cadmium	Navigation int. (1A3d)	[kg]	29	24	18	20	16	18	26	28

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pol_name	IPCC ID	Unit	2000	2001	2002	2003	2004	2005	2006	2007
Cadmium	Civil Aviation int. (1A3a)	[kg]	8	8	7	7	8	8	8	9
Chromium	Industry-Other (1A2f)	[kg]	13	13	13	13	13	14	15	16
Chromium	Civil Aviation (1A3a)	[kg]	2	3	2	2	2	2	2	2
Chromium	Road (1A3b)	[kg]	176	176	179	186	191	192	198	208
Chromium	Railways (1A3c)	[kg]	4	3	3	3	3	4	4	4
Chromium	Navigation (1A3d)	[kg]	9	9	9	9	9	9	9	8
Chromium	Residential (1A4b)	[kg]	2	2	3	3	3	3	4	4
Chromium	Ag./for./fish. (1A4c)	[kg]	24	24	24	24	22	23	23	24
Chromium	Military (1A5)	[kg]	2	2	1	1	4	4	2	3
Chromium	Navigation int. (1A3d)	[kg]	184	147	106	120	100	114	167	183
Chromium	Civil Aviation int. (1A3a)	[kg]	37	38	33	34	39	41	41	43
Copper	Industry-Other (1A2f)	[kg]	435	440	445	450	454	474	513	549
Copper	Civil Aviation (1A3a)	[kg]	83	87	75	74	68	72	76	57
Copper	Road (1A3b)	[kg]	5989	6001	6072	6314	6481	6535	6744	7075
Copper	Railways (1A3c)	[kg]	123	114	113	117	116	125	122	122
Copper	Navigation (1A3d)	[kg]	60	62	64	66	69	68	67	67
Copper	Residential (1A4b)	[kg]	69	76	86	96	109	117	124	123
Copper	Ag./for./fish. (1A4c)	[kg]	581	584	586	586	593	599	613	642
Copper	Military (1A5)	[kg]	60	52	48	50	129	146	68	94
Copper	Navigation int. (1A3d)	[kg]	432	342	240	274	230	268	401	443
Copper	Civil Aviation int. (1A3a)	[kg]	1267	1286	1110	1155	1320	1388	1392	1456
Mercury	Civil Aviation (1A3a)	[kg]	0	0	0	0	0	0	0	0
Mercury	Navigation (1A3d)	[kg]	6	5	5	5	5	5	5	5
Mercury	Ag./for./fish. (1A4c)	[kg]	9	8	9	8	6	8	7	6
Mercury	Military (1A5)	[kg]	0	0	0	0	0	0	0	0
Mercury	Navigation int. (1A3d)	[kg]	43	38	34	34	27	26	31	30
Mercury	Civil Aviation int. (1A3a)	[kg]	0	0	0	0	0	0	0	0
Nickel	Industry-Other (1A2f)	[kg]	18	18	18	19	19	20	21	23
Nickel	Civil Aviation (1A3a)	[kg]	3	4	3	3	3	3	3	2
Nickel	Road (1A3b)	[kg]	247	247	250	260	267	269	278	291
Nickel	Railways (1A3c)	[kg]	5	5	5	5	5	5	5	5
Nickel	Navigation (1A3d)	[kg]	534	501	492	484	503	508	474	456
Nickel	Residential (1A4b)	[kg]	3	3	4	4	4	5	5	5
Nickel	Ag./for./fish. (1A4c)	[kg]	36	35	36	35	33	35	35	35
Nickel	Military (1A5)	[kg]	2	2	2	2	5	6	3	4
Nickel	Navigation int. (1A3d)	[kg]	24364	19050	12906	15043	12715	15126	23174	25869
Nickel	Civil Aviation int. (1A3a)	[kg]	52	53	46	48	54	57	57	60
Lead	Industry-Other (1A2f)	[kg]	0	0	0	0	0	0	0	0
Lead	Civil Aviation (1A3a)	[kg]	1369	1343	1328	1252	1304	1297	1245	1329
Lead	Road (1A3b)	[kg]	57	56	56	56	55	53	52	52
Lead	Railways (1A3c)	[kg]	0	0	0					
Lead	Navigation (1A3d)	[kg]	14	14	13	13	14	14	13	13

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pol_name	IPCC ID	Unit	2000	2001	2002	2003	2004	2005	2006	2007
Lead	Residential (1A4b)	[kg]	1	1	2	2	2	2	2	2
Lead	Ag./for./fish. (1A4c)	[kg]	18	17	18	17	13	15	14	12
Lead	Military (1A5)	[kg]	114	88	106	78	82	59	47	81
Lead	Navigation int. (1A3d)	[kg]	216	177	136	149	122	133	185	198
Lead	Civil Aviation int. (1A3a)	[kg]	118	114	113	106	111	117	22	10
Selenium	Industry-Other (1A2f)	[kg]	3	3	3	3	3	3	3	3
Selenium	Civil Aviation (1A3a)	[kg]	0	1	0	0	0	0	0	0
Selenium	Road (1A3b)	[kg]	35	35	36	37	38	38	40	42
Selenium	Railways (1A3c)	[kg]	1	1	1	1	1	1	1	1
Selenium	Navigation (1A3d)	[kg]	28	27	26	26	27	27	26	26
Selenium	Residential (1A4b)	[kg]	0	0	1	1	1	1	1	1
Selenium	Ag./for./fish. (1A4c)	[kg]	38	36	39	37	29	34	31	28
Selenium	Military (1A5)	[kg]	0	0	0	0	1	1	0	1
Selenium	Navigation int. (1A3d)	[kg]	431	354	273	297	245	267	370	396
Selenium	Civil Aviation int. (1A3a)	[kg]	8	8	7	7	8	8	8	9
Zinc	Industry-Other (1A2f)	[kg]	256	259	262	265	267	279	302	323
Zinc	Civil Aviation (1A3a)	[kg]	49	51	44	43	40	42	45	34
Zinc	Road (1A3b)	[kg]	3523	3530	3572	3714	3812	3844	3967	4162
Zinc	Railways (1A3c)	[kg]	72	67	67	69	68	73	72	72
Zinc	Navigation (1A3d)	[kg]	96	94	94	95	98	97	95	94
Zinc	Residential (1A4b)	[kg]	40	45	50	57	64	69	73	73
Zinc	Ag./for./fish. (1A4c)	[kg]	423	421	428	423	409	423	425	435
Zinc	Military (1A5)	[kg]	35	31	28	29	76	86	40	55
Zinc	Navigation int. (1A3d)	[kg]	997	821	639	693	570	616	848	904
Zinc	Civil Aviation int. (1A3a)	[kg]	745	756	653	679	776	817	819	857
Dioxins/furans	Industry-Other (1A2f)	[g]	0	0	0	0	0	0	0	0
Dioxins/furans	Civil Aviation (1A3a)	[g]	0	0	0	0	0	0	0	0
Dioxins/furans	Road (1A3b)	[g]	0	0	0	0	0	0	0	0
Dioxins/furans	Railways (1A3c)	[g]	0	0	0	0	0	0	0	0
Dioxins/furans	Navigation (1A3d)	[g]	0	0	0	0	0	0	0	0
Dioxins/furans	Residential (1A4b)	[g]	0	0	0	0	0	0	0	0
Dioxins/furans	Ag./for./fish. (1A4c)	[g]	0	0	0	0	0	0	0	0
Dioxins/furans	Military (1A5)	[g]	0	0	0	0	0	0	0	0
Dioxins/furans	Navigation int. (1A3d)	[g]	1	1	0	1	0	0	1	1
Dioxins/furans	Civil Aviation int. (1A3a)	[g]	0	0	0	0	0	0	0	0
Flouranthene	Industry-Other (1A2f)	[kg]	48	48	49	49	50	52	56	60
Flouranthene	Civil Aviation (1A3a)	[kg]	0	0	0	0	0	0	0	0
Flouranthene	Road (1A3b)	[kg]	582	571	575	601	629	665	716	792
Flouranthene	Railways (1A3c)	[kg]	4	4	4	4	4	4	4	4
Flouranthene	Navigation (1A3d)	[kg]	42	41	40	40	42	41	40	40
Flouranthene	Residential (1A4b)	[kg]	8	9	10	11	12	13	14	14
Flouranthene	Ag./for./fish. (1A4c)	[kg]	118	115	119	116	105	112	110	108

