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Danish emission inventories for stationary combustion plants

Inventories until year 2002

Research Notes from NERI No. 200

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Data sheet

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Abstract: Emission inventories for stationary combustion plants are presented and the methodologies and assumptions used for the inventories are described. The pollutants considered are SO_2, NO_X, NMVOC, CH_4, CO, CO_2, N_2O, particulate matter, heavy metals, dioxins and PAH. Since 1990 the fuel consumption in stationary combustion has increased by 14% - the fossil fuel consumption however only by 8%. Despite the increased fuel consumption the emission of several pollutants has decreased due to the improved flue gas cleaning technology, improved burner technology and the change of fuel type used. A considerable decrease of the SO_2, NO_X and heavy metal emissions is mainly a result of decreased emissions from large power plants and waste incineration plants. The greenhouse gas emission has decreased 1,3% since 1990. The emission of CH_4, however, has increased due to increased use of lean-burn gas engines in CHP plants. The emission of PAH increased as a result of the increased combustion of wood in residential boilers and stoves. Uncertainties for the emissions and trends have been estimated.

Keywords:	Emission, combustion, power plants, district heating, CHP, co-generation, incineration, MSW, SO_2, NO_X, NMVOC, CH_4, CO, CO_2, N_2O, PM, heavy metals, dioxin, PAH, greenhouse gas
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Preface

The Danish National Environmental Research Institute (NERI) prepares the Danish atmospheric emission inventories and reports the results on an annual basis to the Climate Convention and to the UNECE Convention on Long-Range Transboundary Air Pollution. This report forms part of the documentation for the inventories and covers emissions from stationary combustion plants. The results of inventories up to 2002 are included. The report updates a similar report published in 2003.

This year the report has been externally reviewed by Jan Erik Johnsson from the Technical University of Denmark. The changes of *emission factors* suggested by Jan Erik Johnsson will not be included until the 2005 reporting, because the review was performed after the 2004 reporting to the Climate Convention and the LRTAP Convention.

Sammendrag

Opgørelser over de samlede danske luftemissioner rapporteres årligt til Klimakonventionen (*UN Framework Convention on Climate Change, UNFCCC*) og til UNECE Konventionen om langtransporteret grænseoverskridende luftforurening (*UNECE Convention on Long-Range Transboundary Air Pollution* der forkortes LRTAP Convention). Endvidere rapporteres drivhusgasemissionen til EU fordi EU – såvel som de enkelte medlemslande – har ratificeret klimakonventionen. De danske emissioner opgøres og rapporteres af Danmarks Miljøundersøgelser (DMU). Emissionsopgørelserne omfatter følgende stoffer af relevans for stationær forbrænding: CO_2, CH_4, N_2O, SO_2, NO_X, NMVOC, CO, partikler, tungmetaller, dioxin og PAH. Foruden de årlige opgørelser over total emission rapporteres også sektoropdelt emission og usikkerhed på opgørelserne. 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 (EMEP/Corinair 2003 og IPCC 1996) 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 2002 er 63 stationære forbrændingsanlæg defineret som punktkilder. Punktkilderne omfatter: kraftværker, decentrale kraftvarmeværker, affaldsforbrændingsanlæg, industrielle forbrændingsanlæg samt raffinaderier. Brændselsforbruget for disse anlæg svarer til 57% af det samlede brændselsforbrug for alle stationære forbrændingsanlæg.

Variationen i årlig import/eksport af strøm medfører at det totale danske brændselsforbrug varierer. Siden 1990 er brændselsforbruget steget med 14%, mens forbruget af fossile brændsler er steget med 8%. 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 samlede danske emission: SO_2, CO_2, tungmetaller og PAH. Endvidere udgør emissionen over 10% for NO_X, CO, NMVOC og partikler. Stationær forbrænding bidrager med mindre end 10% af den samlede danske emission af CH_4 og N_2O.

Indenfor de stationære forbrændingsanlæg er kraftværker og decentrale kraftvarmeværker den betydeligste emissionskilde for SO_2, CO_2, NO_X, og tungmetaller. Gasmotorer installeret på decentrale kraftvarmeværker er den største

CH_4 emissionskilde. Endvidere har gasmotorer en betydelig emission af NMVOC.

Emissioner fra kedler, brændeovne mv. i forbindelse med beboelse er den betydeligste emissionskilde for CO, NMVOC, partikler og PAH. Det er især forbrænding af træ, som bidrager til disse emissioner.

I rapporten vises tidsserier for emissioner fra stationær forbrænding.

Udviklingen i emissionen af drivhusgasser følger udviklingen i CO_2-emissionen ganske tæt. Både CO_2-emissionen og den samlede drivhusgasemission fra stationær forbrænding er faldet lidt fra 1990 til 2002 – CO_2 med 2,3% og drivhusgasemissionen med 1,3%. Emissionerne fluktuerer dog betydeligt pga. variationerne i import/eksport af strøm samt varierende udetemperatur.

CH_4-emissionen fra stationær forbrænding er steget med en faktor 4,5 siden 1990. Denne stigning skyldes, at der i perioden er installeret et betydeligt antal gasmotorer på decentrale kraftvarmeværker.

SO_2-emissionen fra stationær forbrænding er faldet med 95% siden 1980 og 83% siden 1995. 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 50% siden 1985 og 34% siden 1995. 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 strøm.

Forbrænding af træ i villakedler og brændeovne er forøget med 65% siden 1990 og dette har medført en stigning i CO-emissionen. Stigningen i CO-emissionen er dog ikke helt så stor, idet CO-emissionen fra halmfyrede gårdanlæg samtidig er faldet betydeligt.

Emissionen af NMVOC fra stationær forbrænding er øget med 40% siden 1985 og 14% siden 1995. Stigningen skyldes primært idriftsættelsen af gasmotorer på decentrale kraftvarmeværker.

Tungmetalemissionerne er faldet betydeligt siden 1990. Emissionen af de enkelte tungmetaller er reduceret mellem 8% og 84%. Faldet skyldes den forbedrede røggasrensing på affaldsforbrændingsanlæg og på kraftværker.

Emissionen af de forskellige PAH'er er steget 30-60% siden 1990, hvilket hænger sammen med den øgede mængde træ, der forbrændes i brændeovne eller små villakedler.

Summary

Danish emission inventories are prepared on an annual basis and are reported to the *UNECE Framework Convention on Climate Change* (UNFCCC or Climate Convention) and to the UNECE *Convention on Long-Range Transboundary Air Pollution* (LRTAP Convention). Furthermore, a greenhouse gas emission inventory is reported to the EU, due to the EU – as well as the individual member states – being party to the Climate Convention. The annual Danish emission inventories are prepared by the Danish National Environmental Research Institute (NERI). The inventories include the pollutants: CO_2, CH_4, N_2O, SO_2, NO_X, NMVOC, CO, particulate matter, heavy metals, dioxins and PAH. In addition to annual total emissions, the report includes sector specific emissions and uncertainty estimates. Every 5 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 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 (EMEP/Corinair 2003 and IPCC 1996). 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 2002, 63 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 57% of the overall fuel consumption of stationary combustion.