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pol_name	IPCC ID	Unit	2000	2001	2002	2003	2004	2005	2006	2007
Flouranthene	Military (1A5)	[kg]	2	4	2	3	6	6	3	3
Flouranthene	Navigation int. (1A3d)	[kg]	306	266	232	238	191	188	227	226
Flouranthene	Civil Aviation int. (1A3a)	[kg]	0	0	0	0	0	0	0	0
Benzo(b) flouranthene	Industry-Other (1A2f)	[kg]	6	6	6	6	6	6	7	7
Benzo(b) flouranthene	Civil Aviation (1A3a)	[kg]	0	0	0	0	0	0	0	0
Benzo(b) flouranthene	Road (1A3b)	[kg]	59	59	59	62	64	65	69	74
Benzo(b) flouranthene	Railways (1A3c)	[kg]	1	1	1	1	1	1	1	1
Benzo(b) flouranthene	Navigation (1A3d)	[kg]	4	3	3	3	4	4	3	3
Benzo(b) flouranthene	Residential (1A4b)	[kg]	0	0	0	1	1	1	1	1
Benzo(b) flouranthene	Ag./for./fish. (1A4c)	[kg]	12	12	12	12	11	12	11	11
Benzo(b) flouranthene	Military (1A5)	[kg]	0	0	0	0	1	1	0	0
Benzo(b) flouranthene	Navigation int. (1A3d)	[kg]	21	19	17	17	14	13	15	14
Benzo(b) flouranthene	Civil Aviation int. (1A3a)	[kg]	0	0	0	0	0	0	0	0
Benzo(k) flouranthene	Industry-Other (1A2f)	[kg]	6	5	5	6	6	6	6	7
Benzo(k) flouranthene	Civil Aviation (1A3a)	[kg]	0	0	0	0	0	0	0	0
Benzo(k) flouranthene	Road (1A3b)	[kg]	68	67	68	71	74	75	78	84
Benzo(k) flouranthene	Railways (1A3c)	[kg]	1	1	1	1	1	1	1	1
Benzo(k) flouranthene	Navigation (1A3d)	[kg]	2	2	2	2	2	2	2	2
Benzo(k) flouranthene	Residential (1A4b)	[kg]	0	0	0	0	0	0	0	0
Benzo(k) flouranthene	Ag./for./fish. (1A4c)	[kg]	9	9	9	9	9	9	9	9
Benzo(k) flouranthene	Military (1A5)	[kg]	0	0	0	0	1	1	0	0
Benzo(k) flouranthene	Navigation int. (1A3d)	[kg]	10	9	8	8	6	6	7	6
Benzo(k) flouranthene	Civil Aviation int. (1A3a)	[kg]	0	0	0	0	0	0	0	0
Benzo(a) pyrene	Industry-Other (1A2f)	[kg]	3	3	3	3	3	3	3	4
Benzo(a) pyrene	Civil Aviation (1A3a)	[kg]	0	0	0	0	0	0	0	0
Benzo(a) pyrene	Road (1A3b)	[kg]	42	42	43	45	47	50	53	58
Benzo(a) pyrene	Railways (1A3c)	[kg]	0	0	0	0	0	0	0	0
Benzo(a) pyrene	Navigation (1A3d)	[kg]	1	1	1	1	1	1	1	1
Benzo(a) pyrene	Residential (1A4b)	[kg]	0	0	0	0	0	0	0	0
Benzo(a) pyrene	Ag./for./fish. (1A4c)	[kg]	5	5	5	5	5	5	5	5
Benzo(a) pyrene	Military (1A5)	[kg]	0	0	0	0	0	0	0	0
Benzo(a) pyrene	Navigation int. (1A3d)	[kg]	6	5	4	5	4	4	4	4
Benzo(a) pyrene	Civil Aviation int. (1A3a)	[kg]	0	0	0	0	0	0	0	0
Benzo(g,h,i) perylene	Industry-Other (1A2f)	[kg]	5	5	5	5	5	6	6	6
Benzo(g,h,i) perylene	Civil Aviation (1A3a)	[kg]	0	0	0	0	0	0	0	0
Benzo(g,h,i) perylene	Road (1A3b)	[kg]	82	81	83	86	90	95	101	111
Benzo(g,h,i) perylene	Railways (1A3c)	[kg]	0	0	0	0	0	0	0	0
Benzo(g,h,i) perylene	Navigation (1A3d)	[kg]	7	7	7	7	7	7	7	7
Benzo(g,h,i) perylene	Residential (1A4b)	[kg]	1	1	2	2	2	2	2	2
Benzo(g,h,i) perylene	Ag./for./fish. (1A4c)	[kg]	18	17	18	17	15	16	16	15
Benzo(g,h,i) perylene	Military (1A5)	[kg]	0	0	0	0	1	1	0	0
Benzo(g,h,i) perylene	Navigation int. (1A3d)	[kg]	41	37	35	35	28	25	27	25

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pol_name	IPCC ID	Unit	2000	2001	2002	2003	2004	2005	2006	2007
Benzo(g,h,i) perylene	Civil Aviation int. (1A3a)	[kg]	0	0	0	0	0	0	0	0
indeno(1,2,3-c,d) pyrene	Industry-Other (1A2f)	[kg]	3	3	3	3	3	3	3	4
indeno(1,2,3-c,d) pyrene	Civil Aviation (1A3a)	[kg]	0	0	0	0	0	0	0	0
indeno(1,2,3-c,d) pyrene	Road (1A3b)	[kg]	47	47	48	50	52	55	58	63
indeno(1,2,3-c,d) pyrene	Railways (1A3c)	[kg]	0	0	0	0	0	0	0	0
indeno(1,2,3-c,d) pyrene	Navigation (1A3d)	[kg]	6	5	5	5	5	5	5	5
indeno(1,2,3-c,d) pyrene	Residential (1A4b)	[kg]	0	0	1	1	1	1	1	1
indeno(1,2,3-c,d) pyrene	Ag./for./fish. (1A4c)	[kg]	13	12	13	12	10	12	11	10
indeno(1,2,3-c,d) pyrene	Military (1A5)	[kg]	0	0	0	0	0	0	0	0
indeno(1,2,3-c,d) pyrene	Navigation int. (1A3d)	[kg]	34	30	29	29	23	21	22	20
indeno(1,2,3-c,d) pyrene	Civil Aviation int. (1A3a)	[kg]	0	0	0	0	0	0	0	0

Annex 2B-16: Percentage distribution of new sold heavy duty trucks into Euro classes

1. reg. year	Conv.	I	II	III	IV	V	VI	Total
1991	100	0	0	0	0	0	0	100
1992	100	0	0	0	0	0	0	100
1993	75	25	0	0	0	0	0	100
1994	0	100	0	0	0	0	0	100
1995	0	100	0	0	0	0	0	100
1996	0	75	25	0	0	0	0	100
1997	0	0	100	0	0	0	0	100
1998	0	0	100	0	0	0	0	100
1999	0	0	100	0	0	0	0	100
2000	0	0	75	25	0	0	0	100
2001	0	0	43	57	0	0	0	100
2002	0	0	2	98	0	0	0	100
2003	0	0	1	99	0	0	0	100
2004	0	0	1	99	0	0	0	100
2005	0	0	0	96	3	1	0	100
2006	0	0	0	81	14	5	0	100
2007	0	0	0	2	71	27	0	100
2008	0	0	0	0	50	50	0	100
2009	0	0	0	0	25	75	0	100
2010	0	0	0	0	0	100	0	100
2011	0	0	0	0	0	100	0	100
2012	0	0	0	0	0	100	0	100
2013	0	0	0	0	0	100	0	100
2014	0	0	0	0	0	75	25	100
2015	0	0	0	0	0	0	100	100

Annex 2B-17: Uncertainty estimates

Uncertainty estimation, CO_2.

	Gas	Base year emission	Year t emission	Activity data uncertainty	Emission factor uncer-tainty	Combined uncertainty	Combined uncertainty as % of total national emissions in year t	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions in-troduced by emission factor uncertainty	Uncertainty in trend in national emissions in-troduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions
		Input data	Input data	Input data	Input data							
		Gg	Gg	%	%	%	%	%	%	%	%	%
Road transport	CO_2	9275	13198	2	5	5,385	4,170	0,10941436	0,9776	0,5471	2,7650	2,8186
Military	CO_2	119	175	2	5	5,385	0,055	0,00182243	0,0130	0,0091	0,0366	0,0378
Railways	CO_2	297	228	2	5	5,385	0,072	-0,0108911	0,0169	-0,0545	0,0477	0,0724
Navigation (small boats)	CO_2	48	101	21	5	21,587	0,128	0,00301649	0,0075	0,0151	0,2227	0,2232
Navigation (large vessels)	CO_2	666	352	11	5	12,083	0,250	-0,0361279	0,0261	-0,1806	0,4060	0,4444
Fisheries	CO_2	591	382	2	5	5,385	0,121	-0,0269452	0,0283	-0,1347	0,0800	0,1567
Agriculture	CO_2	1272	1166	13	5	13,928	0,953	-0,0326106	0,0864	-0,1631	1,5877	1,5961
Forestry	CO_2	36	17	16	5	16,763	0,017	-0,0020639	0,0013	-0,0103	0,0288	0,0306
Industry (mobile)	CO_2	842	1088	18	5	18,682	1,192	0,00185295	0,0806	0,0093	2,0506	2,0506
Residential	CO_2	113	232	18	5	18,682	0,254	0,00663484	0,0172	0,0332	0,4374	0,4387
Civil aviation	CO_2	243	107	10	5	11,180	0,070	-0,0147906	0,0079	-0,0740	0,1118	0,1340
Total		13.500	17045				19,886					15,1868
Total uncertainties				Year (%):			4,459			Trend (%):		3,897

Uncertainty estimation, CH_4.

	Gas	Base year emission	Year t emission	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	Combined uncertainty as % of total national emissions in year t	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions
		Input data	Input data	Input data	Input data							
		Mg	Mg	%	%	%	%	%	%	%	%	%
Road transport	CH_4	2619	1185	2	40	40,050	29,518	-0,0682396	0,3920	-2,7296	1,1087	2,9461
Military	CH_4	5	8	2	100	100,020	0,470	0,00158057	0,0025	0,1581	0,0071	0,1582
Railways	CH_4	12	9	2	100	100,020	0,551	0,00076356	0,0029	0,0764	0,0083	0,0768
Navigation (small boats)	CH_4	17	25	21	100	102,181	1,561	0,00521326	0,0081	0,5213	0,2412	0,5744
Navigation (large vessels)	CH_4	14	7	11	100	100,603	0,455	-8,178E-05	0,0024	-0,0082	0,0374	0,0383
Fisheries	CH_4	13	9	2	100	100,020	0,584	0,00080643	0,0031	0,0806	0,0088	0,0811
Agriculture	CH_4	105	77	13	100	100,841	4,831	0,00704388	0,0255	0,7044	0,4684	0,8459
Forestry	CH_4	21	4	16	100	101,272	0,276	-0,0022431	0,0015	-0,2243	0,0328	0,2267
Industry (mobile)	CH_4	60	43	18	100	101,607	2,717	0,00371782	0,0142	0,3718	0,3620	0,5189
Residential	CH_4	150	235	18	100	101,607	14,875	0,05148108	0,0779	5,1481	1,9820	5,5165
Civil aviation	CH_4	7	5	10	100	100,499	0,339	0,00052019	0,0018	0,0520	0,0254	0,0579
Total		3023	1608				1126,979					40,5195
Total uncertainties				Year (%):			33,571			Trend (%):		6,365

Uncertainty estimation, N_2O.