The Danish fuel consumption rate fluctuates due to the import/export of electricity. Since 1990 fuel consumption has increased by 14%, fossil fuel consumption, however, only increasing by 8%. The use of coal has decreased whereas the use of natural gas and renewable fuels has increased.

Stationary combustion plants account for more than 50% of the total Danish emission for the following pollutants: SO_2, CO_2, heavy metals and PAH. Furthermore, emissions from stationary combustion plants account for more than 10% of the total Danish emission for the following pollutants: NO_X, CO, NMVOC and particulate matter. Stationary combustion plants account for less than 10% of the total Danish CH_4 and N_2O emission.

Public power plants represent the most important stationary combustion emission source for SO_2, CO_2, NO_X and heavy metals.

Lean-burn gas engines installed in decentralised CHP plants are the largest emission source for CH_4. Furthermore, these plants also represent a considerable emission source for NMVOC.

Residential plants are the most important stationary combustion source for CO, NMVOC, particulate matter and PAH. Wood combustion in residential plants is the predominant emission source.

The report in hand includes time-series for stationary combustion plants for the range of pollutants.

The development in greenhouse gas (GHG) emission follows that of CO_2 emission very closely. Both CO_2 and the total GHG emission decreased slightly from 1990 to 2002, CO_2 by 2,3% and GHG by 1,3%. However, fluctuations in the GHG emission level are significant, the fluctuations in the time-series arising from electricity import/export and outdoor temperature variations from year to year.

The CH_4 emission from stationary combustion has increased by a factor of 4,5 since 1990. This is a result of the considerable number of lean-burn gas engines installed in CHP plants in Denmark during this period.

SO_2 emission from stationary combustion plants has decreased by 95% from 1980 and 83% from 1995. The large emission decrease is mainly a result of the reduced emission from electricity and district heat production made possible by installation of desulphurisation plants and due to the use of fuels with lower sulphur content.

The NO_x emission from stationary combustion plants has decreased by 50% since 1985 and 34% since 1995. The reduced emission is mainly a result of the reduced emission from electricity and district heat production plants in which the use of low NO_x burners has increased. Also, de-NO_x flue gas cleaning units have been put into operation in a greater number of the larger power plants. The fluctuations in the time-series follow fluctuations in fuel consumption in power plants, these occurring due to electricity import/export.

Wood consumption in residential plants has increased by 65% since 1990 causing an increase in the CO emission. The increase in CO from residential plants is less steep than the increase in wood consumption as the CO emission from straw-fired farmhouse boilers has decreased considerably.

The NMVOC emission from stationary combustion plants has increased by 40% from 1985 and 14% from 1995. The increased NMVOC emission results mainly from the increased use of lean-burn gas engines.

All heavy metal emissions have decreased considerably since 1990 – between 8% and 84%. The decreases result from improvements in flue gas cleaning systems installed in municipal waste incineration plants and in power plants.

The PAH emission has increased since 1990 due to increased combustion of wood in residential plants.

1 Introduction

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

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

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

2 Total Danish emissions, international conventions and reduction targets

2.1 Total Danish emissions

An overview of the Danish emission inventories for 2002 including all sectors is shown in Table 1-Table 4. The emission inventories reported to the LRTAP Convention and to the Climate Convention are organised in 6 main source categories and a number of sub categories. The emission source *1 Energy* covers combustion in stationary and mobile sources as well as fugitive emissions from the energy sector. Emissions from incineration of municipal waste in power plants or district heating plants are included in the source category *1 Energy*, rather than in the source category *6 Waste*.

Links to the latest emission inventories can be found on the NERI home page: *http://www2.dmu.dk/1_Viden/2_Miljoe-tilstand/3_luft/4_adaei/default_en.asp* or via www.dmu.dk. Surveys of the latest inventories and the updated emission factors are also available on the NERI homepage.

Note that according to convention decisions emissions from certain specific sources are not included in the inventory totals. These emissions are reported as memo items and are thus estimated, but not included in the totals. The data for the total Danish emission included in this report does not include memo items.

- CO_2 emission from renewable fuels is not included in national totals, but reported as a memo item.
- Emissions from international bunkers and from international aviation are not included in national totals.

Further emission data for stationary combustion plants are provided in Chapters 5-9.

Table 1 Greenhouse gas emission for the year 2002 (Illerup et al. 2004a).

Pollutant	CO_2	CH_4	N_2O	HFCs, PFCs and SF6
Unit		Gg CO_2 equivalent		
1. Energy	52457	739	832	
2. Industrial Processes	1595	-	774	716
3. Solvent and Other Product Use	112	-	-	
4. Agriculture	-	3764	6370	
5. Land-Use Change and Forestry	-3813	-	-	
6. Waste	-	1131	-	
Total Danish emission (gross)[1)]		**68491**		
Total Danish emission (net) [2)]		**64678**		

1) Not including Land-Use Change and Forestry
2) Including Land-Use Change and Forestry

Table 2 Emissions 2002 reported to the LRTAP Convention (Illerup et al. 2004b).

Pollutant	NO_x Gg	CO Gg	NMVOC Gg	SO_2 Gg	TSP Mg	PM_{10} Mg	$PM_{2.5}$ Mg
1. Energy	200	577	84	25	16633	14311	12447
2. Industrial Processes	0,4	-	1	-	501	306	204
3. Solvent and Other Product Use	-	-	38	-	-	-	-
4. Agriculture	-	-	1	-	16653	7495	1665
5. Land-Use Change and Forestry	-	-	-	-	-	-	-
6. Waste	-	-	-	-	-	-	-
Total Danish emission	**200**	**577**	**124**	**25**	**33788**	**22112**	**14316**

Table 3 Emissions 2002 reported to the LRTAP Convention (Illerup et al. 2004b).

Pollutant	Pb Mg	Cd Mg	Hg Mg	As Mg	Cr Mg	Cu Mg	Ni Mg	Se Mg	Zn Mg
1. Energy	5,19	0,66	1,19	0,77	1,64	8,64	13,38	1,88	22,91
2. Industrial Processes	0,07	0,005	-	-	-	0,04	-	-	0,63
3. Solvent and Other Product Use	-	-	-	-	-	-	-	-	-
4. Agriculture	-	-	-	-	-	-	-	-	-
5. Land-Use Change and Forestry	-	-	-	-	-	-	-	-	-
6. Waste	-	-	-	-	-	-	-	-	-
Total Danish emission	**5,25**	**0,66**	**1,19**	**0,77**	**1,64**	**8,68**	**13,38**	**1,88**	**23,54**

Table 4 Emissions 2002 reported to the LRTAP Convention (Illerup et al. 2004b).