	Gas	Base year emission	Year t emission	Activity data uncer-tainty	Emission factor uncer-tainty	Combined uncertainty	Combined uncertainty as % of total national emissions in year t	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions in-troduced by emission factor uncertainty	Uncertainty in trend in national emissions in-troduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions
		Input data	Input data	Input data	Input data							
		Mg	Mg	%	%	%	%	%	%	%	%	%
Road transport	N_2O	312	409	2	50	50,040	35,463	0,09764625	0,8171	4,8823	2,3112	5,4017
Military	N_2O	4	6	2	1000	1000,002	9,874	0,00281399	0,0114	2,8140	0,0322	2,8142
Railways	N_2O	8	6	2	1000	1000,002	10,884	-0,0063099	0,0125	-6,3099	0,0355	6,3100
Navigation (small boats)	N_2O	1	3	21	1000	1000,220	5,984	0,004002	0,0069	4,0020	0,2049	4,0072
Navigation (large vessels)	N_2O	42	22	11	1000	1000,060	38,642	-0,0521212	0,0446	-52,1212	0,6931	52,1258
Fisheries	N_2O	37	24	2	1000	1000,002	41,794	-0,0373324	0,0482	-37,3324	0,1363	37,3327
Agriculture	N_2O	49	49	13	1000	1000,084	85,225	-0,0153157	0,0983	-15,3157	1,8064	15,4219
Forestry	N_2O	1	1	16	1000	1000,128	0,940	-0,0002081	0,0011	-0,2081	0,0245	0,2095
Industry (mobile)	N_2O	34	46	18	1000	1000,162	79,795	0,01301216	0,0920	13,0122	2,3416	13,2212
Residential	N_2O	2	4	18	1000	1000,162	6,206	0,0031974	0,0072	3,1974	0,1821	3,2026
Civil aviation	N_2O	10	7	10	1000	1000,050	11,980	-0,009913	0,0138	-9,9130	0,1953	9,9149
Total		500	576				18562,903					4725,0415
Total uncertainties				Year (%):			136,246			Trend (%):		68,739

Uncertainty estimation, SO_2.

	Gas	Base year emission	Year t emission	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	Combined uncertainty as % of total national emissions in year t	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions
		Input data	Input data	Input data	Input data							
		Gg SO_2	Gg SO_2	%	%	%	%	%	%	%	%	%
Road Transportation	SO_2	5767	83	2	50	50,040	2,687	-0,034090009	0,0055	-1,7045005	0,015691643	1,7045727
Other mobile sources	SO_2	9216	1465	10	50	50,990	48,252	0,034012007	0,0978	1,70060037	1,382787945	2,19183579
Total		14983,405	1548,171				2335,512					7,70971219
Total uncertainties					Year (%):		48,327			Trend (%):		2,777

Uncertainty estimation, NO_X.

	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 NO_X	Gg NO_X	%	%	%	%	%	%	%	%	%
Road Transportation	NO_X	105934	64485	2	50	50,040	30,920	-0,038341801	0,4114	-1,91709	1,16368702	2,24263276
Other mobile sources	NO_X	50801	39875	10	100	100,499	38,400	0,038476237	0,2544	3,84762366	3,597925027	5,26775781
Total	NO_X	156734,61	104359,73				2430,600					32,778674
Total uncertainties					Year (%):		49,301			Trend (%):		5,725

Uncertainty estimation, NMVOC.

	Gas	Base year emission	Year t emission	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	Combined uncertainty as % of total national emissions in year t	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions
		Input data Gg NMVOC	Input data Gg NMVOC	Input data %	Input data %	%	%	%	%	%	%	%
Road Transportation	NMVOC	81811	20364	2	50	50,040	30,049	-0,08608693	0,2110	-4,3043465	0,596744638	4,34551525
Other mobile sources	NMVOC	14710	13548	10	100	100,499	40,149	0,086684494	0,1404	8,6684494	1,985010766	8,89282198
Total	NMVOC	96520,951	33911,917				2514,907					97,9657855
Total uncertainties					Year (%):		50,149			Trend (%):		9,898

Uncertainty estimation, CO.

	Gas	Base year emission	Year t emission	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	Combined uncertainty as % of total national emissions in year t	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions
		Input data Gg CO	Input data Gg CO	Input data %	Input data %	%	%	%	%	%	%	%
Road Transportation	CO	459541	155084	2	50	50,040	28,000	-0,113050655	0,2689	-5,6525327	0,76047864	5,70345984
Other mobile sources	CO	117260	122071	10	100	100,499	44,264	0,113720151	0,2116	11,3720151	2,992968172	11,7592766
Total	CO	576800,88	277155,48				2743,311					170,81004
Total uncertainties					Year (%):		52,377			Trend (%):		13,069

Uncertainty estimation, NH_3.

	Gas	Base year emission	Year t emission	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	Combined uncertainty as % of total national emissions in year t	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions
		Input data	Input data	Input data	Input data							
		Gg NH_3	Gg NH_3	%	%	%	%	%	%	%	%	%
Road Transportation	NH_3	70	1791	2	1000	1000,002	995,755	1,771595369	23,4881	1771,59537	66,43437006	1772,84057
Other mobile sources	NH_3	6	8	10	1000	1000,050	4,247	-1,786463342	0,1002	-1786,4633	1,416844548	1786,4639
Total	NH_3	76,247628	1798,5506				991545,487					6334416,95
Total uncertainties					Year (%):		995,764			Trend (%):		2517

Uncertainty estimation, TSP.

	Gas	Base year emission	Year t emission	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	Combined uncertainty as % of total national emissions in year t	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions
		Input data	Input data	Input data	Input data							
		Gg TSP	Gg TSP	%	%	%	%	%	%	%	%	%
Road Transportation	TSP	6929	5763	2	50	50,040	35,190	0,089615493	0,4735	4,48077465	1,339357379	4,67666758
Other mobile sources	TSP	5240	2432	10	100	100,499	29,824	-0,089739342	0,1998	-8,9739342	2,825938653	9,40836987
Total	TSP	12169,148	8194,1981				2127,809					110,388643
Total uncertainties					Year (%):		46,128			Trend (%):		10,507

Uncertainty estimation, Arsenic.

	Gas	Base year emission	Year t emission	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	Combined uncertainty as % of total national emissions in year t	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions
		Input data	Input data	Input data	Input data							
		kg	kg	%	%	%	%	%	%	%	%	%
Road Transportation	Arsenic	0	0	2	1000	1000,002	0,000	0	0,0000	0	0	0
Other mobile sources	Arsenic	62	18	10	1000	1000,050	1000,050	0	0,2948	0	4,169455513	4,16945551
Total	Arsenic	62,035802	18,289707				1000100,000					17,3843593
Total uncertainties					Year (%):		1000,050			Trend (%):		4,169

Uncertainty estimation, Cadmium.

	Gas	Base year emission	Year t emission	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	Combined uncertainty as % of total national emissions in year t	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions
		Input data	Input data	Input data	Input data							
		kg	kg	%	%	%	%	%	%	%	%	%
Road Transportation	Cadmium	29	42	2	1000	1000,002	775,048	0,137824233	0,9419	137,824233	2,664072602	137,849978
Other mobile sources	Cadmium	15	12	10	1000	1000,050	224,965	-0,138266215	0,2734	-138,26622	3,866179481	138,320257
Total	Cadmium	44,162276	53,669181				651308,195					38135,1102
Total uncertainties					Year (%):		807,037			Trend (%):		195,282

Uncertainty estimation, Chromium.

	Gas	Base year emission	Year t emission	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	Combined uncertainty as % of total national emissions in year t	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions
		Input data	Input data	Input data	Input data							
		kg	kg	%	%	%	%	%	%	%	%	%
Road Transportation	Chromium	146	208	2	1000	1000,002	776,814	0,14440749	0,9348	144,40749	2,644029471	144,431693
Other mobile sources	Chromium	77	60	10	1000	1000,050	223,198	-0,144856567	0,2686	-144,85657	3,798301511	144,906356
Total	Chromium	222,5897	267,86134				653257,946					41858,3661
Total uncertainties					Year (%):		808,244			Trend (%):		204,593

Uncertainty estimation, Copper.

	Gas	Base year emission	Year t emission	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	Combined uncertainty as % of total national emissions in year t	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions
		Input data	Input data	Input data	Input data							
		kg	kg	%	%	%	%	%	%	%	%	%
Road Transportation	Copper	4965	7075	2	1000	1000,002	810,447	0,07381129	1,0749	73,8112905	3,040386197	73,8738827
Other mobile sources	Copper	1617	1655	10	1000	1000,050	189,564	-0,074185887	0,2514	-74,185887	3,555567582	74,2710432
Total	Copper	6582,1835	8730,3149				692759,082					10973,5384
Total uncertainties					Year (%):		832,322			Trend (%):		104,755

Uncertainty estimation, Mercury.

	Gas	Base year emission	Year t emission	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	Combined uncertainty as % of total national emissions in year t	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions
		Input data	Input data	Input data	Input data							
		kg	kg	%	%	%	%	%	%	%	%	%
Road Transportation	Mercury	0	0	2	1000	1000,002	0,000	0	0,0000	0	0	0
Other mobile sources	Mercury	17	11	10	1000	1000,050	1000,050	0	0,6577	0	9,301333814	9,30133381
Total	Mercury	16,931552	11,135943				1000100,000					86,5148107
Total uncertainties					Year (%):		1000,050			Trend (%):		9,301

Uncertainty estimation, Nickel.

	Gas	Base year emission	Year t emission	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	Combined uncertainty as % of total national emissions in year t	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions
		Input data	Input data	Input data	Input data							
		kg	kg	%	%	%	%	%	%	%	%	%
Road Transportation	Nickel	204	291	2	1000	1000,002	354,714	0,076298834	0,0937	76,2988338	0,265109839	76,2992944
Other mobile sources	Nickel	2904	530	10	1000	1000,050	645,319	-0,075642355	0,1705	-75,642355	2,411411931	75,6807817
Total	Nickel	3108,0281	821,27484				542258,689					11549,163
Total uncertainties					Year (%):		736,382			Trend (%):		107,467

Uncertainty estimation, Lead.

	Gas	Base year emission	Year t emission	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	Combined uncertainty as % of total national emissions in year t	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions
		Input data	Input data	Input data	Input data							
		kg	kg	%	%	%	%	%	%	%	%	%
Road Transportation	Lead	97510	52	2	1000	1000,002	34,812	-0,0128832	0,0005	-12,8832	0,001413895	12,8832003
Other mobile sources	Lead	6178	1437	10	1000	1000,050	965,237	0,012996612	0,0139	12,9966123	0,196009353	12,9980903
Total	Lead	103687,72	1488,9392				932893,866					334,927199
Total uncertainties					Year (%):		965,864			Trend (%):		18,301

Uncertainty estimation, Selenium.

	Gas	Base year emission	Year t emission	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	Combined uncertainty as % of total national emissions in year t	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions
		Input data	Input data	Input data	Input data							
		kg	kg	%	%	%	%	%	%	%	%	%
Road Transportation	Selenium	29	42	2	1000	1000,002	414,277	0,147111495	0,3055	147,111495	0,864095909	147,114033
Other mobile sources	Selenium	107	59	10	1000	1000,050	585,753	-0,146277627	0,4319	-146,27763	6,10849246	146,405115
Total	Selenium	136,15561	100,40655				514731,980					43076,9965
Total uncertainties					Year (%):		717,448			Trend (%):		207,550

Uncertainty estimation, Zinc.

	Gas	Base year emission	Year t emission	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	Combined uncertainty as % of total national emissions in year t	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions
		Input data	Input data	Input data	Input data							
		kg	kg	%	%	%	%	%	%	%	%	%
Road Transportation	Zinc	2921	4162	2	1000	1000,002	793,268	0,096891499	1,0225	96,8914994	2,89198534	96,9346493
Other mobile sources	Zinc	1150	1085	10	1000	1000,050	206,744	-0,097311898	0,2665	-97,311898	3,768401792	97,3848364
Total	Zinc	4070,5314	5246,6605				672017,551					18880,1326
Total uncertainties					Year (%):		819,767			Trend (%):		137,405

Uncertainty estimation, Dioxins.