Pollutant	Benzo(a)-pyrene Mg	Benzo(b)fluo-ranthene Mg	Benzo(k)-fluoranthene Mg	Indeno(1,2,3-c,d)pyrene Mg	Dioxin [1] g I-teq
1. Energy	2,89	3,87	1,33	2,13	30,29
2. Industrial Processes	-	-	-	-	1,00
3. Solvent and Other Product Use	-	-	-	-	13,25
4. Agriculture	-	-	-	-	-
5. Land-Use Change and Forestry	-	-	-	-	-
6. Waste	-	-	-	-	22,85
7. Other	-	-	-	-	10,25
Total Danish emission	**2,89**	**3,87**	**1,33**	**2,13**	**77,64**

1) Dioxin emission inventories are estimated by the Danish Environmental Protection Agency

2.2 International conventions and reduction targets

Denmark is a party to two international conventions relevant with regard to emissions from stationary combustion plants:

- The UNECE Convention on Long Range Transboundary Air Pollution (LRTAP Convention or the Geneva Convention)
- The UN Framework Convention on Climate Change under the Intergovernmental Panel on Climate Change (IPCC). The convention is also called UNFCCC or the Climate Convention.

The LRTAP Convention is a framework convention and has expanded to cover 8 protocols:

- *EMEP Protocol*, 1984 (Geneva).
- *Protocol on Reduction of Sulphur Emissions*, 1985 (Helsinki).
- *Protocol concerning the Control of Emissions of Nitrogen Oxides*, 1988 (Sofia).
- *Protocol concerning the Control of Emissions of Volatile Organic Compounds*, 1991 (Geneva).
- *Protocol on Further Reduction of Sulphur Emissions*, 1994 (Oslo).
- *Protocol on Heavy Metals*, 1988 (Aarhus).
- *Protocol on Persistent Organic Pollutants (POPs)*, 1998 (Aarhus).
- *Protocol to Abate Acidification, Eutrophication and Ground-level Ozone*, 1999 (Gothenburg).

The reduction targets/emission ceilings included in the protocols of the LRTAP Convention are stated in Table 5.

Table 5 Danish reduction targets / emission ceiling, LRTAP Convention.

Pollutant	Reduction / emission ceiling	Reference	Comment
SO_2	55 Gg in 2010	Gothenburg protocol	The ceiling equals 218% of the 2002 emission
NO_X	127 Gg in 2010	Gothenburg protocol	The ceiling equals 63% of the 2002 emission
NMVOC	85 Gg in 2010	Gothenburg protocol	The ceiling equals 69% of the 2002 emission

The Climate Convention is a framework convention from 1992. The Kyoto protocol is a protocol to the Climate Convention.

The Kyoto protocol sets legally-binding emission targets and timetables for 6 greenhouse gases: CO_2, CH_4, N_2O, HFC, PFC and SF_6. The greenhouse gas emission of each of the 6 pollutants is translated to CO_2 equivalents, which can be totalled to produce total greenhouse gas (GHG) emission in CO_2 equivalent. Denmark is obliged to reduce the average 2008-2010 GHG emission by 21% compared to the 1990 emission level.

EU is a party to the Climate Convention and, thereby, EU countries are obliged to submit emission data to the EU Monitoring Mechanism for CO_2 and other Greenhouse Gases.

3 Methodology and references

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 EMEP/Corinair Emission Inventory Guidebook 3rd edition, prepared by the UNECE/EMEP Task Force on Emissions Inventories and Projections (EMEP/Corinair 2003). 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.

The emission inventory for dioxin is reported by the Danish Environmental Protection Agency (Hansen & Hansen 2003). Dioxin emission data are presented, but not further discussed in this report.

3.1 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 both the Climate Convention and the LRTAP Convention is based on a correspondence list between SNAP and IPCC enclosed in Appendix 3.

The sector codes applied in the reporting activity will be referred to as IPCC sectors. The IPCC sectors define 6 main source categories, listed in Table 6, and a number of subcategories. Stationary combustion is part of the IPCC sector 1, *Energy*. Table 7 presents subsectors in the IPCC energy sector. The table also presents the sector in which the NERI documentation is included. Stationary combustion is defined as combustion activities in the SNAP sectors 01-03.

Table 6 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 7 IPCC source categories for the energy sector.

IPCC id	IPCC sector name	NERI reporting
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
1A2d	Pulp, Paper and Print	Stationary combustion
1A2e	Food Processing, Beverages and Tobacco	Stationary combustion
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.

3.2 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 2002, 63 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
- A few large industrial combustion plants
- Petroleum refining plants

The fuel consumption of stationary combustion plants registered as large point sources is 326 PJ (2002). This corresponds to 57% of the overall fuel consumption for stationary combustion.

A list of the large point sources for 2002 and the fuel consumption rates is provided in Appendix 7. The number of large point sources registered in the databases increased from 1990 to 2002. In the emission database for the years before 1990 no large point sources have been registered.

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 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, NMVOC, PM and metals 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 Elsam and E2, 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. Emissions of the greenhouse gases (CO_2, CH_4 and N_2O) from the large point sources are all based on the area source emission factors.

3.3 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.

3.4 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 2003a). Some fuel types in the official Danish energy statistics are added to obtain a less detailed fuel aggregation level, see Appendix 9. The calorific values on which the energy statistics are based are also enclosed in Appendix 9.

The fuel consumption of the IPCC sector *1A2 Manufacturing industries and construction* (corresponding to SNAP sector *03 Combustion in manufacturing industries)* has not yet been disaggregated into specific industries. In Climate Convention reporting, the emissions are included in sector *1A2f Industry, Other* as, technically, it is not possible to report the emission in the aggregated source category, *1A2 Manufacturing industries and construction*. However, NERI and the Danish Energy Authority have initiated work that should ensure that fuel consumption rates in each industrial subsector will be able to be reported in the year to come.

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 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 databases refers to this database (DEA 2003c).

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

Emissions from non-energy use of fuels have not been included in the Danish inventory, to date, but the non-energy use of fuels is, however, included in the reference approach for Climate Convention reporting. The Danish energy statistics include three fuels used for non-energy purposes: Bitumen, white spirit

and lube oil. The fuels used for non-energy purposes add up to less than 2% of the total fuel consumption in Denmark.

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

Fuel consumption data are presented in Chapter 4.

3.5 Emission factors

For each fuel and SNAP category (sector and e.g. type of plant) a set of general area source emission factors has been determined. The emission factors are either nationally referenced or based on the international guidebooks: EMEP/Corinair Guidebook (EMEP/Corinair 2003) and IPCC Reference Manual (IPCC 1996).

A complete list of emission factors including time-series and references is provided in Appendix 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 6. The implied emission factors are calculated as total emission divided by total fuel consumption.