	Gas	Base year emission	Year t emission	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	Combined uncertainty as % of total national emissions in year t	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions
		Input data	Input data	Input data	Input data							
		g dioxins	g dioxins	%	%	%	%	%	%	%	%	%
Road Transportation	Dioxins	1	0	2	1000	1000,002	520,245	-0,080039159	0,1624	-80,039159	0,459468573	80,0404781
Other mobile sources	Dioxins	0	0	10	1000	1000,050	479,780	0,080484104	0,1498	80,484104	2,118549127	80,511982
Total	Dioxins	1,1042442	0,344801				500843,767					12888,6574
Total uncertainties					Year (%):		707,703			Trend (%):		113,528

Uncertainty estimation, Flouranthene.

	Gas	Base year emission	Year t emission	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	Combined uncertainty as % of total national emissions in year t	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions
		Input data	Input data	Input data	Input data							
		kg	kg	%	%	%	%	%	%	%	%	%
Road Transportation	Flouranthene	789	792	2	1000	1000,002	775,886	0,019330479	0,7596	19,3304785	2,148558482	19,4495168
Other mobile sources	Flouranthene	255	229	10	1000	1000,050	224,127	-0,019429206	0,2194	-19,429206	3,103076503	19,675445
Total	Flouranthene	1043,1665	1021,313				652231,733					765,406838
Total uncertainties					Year (%):		807,609			Trend (%):		27,666

Uncertainty estimation, Benzo(b) flouranthene.

	Gas	Base year emission	Year t emission	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	Combined uncertainty as % of total national emissions in year t	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions
		Input data	Input data	Input data	Input data							
		kg	kg	%	%	%	%	%	%	%	%	%
Road Transportation	Benzo(b) flouranthene	65	74	2	1000	1000,002	756,944	0,053139614	0,8088	53,1396145	2,287584113	53,1888303
Other mobile sources	Benzo(b) flouranthene	27	24	10	1000	1000,050	243,069	-0,053358819	0,2597	-53,358819	3,672759498	53,4850698
Total	Benzo(b) flouranthene	91,784063	98,070026				632047,410					5689,70436
Total uncertainties					Year (%):		795,014			Trend (%):		75,430

Uncertainty estimation, Benzo(k) flouranthene.

	Gas	Base year emission	Year t emission	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	Combined uncertainty as % of total national emissions in year t	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions
		Input data	Input data	Input data	Input data							
		kg	kg	%	%	%	%	%	%	%	%	%
Road Transportation	Benzo(k) flouranthene	65	84	2	1000	1000,002	809,986	0,066417805	0,9656	66,4178052	2,731213192	66,4739376
Other mobile sources	Benzo(k) flouranthene	21	20	10	1000	1000,050	190,025	-0,066754184	0,2265	-66,754184	3,20359103	66,8310112
Total	Benzo(k) flouranthene	86,723185	103,38772				692187,392					8885,16843
Total uncertainties					Year (%):		831,978			Trend (%):		94,261

Uncertainty estimation, Benzo(a) pyrene.

	Gas	Base year emission	Year t emission	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	Combined uncertainty as % of total national emissions in year t	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions
		Input data	Input data	Input data	Input data							
		kg	kg	%	%	%	%	%	%	%	%	%
Road Transportation	Benzo(a) pyrene	45	58	2	1000	1000,002	854,281	0,052927714	1,0506	52,9277139	2,971671387	53,0110717
Other mobile sources	Benzo(a) pyrene	11	10	10	1000	1000,050	145,727	-0,053256192	0,1792	-53,256192	2,53448926	53,3164669
Total	Benzo(a) pyrene	55,569601	68,342827				751033,377					5652,81937
Total uncertainties					Year (%):		866,622			Trend (%):		75,185

Uncertainty estimation, Benzo(g,h,i) perylene.

	Gas	Base year emission	Year t emission	Activity Data uncertainty	Emission factor uncertainty	Combined uncertainty	Combined uncertainty as % of total national emissions in year t	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions
		Input data	Input data	Input data	Input data							
		kg	kg	%	%	%	%	%	%	%	%	%
Road Transportation	Benzo(g,h,i) perylene	95	111	2	1000	1000,002	782,979	0,061450736	0,8432	61,4507361	2,384988531	61,497001
Other mobile sources	Benzo(g,h,i) perylene	36	31	10	1000	1000,050	217,034	-0,061727123	0,2337	-61,727123	3,305317485	61,8155554
Total	Benzo(g,h,i) perylene	131,41193	141,52303				660159,072					7603,04403
Total uncertainties					Year (%):		812,502			Trend (%):		87,195

Uncertainty estimation, indeno(1,2,3-c,d) pyrene.

	Gas	Base year emission	Year t emission	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	Combined uncertainty as % of total national emissions in year t	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions
		Input data	Input data	Input data	Input data							
		kg	kg	%	%	%	%	%	%	%	%	%
Road Transportation	indeno(1,2,3-c,d) pyr.	43	63	2	1000	1000,002	755,918	0,143575794	0,9371	143,575794	2,650384852	143,600255
Other mobile sources	indeno(1,2,3-c,d) pyr.	24	20	10	1000	1000,050	244,096	-0,143974514	0,3026	-143,97451	4,279010543	144,038087
Total	indeno(1,2,3-c,d) pyr.	67,521282	83,701021				630994,834					41368,0038
Total uncertainties					Year (%):		794,352			Trend (%):		203,391

Annex 2C

Agriculture

Annex 2C.1 Background information - NH_3 from Manure Management

1. N-excretion

In Table 2C.1 is given the average N-excretion for each NFR livestock category from 1985 to 2006. Notice that each livestock category is an aggregated average of different subcategories (see Table 6.3 in Chapter 6). The N-excretion is based on information from the Danish Institute of Agricultural Science. Calculations are partly adjusted to TAN in the years 2003-2007.

Table 2C.1 Nitrogen excretion rates in average, 1985 – 2007, kg N/hd/yr.

Livestock categories:	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
Dairy cattle	121.49	123.66	125.82	128.05	130.33	129.49	128.63	127.76	126.89	126.06	125.22	125.09
Non-dairy	35.73	35.77	35.91	36.13	36.33	36.57	36.68	36.80	36.92	36.64	36.56	36.62
Sheep	21.04	21.04	21.04	21.04	21.04	21.18	21.33	21.47	21.61	21.76	21.90	20.11
Goats	21.04	21.04	21.04	21.04	21.04	21.18	21.33	21.47	21.61	21.76	21.90	20.11
Horses	50.00	50.00	50.00	50.00	50.00	48.89	47.77	46.66	45.54	44.42	43.31	43.31
Swine	13.20	13.13	12.70	12.58	12.28	11.62	11.43	11.17	10.40	10.38	9.62	9.89
Poultry	0.50	0.52	0.53	0.60	0.60	0.65	0.66	0.58	0.59	0.66	0.62	0.60
Fur farming	5.28	5.20	5.11	5.03	4.93	4.90	4.83	4.80	4.75	4.70	4.65	4.66
N-excretion. total (M kg N/year)	268	270	272	274	277	274	273	271	268	266	264	260

Continued

Livestock categories:	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Dairy cattle	124.94	124.82	124.60	125.31	125.31	127.74	129.79	131.56	133.30	134.66	74.57
Non-dairy	36.74	36.71	36.98	37.20	37.61	37.59	37.44	38.39	38.74	38.00	38.88
Sheep	18.32	16.53	14.75	16.95	16.95	16.95	16.95	16.95	16.95	16.95	16.95
Goats	18.32	16.53	14.75	16.95	16.95	16.36	16.36	16.36	16.36	16.36	15.41
Horses	43.31	43.31	43.31	43.31	43.31	43.31	43.31	43.31	43.31	43.31	39.56
Swine	9.74	9.65	9.83	9.65	9.17	9.58	9.25	9.48	8.97	8.55	4.86
Poultry	0.62	0.62	0.57	0.55	0.57	0.59	0.66	0.75	0.73	0.63	0.59
Fur farming	4.65	4.64	4.63	4.63	4.62	4.61	4.61	5.09	5.38	5.18	3.99
N-excretion. total (M kg N/year)	257	253	249	255	254	257	258	262	264	264	195

Calculations partly adjusted to TAN (2003-2007).

2. Stable system

A systematic statement of the stabling of husbandry does not exist and the stabling is therefore based on estimate from the Danish Agricultural Advisory Centre (Rasmussen, J.B. and Lundgaard, N.H., pers. comm.). The structural development in the agricultural sector has an influence in change of stable types. The last few years new stables have been build and for most of these new stables, tied-up stables are replaced by bigger stables with loose-holding. In 1985 85% of the dairy cattle were kept in tied-up stables and in 2007 the part is reduced to 17%. In loose-holding systems the cattle have more space and this will increase the ammonia emission per animal compared to the tied-up stables. In Table 2C.2 the distribution of stable type for dairy cattle and slaughtering pigs from 1985-2006 is listed.

Table 2C.2 The percentage distribution of stable type – Dairy cattle and slaughtering pigs 1985 – 2007.

Distribution of stable type	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
Dairy cattle												
Tied-up stables	85	84	83	81	80	79	78	77	76	74	73	72
Loose-holdings with beds	14	15	15	16	17	18	18	19	20	21	21	22
Deep litter	1	1	2	2	3	3	4	4	5	5	6	6
Slaughtering pigs												
Full slatted floor	29	33	38	42	47	51	56	60	60	60	60	60
Partly slatted floor	30	29	27	26	24	23	21	20	21	23	24	25
Solid floor	40	36	33	29	26	22	19	15	14	12	11	9
Deep litter	1	2	2	3	3	4	4	5	5	5	5	6

Distribution of stable type	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Dairy cattle											
Tied-up stables	66	60	60	46	40	35	26	22	26	26	17
Loose-holdings with beds	26	30	30	43	49	54	63	67	66	66	76
Deep litter	8	10	10	11	11	11	11	11	8	8	7
Slaughtering pigs											
Full slatted floor	60	60	60	58	57	56	55	53	49	49	53
Partly slatted floor	26	28	29	31	33	34	35	38	38	38	39
Solid floor	8	6	5	5	4	4	4	3	7	7	4
Deep litter	6	6	6	6	6	6	6	6	6	6	5

3. Emission of ammonia

3.1 Stable

The emission from stables is thus determined by a number of different conditions that depends on stable type and the different kinds of manure disposal systems placed in these stables. Faculty of Agricultural Sciences, University of Aarhus has carried out a number of emission surveys and estimated emission coefficients for different types of stables (Poulsen et al., 2001). In Table 2C.3 is shown the emission from Dairy cattle and slaughtering pigs in different stable systems. For the slurry and liquid manure is given TAN emission coefficients (TAN ab animal) and for solid and deep litter manure is given N ab animal, because the emission coefficients for solid and deep litter is not jet adjusted to TAN.

Table 2C.3 Ammonia emission from stables 2007 – Dairy cattle and slaughtering pigs.

Livestock category	Manure system	Manure type	Ammonia emission pct NH_3-N of N ab Animal	Ammonia emission pct NH_3-N of TAN ab Animal
Dairy cattle	Tied-up	Solid manure	6.0	
		+ Liquid		10.0
	Tied-up	Slurry		6.0
	Loose-holding with beds, slatted floor	Slurry		16.0
	Loose-holding with beds, slatted floor, scrapes	Slurry		12.0
	Loose-holding with beds, solid floor	Slurry		20.0
	Loose-holding with beds, drained floor	Slurry		8.0
	Deep litter (all)	Deep litter	6.0	
	Deep litter, slatted floor	Deep litter	6.0	
		+ Slurry		16.0
	Deep litter, slatted floor, scrapes	Deep litter	6.0	
		+ Slurry		12.0
	Deep litter, solid floor, scrapes	Deep litter	6.0	
		+ Slurry		20.0
Slaughtering pigs	Full slatted floor	Slurry		24.0
	Partly slatted floor (50-75% solid floor)	Slurry		13.0
	Partly slatted floor (25-49% solid floor)	Slurry		17.0
	Solid floor	Solid manure	25.0	
		+ Liquid		27.0
	Deep litter	Deep litter	25.0	
	Partly slatted floor and partly deep litter	Deep litter	25.0	
		+ Slurry		18.0

3.2 Storage

Livestock manure is collected either as solid manure or as slurry depending on stable type. In Table 2C.4 is shown the emission factor used for storage. It is assumed that the part of solid manure taken directly from the stable into the field is 80% from cattle, 25% from pigs, 50% sows, 15% from poultry and 5% from hens (Poulsen et al. 2001). The remaining part of the solid manure is deposited in stock piles in the field before field application.

By law all slurry tanks have to be covered by a crust in order to reduce ammonia emission. However, investigations show that that slurry tanks were incompletely covered earlier (COWI 2000), which result in a higher ammonia emission. In 2007 it is assumed that 5% of the tanks with pig slurry and 2% of tanks with cattle slurry are incompletely covered. This information has been incorporated in the emission inventory.

Table 2C.4 Emission factors for storage 2007 (Poulsen, H.D., 2008).