3.5.1 CO_2

The CO_2 emission factors applied for 2002 are presented in Table 8. For municipal waste and natural gas, time-series have been estimated. For all other fuels the same emission factor is applied for 1990-2002.

In reporting for the Climate Convention, the CO_2 emission is aggregated to five fuel types: Solid fuel, Liquid fuel, Gas, Biomass and Other fuels. The correspondence list between the NERI fuel categories and the IPCC fuel categories is also provided in Table 8.

Only emissions from fossil fuels are included in the national total CO_2 emission. The biomass emission factors are also included in the table, because emissions from biomass are reported to the Climate Convention as a memo item.

The CO_2 emission from incineration of municipal waste (94,5 + 17,6 kg/GJ) is divided into two parts: The emission from combustion of the plastic content of the waste, which is included in the national total, and the emission from combustion of the rest of the waste – the biomass part, which is reported as a memo item. In the IPCC reporting, the CO_2 emission from combustion of the plastic content of the waste is reported in the fuel category, *Other fuels*. However, this split is not applied in either fuel consumption or other emissions, because it is only relevant for CO_2. Thus, the full consumption of municipal waste is included in the fuel category, *Biomass,* and the full amount of non-CO_2

emissions from municipal waste combustion is also included in the *Biomass*-category.

The CO_2 emission factors have been confirmed by the two major power plant operators, both directly (Christiansen, 1996 and Andersen, 1996) and indirectly, by applying the NERI emission factors in the annual environmental reports for the large power plants and by accepting use of the NERI factors in Danish legislation.

Danish legislation concerning CO_2 emission from power plants (Lov nr. 376 1999) has been based on standard CO_2 emission factors for each fuel. Thus, power plant operators have not been encouraged to estimate CO_2 emission factors based on their own fuel analysis. In future legislation (Lov om CO_2-kvoter, høringsudgave 2004) operators of large power plants are obliged to verify the applied emission factors, which will lead to the availability of improved emission factors for national emission inventories in future.

Table 8 CO_2 emission factors 2002.

Fuel	Emission factor		Unit	Reference type	IPCC fuel
	Biomass	Fossil fuel			Category
Coal		95	kg/GJ	Country specific	Solid
Brown coal briquettes		94,6	kg/GJ	IPCC reference manual	Solid
Coke oven coke		108	kg/GJ	IPCC reference manual	Solid
Petroleum coke		92	kg/GJ	Country specific	Liquid
Wood	102		kg/GJ	Corinair	Biomass
Municipal waste	94,5	17,6	kg/GJ	Country specific	Biomass / Other fuels
Straw	102		kg/GJ	Country specific	Biomass
Residual oil		78	kg/GJ	Corinair	Liquid
Gas oil		74	kg/GJ	Corinair	Liquid
Kerosene		72	kg/GJ	Corinair	Liquid
Fish & rape oil	102		kg/GJ	Corinair	Biomass
Orimulsion		80	kg/GJ	Country specific	Liquid
Natural gas		57,28	kg/GJ	Country specific	Gas
LPG		65	kg/GJ	Corinair	Liquid
Refinery gas		56,9	kg/GJ	Country specific	Liquid
Biogas	83,6		kg/GJ	Country specific	Biomass

Coal

The emission factor 95 kg/GJ is based on Fenhann & Kilde 1994. The CO_2 emission factors have been confirmed by the two major power plant operators in 1996 (Christiansen 1996 and Andersen 1996). Elsam reconfirmed the factor in 2001 (Christiansen 2001). The same emission factor is applied for 1990-2002.

Brown coal briquettes

The emission factor 94,6 kg/GJ is based on a default value from the IPCC guidelines assuming full oxidation. The default value in the IPCC guidelines is 25,8 t C/TJ, corresponding to $25{,}8 \cdot (12+2 \cdot 16)/12 = 94{,}6$ kg CO_2/GJ assuming full oxidation. In the inventories for 1990-2001 brown coal briquettes have been included in the fuel category, coal.

Coke oven coke

The emission factor 108 kg/GJ is based on a default value from the IPCC guidelines assuming full oxidation. The default value in the IPCC guidelines is 29,5 t C/TJ, corresponding to 29,5·(12+2·16)/12 = 108 kg CO_2/GJ assuming full oxidation. In the inventories for 1990-2001 coke has been included in the fuel category, coal.

Petroleum coke

The emission factor 92 kg/GJ has been estimated by SK Energy (a former major power plant operator in eastern Denmark) in 1999 based on a fuel analysis carried out by dk-Teknik in 1993 (Bech 1999). The emission factor level was confirmed by a new fuel analysis, which, however, is considered confidential. The same emission factor is applied for 1990-2002.

Wood

The emission factor for wood, 102 kg/GJ, refers to Fenhann & Kilde 1994. The factor is based on the interval stated in a former edition of the EMEP/Corinair Guidebook and the actual value is the default value from the Collector database. The same emission factor is applied for 1990-2002.

Municipal waste

The CO_2 emission from incineration of municipal waste is divided into two parts: The emission from combustion of the plastic content of the waste, which is included in the national total, and the emission from combustion of the rest of the waste – the biomass part, which is reported as a memo item.

The plastic content of waste was estimated to be 6,6 w/w% in 2003 (Hulgaard 2003). The weight share, lower heating values and CO_2 emission factors for different plastic types are estimated by Hulgaard in 2003 (Table 9). The total weight share for plastic and for the various plastic types is assumed to be the same for all years (NERI assumption).

Table 9 Data for plastic waste in Danish municipal waste (Hulgaard 2003)[1)2)].

Plastic type	Mass share of plastic in municipal waste in Denmark		Lower heating value of plastic	Energy content of plastic	CO_2 emission factor for plastic	CO_2 emission factor
	kg plastic/ kg municipal waste	% of plastic	MJ/kg plastic	MJ/kg municipal waste	g/MJ plastic	g/kg municipal waste
PE	0,032	48	41	1,312	72,5	95
PS/EPS	0,02	30	37	0,74	86	64
PVC	0,007	11	18	0,126	79	10
Other (PET, PUR, PC, POM, ABS, PA etc.)	0,007	11	24	0,168	95	16
Total	0,066	100	35,5	2,346	78,7	185

Hulgaard 2003 refers to:
1) TNO report 2000/119, Eco-efficiency of recovery scenarios of plastic packaging, Appendices, July 2001 by P.G. Eggels, A.M.M. Ansems, B.L. van der Ven, for Association of Plastic Manufacturers in Europe
2) Kost, Thomas, Brennstofftechnische Charakterisierung von Haushaltabfällen, Technische Universität Dresden, Eigenverlag des Forums für Abfallwirtschaft und Altlasten e.V., 2001

Based on emission measurements on 5 municipal waste incineration plants (Jørgensen & Johansen, 2002) the total CO_2 emission factor for municipal waste incineration has been determined to be 112,1 kg/GJ. The CO_2 emission from the biomass part is the total CO_2 emission minus the CO_2 emission from the plastic part.