	Liquid manure	Slurry	Solid manure	Deep litter	
	Loss of NH_3-N in %				
Animal category	of TAN ab stable	of TAN ab stable	of N ab stable	of N ab stable	
Cattle	2.2	3.4	3.0	3.0	
Swine	2.2	2.5	13.0	13.0	
Poultry		2.0[a]	5.0	5.0	Hens and pullet
				8.0	Broilers
				8.0	Turkey, geese and ducks
Fur farming		2.9	8.0		
Sheep/goats				3.0	
Horses				3.0	

[a] Loss of NH_3-N in % of N ab stable.

3.3 Spreading in fields

There is no statistical information on how the farmer handling the manure in practice. In calculation of emission from application of manure on the fields is used to different weighted emission factors, which distinguish between solid manure and liquid manure. In 2007 the emission factor for solid manure is estimated to 32% and liquid manure is estimated to 18% for cattle and 12% for swine of TAN ab storage.

The weighted emission factor will vary from year to year depending on changes in the practice of spreading. The weighted emission factor is based on background estimates of time of spreading, application methods, spreading in growing crops or on bare soil and the time from spreading to ploughing in soil. In Table 2C.5 background information for 2007 are given.

Table 2C.5 Estimate for application method, time of spreading and time before the manure is incorporated in the soil (Based on information from the Organisation "Danish Agriculture").

Application methods 2007	Time of spreading	Percentage distribution of manure		Time before incorporation in soil							
				0		Harrowed		Ploughed		Not incorporated	
		Cattle	Swine	Cattle	Swine	Cattle	Swine	Cattle	Swine	Cattle	Swine
Liquid manure											
Incorporated	winter-spring	47	21	47	21	-	-	-	-	-	-
Incorporated	summer-autumn	13	3	13	3	-	-	-	-	-	-
Trailing horses	winter-spring	28	67	-	-	3	5	3	5	22	57
Trailing horses	spring-summer	3	3	-	-	-	-	-	-	3	3
Trailing horses	late summer-autumn	9	6	-	-	3	2	2	1	4	3
Broad spreading	winter-spring	-	-	-	-	-	-	-	-	-	-
Broad spreading	spring-summer	-	-	-	-	-	-	-	-	-	-
Broad spreading	late summer-autumn	-	-	-	-	-	-	-	-	-	-
Total		100	100	60	24	6	7	5	6	29	63
				Time before incorporation in soil							
				0		4 hours		6 hours		Not incorporated	
				Cattle	Swine	Cattle	Swine	Cattle	Swine	Cattle	Swine
Solid manure											
Broad spreading	winter-spring	81	81	-	-	60	60	12	12	9	9
Broad spreading	spring-summer	0	0	-	-	-	-	-	-	-	-
Broad spreading	late summer-autumn	19	19	-	-	8,5	8,5	8,5	8,5	2	2
Total		100	100	-	-	68.5	68.5	20.5	20.5	11	11

Annex 2C.2 Background information - NH_3 from Agricultural Soils

1. Synthetic fertiliser

Since 1985 there has been a significant decrease in use of synthetic fertiliser. This is due to requirements to utilising of nitrogen in manure as outlined for example in the Action Plan on the Aquatic Environment. Further, the use of different fertiliser types has changed. At present, urea constitutes less than 1% of the total nitrogen used as fertiliser (Table 2C.6). It is estimated that 1.9% of the total nitrogen used in synthetic fertiliser is emitted as ammonia in 2007. It means the implied emission factor for 2007 is 1.9% compared to 10% in the EMEP-CLRTAP Guidebook.

Data on the use of synthetic fertiliser is based on the sale estimations collected by the Danish Plant Directorate (2007). Emission factors are based on the values given in EMEP/EEA (2009).

The use of mineral fertiliser includes fertiliser used in parks, golf courses and private gardens. Approximately 1-2 percent of the mineral fertiliser can be related to this use out side the agriculture area.

Table 2C.6 Synthetic fertiliser consumption 2007 and emission factors.

Synthetic fertiliser year 2007	NH_3 Emission factor[1], Kg NH_3-N pr kg N	Consumption[2], t N
Fertiliser type		
Calcium and boron calcium nitrate	0.01	0.2
Ammonium sulphate	0.02	4.5
Calcium ammonium nitrate and other nitrate types	0.01	83.4
Ammonium nitrate	0.01	6.9
Liquid ammonia	0.02	3.9
Urea	0.13	0.5
Other nitrogen fertiliser	0.06	18.1
Magnesium fertiliser	0.01	0.0
NPK-fertiliser	0.01	66.8
Diammonphosphate	0.01	0.6
Other NP fertiliser types	0.01	4.2
NK fertiliser	0.01	5.5
Total consumption of N in synthetic fertiliser		194.6
Total emission of NH_3-N (M kg)	3.69	
Average NH_3-N emission (FracGASF)	0.02	

[1] EMEP/EEA (2009).

[2] The Danish Plant Directorate.

2. Grazing

It is assumed that 5% of the manure from dairy cattle is deposited in the field, which corresponding to 18 days per year. For heifers 36% of the nitrogen in the manure is estimated deposited during grazing, 61% for suckling cows, 50% for horses and 73% for sheep and goats.

An emission factor of 7% of the total nitrogen content is assumed to evaporate as NH_3 (Jarvis *et al*. 1998a, Jarvis *et al*. 1989b and Bussink 1994). The emission factor is used on all animal categories.

3. Crops

In the Danish emission inventory it is chosen to include NH_3 emission from crops, despite the uncertainties related to this emission source. Literature research shows that the volatilisation from crop types differs considerably (Andersen *et al*. 1999). The emission factors for crops are lowered from 5 to 2 % for crops and from 3 to 0.5 % for grass based on a literary survey (Gyldenkærne and Albrektsen, 2009). However, as for the emission ceiling given in the Gothenburg-Protocol and the EU NEC Directive the emission from crops is not taken into account.

Table 2C.7 Emission factor used to estimate the emission of ammonia from crops.

Emission factor	Crops kg N pr ha
Cash crops. beets and silage maize	2
Grass/clover in rotation	0.5
Permanent grass	0.5
Set-a side	0

4. Ammonia treated straw

Ammonia is used for conservation of straw for feeding. Investigations show that 80-90% of the supplied ammonia (given in NH_3-N) will emit (Andersen *et al*. 1999). However, the emissions can be reduced particularly if the right dose is used. Therefore it is estimated that the emission factor is 65% of the applied ammonia (given in NH_3-N). Information on ammonia used for treatment of straw is collected from ammonia suppliers. Ammonia treated straw has been prohibited from 2006

As for the emission ceiling given in the Gothenburg-Protocol and the EU NEC Directive the emission from ammonia treated straw is not taken into account.

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