Thus, in 2003 the CO_2 emission factor for the plastic content of waste was estimated to be 185g/kg municipal waste (Table 9). The CO_2 emission per GJ of waste is calculated based on the lower heating values for waste listed in Table 10 (DEA 2003b). It has been assumed that the plastic content in weight per cent is constant, resulting in a decreasing energy per cent since the lower heating value (LHV) is increasing. However, the increasing LHV may be a result of increasing plastic content in the municipal waste and this will be investigated in future work. Time-series for the CO_2 emission factor for plastic content in waste are included in Table 10.

Emission data from four waste incineration plants (Jørgensen & Johansen 2002) demonstrate the fraction of the carbon content of the waste not oxidised to be approximately 0,3%. The unoxidised fraction of the carbon content is assumed to originate from the biomass content, and all carbon originating from plastic are assumed to be oxidised.

Table 10 CO_2 emission factor for municipal waste, plastic content and biomass content.

Year	Lower heating value of municipal waste [1]	Plastic content	CO_2 emission factor for plastic [3]	CO_2 emission factor for plastic	CO_2 emission factor for municipal waste, total [2]	CO_2 emission factor for biomass content of waste
	[GJ/Mg]	[% of energy]	[g/kg waste]	[kg/GJ waste]	[kg/GJ waste]	[kg/GJ waste]
1990	8,20	28,6	185	22,5	112,1	89,6
1991	8,20	28,6	185	22,5	112,1	89,6
1992	9,00	26,1	185	20,5	112,1	91,6
1993	9,40	25,0	185	19,6	112,1	92,5
1994	9,40	25,0	185	19,6	112,1	92,5
1995	10,00	23,5	185	18,5	112,1	93,6
1996	10,50	22,3	185	17,6	112,1	94,5
1997	10,50	22,3	185	17,6	112,1	94,5
1998	10,50	22,3	185	17,6	112,1	94,5
1999	10,50	22,3	185	17,6	112,1	94,5
2000	10,50	22,3	185	17,6	112,1	94,5
2001	10,50	22,3	185	17,6	112,1	94,5
2002	10,50	22,3	185	17,6	112,1	94,5

1) DEA 2003b
2) Based on data from Jørgensen & Johansen 2002
3) From Table 9

Straw

The emission factor for straw, 102 kg/GJ refers to Fenhann & Kilde 1994. The factor is based on the interval stated in the EMEP/Corinair Guidebook (EMEP/Corinair 2003) and the actual value is the default value from the Collecter database. The same emission factor is applied for 1990-2002.

Residual oil

The emission factor 78 kg/GJ refers to Fenhann & Kilde 1994. The factor is based on the interval stated in the EMEP/Corinair Guidebook (EMEP/Corinair 2003). The factor is slightly higher than the IPCC default emission factor for residual fuel oil (77,4 kg/GJ assuming full oxidation). The CO_2 emission factors have been confirmed by the two major power plant operators in 1996 (Christiansen 1996 and Andersen 1996). The same emission factor is applied for 1990-2002.

Gas oil

The emission factor 74 kg/GJ refers to Fenhann & Kilde 1994. The factor is based on the interval stated in the EMEP/Corinair Guidebook (EMEP/Corinair 2003). The factor agrees with the IPCC default emission fac-

tor for gas oil (74,1 kg/GJ assuming full oxidation). The CO_2 emission factors have been confirmed by the two major power plant operators in 1996 (Christiansen 1996 and Andersen 1996). The same emission factor is applied for 1990-2002.

Kerosene

The emission factor 72 kg/GJ refers to Fenhann & Kilde 1994. The factor agrees with the IPCC default emission factor for other kerosene (71,9 kg/GJ assuming full oxidation). The same emission factor is applied for 1990-2002.

Fish & rape oil

The emission factor is assumed to be the same as for straw – 102 kg/GJ. In the period 1990-2000 fish and rape oil have been included in the fuel category, straw. The consumption of fish and rape oil is relatively low.

Orimulsion

The emission factor 80 kg/GJ refers to the Danish Energy Authority (DEA 2004). The IPCC default emission factor is almost the same: 80,7 kg/GJ assuming full oxidation. The CO_2 emission factors have been confirmed by the only major power plant operator using orimulsion (Andersen 1996). The same emission factor is applied for 1990-2002.

Natural gas

The emission factor for natural gas is estimated by the Danish gas transmission company, DONG (Lindgren 2003). Only natural gas from the Danish gas fields is utilised in Denmark. The calculation is based on gas analysis carried out daily by DONG. DONG and the Danish Gas Technology Centre have calculated emission factors for 2000-2002. The emission factor applied for 1990-1999 refers to Fenhann & Kilde 1994. This emission factor was confirmed by the two major power plant operators in 1996 (Christiansen 1996 and Andersen 1996). Time-series for the CO_2 emission factors is provided in Table 11.

Table 11 CO_2 emission factor for natural gas.

Year	CO_2 emission factor
1990-1999	56,9 kg/GJ
2000	57,1 kg/GJ
2001	57,25 kg/GJ
2002	57,28 kg/GJ

LPG

The emission factor 65 kg/GJ refers to Fenhann & Kilde 1994. The emission factor is based on the EMEP/Corinair Guidebook (EMEP/Corinair 2003). The emission factor is somewhat higher than the IPCC default emission factor (63 kg/GJ assuming full oxidation). The same emission factor is applied for 1990-2002.

Refinery gas

The emission factor applied for refinery gas is the same as the emission factor for natural gas 1990-1999. The emission factor is within the interval of the emission factor for refinery gas stated in the EMEP/Corinair Guidebook (EMEP/Corinair 2003). The same emission factor is applied for 1990-2002.

Biogas

The emission factor 83,6 kg/GJ is based on a biogas with 65% (vol.) CH_4 and 35% (vol.) CO_2. Danish Gas Technology Centre has stated that this is a typical manure-based biogas as utilised in stationary combustion plants (Kristensen 2001).

3.5.2 CH_4

The CH_4 emission factors applied for 2002 are presented in Table 12. In general, the same emission factors have been applied for 1990-2002. However, a time-series has been estimated for gas engines.

Emission factors for gas engines, gas turbines and CHP plants combusting wood, straw or municipal waste all refer to emission measurements carried out on Danish plants (Nielsen & Illerup 2003). Other emission factors refer to the EMEP/Corinair Guidebook (EMEP/Corinair 2003).

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

Table 12 CH_4 emission factors 1990-2002.

Fuel	ipcc_id	SNAP_id	Emission factor [g/GJ]	Reference
COAL	1A1a	010101, 010102, 010103	1,5	EMEP/Corinair 2003
COAL	1A1a, 1A2f, 1A4b, 1A4c	010202, 010203, 0301, 0202, 0203	15	EMEP/Corinair 2003
BROWN COAL BRI.	all	all	15	EMEP/Corinair 2003, assuming same emission factor as for coal
COKE OVEN COKE	all	all	15	EMEP/Corinair 2003, assuming same emission factor as for coal
PETROLEUM COKE	all	all	15	EMEP/Corinair 2003
WOOD AND SIMIL.	1A1a	010102, 010103, 010104	2	Nielsen & Illerup 2003
WOOD AND SIMIL.	1A4b	0202	200	EMEP/Corinair 2003
WOOD AND SIMIL.	1A1a, 1A2f, 1A4a, 1A4c	all other	32	EMEP/Corinair 2003
MUNICIP. WASTES	1A1a	010102, 010103, 010104, 010105	0,59	Nielsen & Illerup 2003
MUNICIP. WASTES	1A1a, 1A2f, 1A4a	all other	6	EMEP/Corinair 2003
STRAW	1A1a	010102, 010103	0,5	Nielsen & Illerup 2003
STRAW	1A1a, 1A2f	010202, 010203, 030102, 030105	32	EMEP/Corinair 2003
STRAW	1A4a, 1A4b, 1A4c	0201, 0202, 0203, 020302	200	EMEP/Corinair 2003
RESIDUAL OIL	all	all	3	EMEP/Corinair 2003
GAS OIL	all	all	1,5	EMEP/Corinair 2003
KEROSENE	all	all	7	EMEP/Corinair 2003
FISH & RAPE OIL	1A1a	010203	32	EMEP/Corinair 2003, assuming same emission factor as straw
FISH & RAPE OIL	1A2f	030105	32	EMEP/Corinair 2003, assuming same emission factor as straw
FISH & RAPE OIL	1A4c	020304	200	EMEP/Corinair 2003, assuming same emission factor as straw
ORIMULSION	1A1a	010101	3	EMEP/Corinair 2003, assuming same emission factor as residual oil
NATURAL GAS	1A1a	0101, 010101, 010102, 010202	6	DGC 2001
NATURAL GAS	1A1a	010103, 010203	15	Gruijthuijsen & Jensen 2000
NATURAL GAS	1A1a, 1Ab, 1Ac, 1A2f, 1A4a, 1A4c	Gas turbines: 010104, 010304, 010504, 030104, 020104, 020303	1,5	Nielsen & Illerup 2003
NATURAL GAS	1A1a, 1A1c, 1A2f, 1A4a, 1A4b, 1A4c	Gas engines: 010105, 010405, 010505, 030105, 020105, 020204, 020304	1) 520	Nielsen & Illerup 2003
NATURAL GAS	1A1c, 1A2f, 1A4a, 1A4b, 1A4c	010502, 0301, 0201, 0202, 0203	6	DGC 2001
NATURAL GAS	1A2f, 1A4a, 1A4b	030103, 030106, 020103, 020202	15	Gruijthuijsen & Jensen 2000
LPG	all	all	1	EMEP/Corinair 2003
REFINERY GAS	1A1b	010303, 010304	2	EMEP/Corinair 2003
BIOGAS	1A1a, 1A1c, 1A2f, 1A4a, 1A4c	Gas engines: 010105, 010405, 010505, 030105, 020105, 020304	323	Nielsen & Illerup 2003
BIOGAS	1A1a, 1A2f, 1A4a, 1A4c	all other	4	EMEP/Corinair 2003

1) 2002 emission factor. Time-series is shown below

3.5.2.1 CHP plants

A considerable portion of the electricity production in Denmark is based on decentralised CHP plants, and well-documented emission factors for these plants are, therefore, of importance. In a project carried out for the electricity transmission company in Western Denmark, Eltra, emission factors for CHP plants <25MW_e have been estimated. The work was reported in 2003 (Nielsen & Illerup 2003) and the results have been fully implemented in the inventory reported in 2004.

The work included municipal waste incineration plants, CHP plants combusting wood and straw, natural gas and biogas-fuelled (reciprocating) engines, and natural gas fuelled gas turbines. CH_4 emission factors for these plants all refer to Nielsen & Illerup 2003. The estimated emission factors were based on existing emission measurements as well as on emission measurements carried out within the project. The number of emission data sets was comprehensive. Emission factors for subgroups of each plant type were estimated, e.g. the CH_4 emission factor for different gas engine types have been determined.

Gas engines, natural gas

SNAP 010105, 010405, 010505, 020105, 020204, 020304 and 030105

The emission factor for natural gas engines was determined as 520 g/GJ in 2000 and the same emission factor has been applied for 2001 and 2002. The emission factor for natural gas engines was based on 291 emission measurements on 114 different plants. The plants from which emission measurements were available represent 44% of the total gas consumption in gas engines. The emission factor was estimated based on fuel consumption of each gas engine type and the emission factor for each engine type. The majority of emission measurements that were not performed within the project related solely to emission of total unburned hydrocarbon (CH_4 + NMVOC). A constant disaggregation factor was estimated based on a number of emission measurements including both CH_4 and NMVOC.

The emission factor for lean-burn gas engines is relatively high, especially for prechamber engines, which account for more than half the gas consumption in Danish gas engines. However, the emission factors for different prechamber engine types differ considerably.

The installation of natural gas engines in decentralised CHP plants in Denmark has taken place since 1990. The first engines installed were relatively small open-chamber engines and in later years prechamber engines were mainly installed. As mentioned above, prechamber engines have a higher emission factor than open-chamber engines, therefore, the emission factor has changed during the period 1990-2002. A time-series for the emission factor has been estimated and is presented below (Nielsen & Illerup 2003). The time-series was based on:

- Emission factors for different engine types
- Data for year of installation for each engine and fuel consumption of each engine 1994-2002 from the Danish Energy Authority (DEA 2003c)
- Research concerning the CH_4 emission from gas engines carried out in 1997 (Nielsen & Wit 1997)

Table 13 Time-series for the CH_4 emission factor for natural gas fuelled engines.

Year	Emission factor [g/GJ]
1990	257
1991	299
1992	347
1993	545
1994	604
1995	612
1996	596
1997	534
1998	525
1999	524
2000	520
2001	520
2002	520

Gas engines, biogas

SNAP 010105, 010405, 010505, 020105, 020304 and 030105

The emission factor for biogas engines was estimated to 323 g/GJ in 2000 and the same emission factor has been applied for 2001 and 2002. The emission factor for biogas engines was based on 18 emission measurements on 13 different plants. The plants from which emission measurements were available represent 18% of the total gas consumption in gas engines.

The emission factor is lower than the factor for natural gas, mainly because most engines are lean-burn open-chamber engines - not prechamber engines. A time-series for the emission factor has been estimated. Danish energy statistics only specify biogas consumption in gas engines from 1998, the emission factor time-series for 1998-2002 being presented below. Despite that biogas consumption in gas engines actually started before 1998, the error is considered acceptable due to the consumption being very low.

Table 14 Time-series for the CH_4 emission factor for biogas fuelled engines.

Year	Emission factor [g/GJ]
1998	314
1999	318
2000	323
2001	323
2002	323

Gas turbines, natural gas

SNAP 010104, 010304, 010504, 020104, 020303 and 030104

The emission factor for gas turbines was estimated to be below 1,5g/GJ and the emission factor 1,5 g/GJ has been applied for all years. The emission factor was based on emission measurements on 9 plants.

CHP, wood

SNAP 010102 and, 010103 and 010104

The emission factor for CHP plants combusting wood was estimated to be below 2,1 g/GJ and the emission factor 2,1 g/GJ has been applied for all years. The emission factor was based on emission measurements on 3 plants.

CHP, straw

SNAP 010102 and 010103

The emission factor for CHP plants combusting straw was estimated to be below 0,5g/GJ and the emission factor 0,5g/GJ has been applied for all years. The emission factor was based on emission measurements on 4 plants.

CHP, municipal waste

SNAP 010102, 010103, 010104 and 010105

The emission factor for CHP plants combusting municipal waste was estimated to be below 0,6g/GJ and the emission factor 0,6g/GJ has been applied for all years. The emission factor was based on emission measurements on 16 plants.

3.5.2.2 Other stationary combustion plants

Emission factors for other plants refer to the EMEP/Corinair Guidebook (EMEP/Corinair 2003), the Danish Gas Technology Centre (DGC 2001) or Gruijthuijsen & Jensen 2000. The same emission factors are applied for 1990-2002.

3.5.3 N_2O

The N_2O emission factors applied for the 2002 inventory are listed in Table 15. The same emission factors have been applied for 1990-2002.

Emission factors for gas engines, gas turbines and CHP plants combusting wood, straw or municipal waste all refer to emission measurements carried out on Danish plants (Nielsen & Illerup 2003). Other emission factors refer to the EMEP/Corinair Guidebook (EMEP/Corinair 2003).

Table 15 N_2O emission factors 1990-2002.

Fuel	ipcc_id	SNAP_id	Emission factor [g/GJ]	Reference
COAL	all	all	3	EMEP/Corinair 2003
BROWN COAL BRI.	all	all	3	EMEP/Corinair 2003
COKE OVEN COKE	all	all	3	EMEP/Corinair 2003
PETROLEUM COKE	all	all	3	EMEP/Corinair 2003
WOOD AND SIMIL.	1A1a	010102, 010103, 010104	0,8	Nielsen & Illerup 2003
WOOD AND SIMIL.	1A1a	010105, 010202, 010203, 010205	4	EMEP/Corinair 2003
WOOD AND SIMIL.	1A2f, 1A4a, 1A4b, 1A4c	all	4	EMEP/Corinair 2003
MUNICIP. WASTES	1A1a	010102, 010103, 010104, 010105	1,2	Nielsen & Illerup 2003
MUNICIP. WASTES	1A1a	010203	4	EMEP/Corinair 2003
MUNICIP. WASTES	1A2f, 1A4a	030102, 0201, 020103	4	EMEP/Corinair 2003
STRAW	1A1a	010102, 010103	1,4	Nielsen & Illerup 2003
STRAW	1A1a	010202, 010203	4	EMEP/Corinair 2003
STRAW	1A2f, 1A4a, 1A4b, 1A4c	all	4	EMEP/Corinair 2003
RESIDUAL OIL	all	all	2	EMEP/Corinair 2003
GAS OIL	all	all	2	EMEP/Corinair 2003
KEROSENE	all	all	2	EMEP/Corinair 2003
FISH & RAPE OIL	all	all	4	EMEP/Corinair 2003, assuming same emission factor as municipal waste
ORIMULSION	1A1a	010101	2	EMEP/Corinair 2003, assuming same emission factor as residual oil
NATURAL GAS	1A1a	0101, 010101, 010102, 010103, 010202, 010203	1	EMEP/Corinair 2003
NATURAL GAS	1A1a, 1Ab, 1Ac, 1A2f, 1A4a, 1A4c	Gas turbines: 010104, 010304, 010504, 030104, 020104, 020303	2,2	Nielsen & Illerup 2003
NATURAL GAS	1A1a, 1A1c, 1A2f, 1A4a, 1A4b, 1A4c	Gas engines: 010105, 010405, 010505, 030105, 020105, 020204, 020304	1,3	Nielsen & Illerup 2003
NATURAL GAS	1A1c, 1A2f, 1A4a, 1A4b, 1A4c	010502, 0301, 030103, 030106, 0201, 020103, 0202, 020202, 0203	1	EMEP/Corinair 2003
LPG	all	all	2	EMEP/Corinair 2003
REFINERY GAS	all	all	2	EMEP/Corinair 2003
BIOGAS	1A1a	010102, 010103, 010203	2	EMEP/Corinair 2003
BIOGAS	1A1a, 1A1c, 1A2f, 1A4a, 1A4c	010105, 010405, 010505, 030105, 020105, 020304	0,5	Nielsen & Illerup 2003
BIOGAS	1A2f, 1A4a, 1A4c	0301, 030102, 0201, 020103, 0203	2	EMEP/Corinair 2003

3.5.4 SO_2, NO_x, NMVOC and CO

Emission factors for SO_2, NO_x, NMVOC and CO are listed in Appendix 5. The appendix includes references and time-series.

The emission factors refer to:

- The EMEP/Corinair Guidebook (EMEP/CorinAir 2003)
- The IPCC Guidelines, Reference Manual (IPCC 1996)
- Danish legislation:
  - Miljøstyrelsen 2001 (Danish Environmental Protection Agency)
  - Miljøstyrelsen 1990 (Danish Environmental Protection Agency)
  - Miljøstyrelsen 1998 (Danish Environmental Protection Agency)
- Danish research reports including:
  - An emission measurement program for decentralised CHP plants (Nielsen & Illerup 2003)
  - Research and emission measurements programs for biomass fuels:
    - Nikolaisen et al., 1998
    - Jensen & Nielsen, 1990
    - Dyrnum et al., 1990
    - Hansen et al., 1994

  - Serup et al., 1999
  - Research and environmental data from the gas sector:
    - Gruijthuijsen & Jensen 2000
    - Danish Gas Technology Centre 2001
- Calculations based on plant-specific 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 5.

3.5.5 Particulate matter (PM)

Emission factors for PM are listed in Appendix 5. The appendix includes references. The emission factors are based on:

- The TNO/CEPMEIP emission factor database (TNO CEPMEIP 2001), and;

a considerable number of country-specific factors (Nielsen et al. 2003) referring to:

- Danish legislation:
  - Miljøstyrelsen 2001 (Danish Environmental Protection Agency).
  - Miljøstyrelsen 1990 (Danish Environmental Protection Agency).
- Calculations based on plant-specific emission data from a considerable number of municipal waste incineration plants.
- Danish research reports including:
  - 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.

The same emission factors are applied for 2000-2002.

3.5.6 Heavy metals

Emission factors for 2002 for heavy metals (HM) are presented in Appendix 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 1990-2002.

3.5.7 PAH

Emission factors 2002 for PAHs are shown in Appendix 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 2002 and Jensen 2001).

The same emission factors are applied for all years. In general, emission factors for PAH are uncertain.

4 Fuel consumption data

In 2002 total fuel consumption for stationary combustion plants was 568 PJ of which 490 PJ was fossil fuels. The fuel consumption rates are shown in Appendix 4.

Fuel consumption distributed on the stationary combustion subsectors is shown in Figure 1 and Figure 2. The majority - 59% - of all fuels is combusted in the sector, *Electricity and heat production.* Other sectors with high fuel consumption are *Residential* and *Industry*.

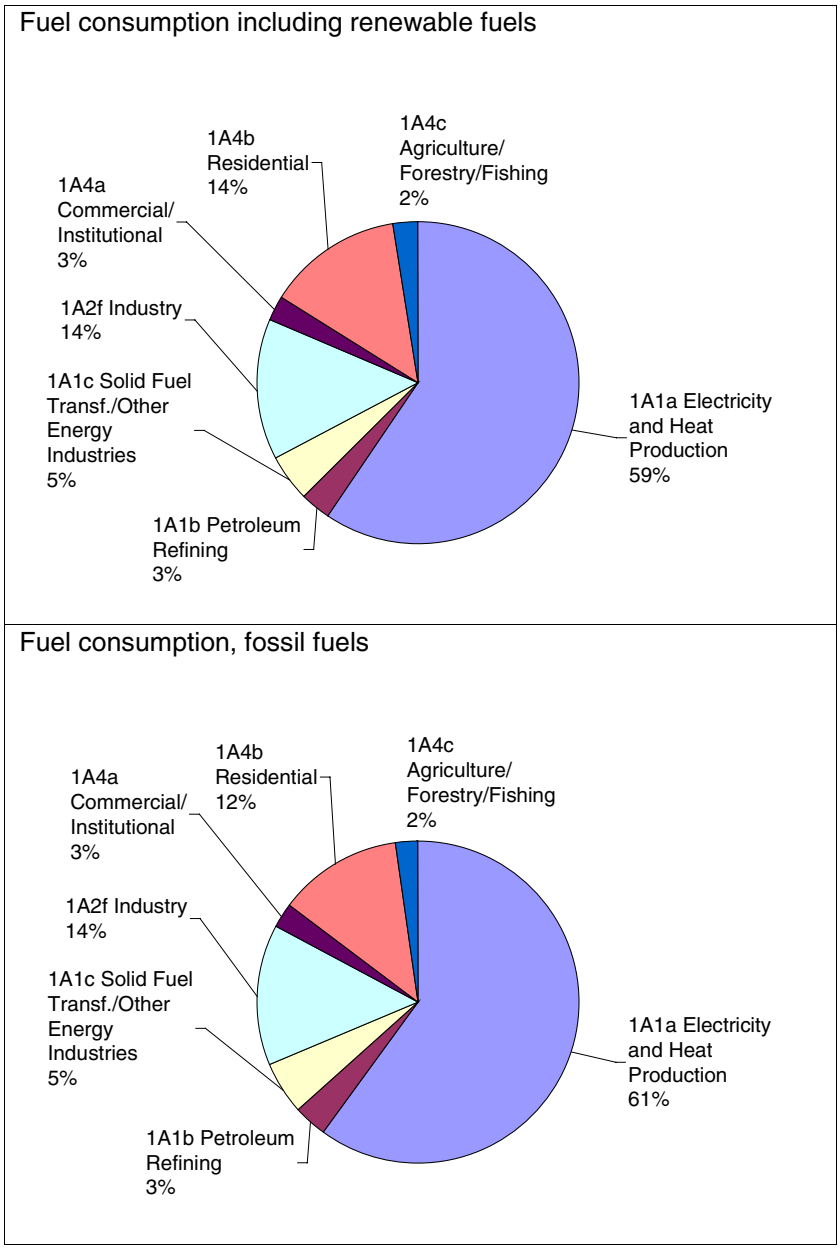


Figure 1 Fuel consumption rate of stationary combustion, 2002 (based on DEA 2003a).

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

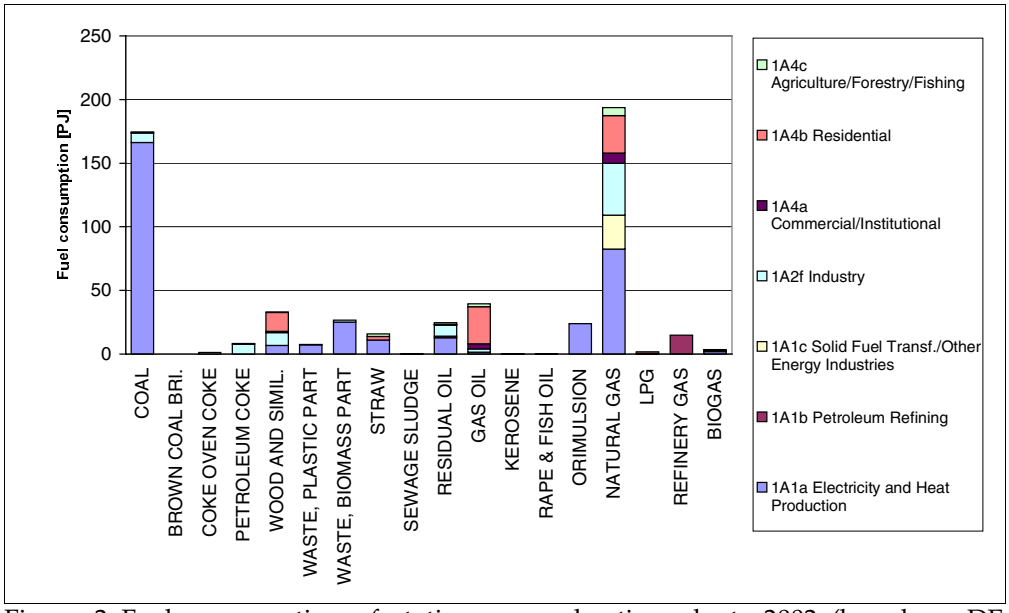


Figure 2 Fuel consumption of stationary combustion plants 2002 (based on DEA 2003a).

Fuel consumption time-series for stationary combustion plants are presented in Figure 3. The total fuel consumption has increased by 14% from 1990 to 2002, while the fossil fuel consumption has only increased by 8%. The consumption of natural gas and renewable fuels has increased since 1990 whereas coal consumption has decreased.

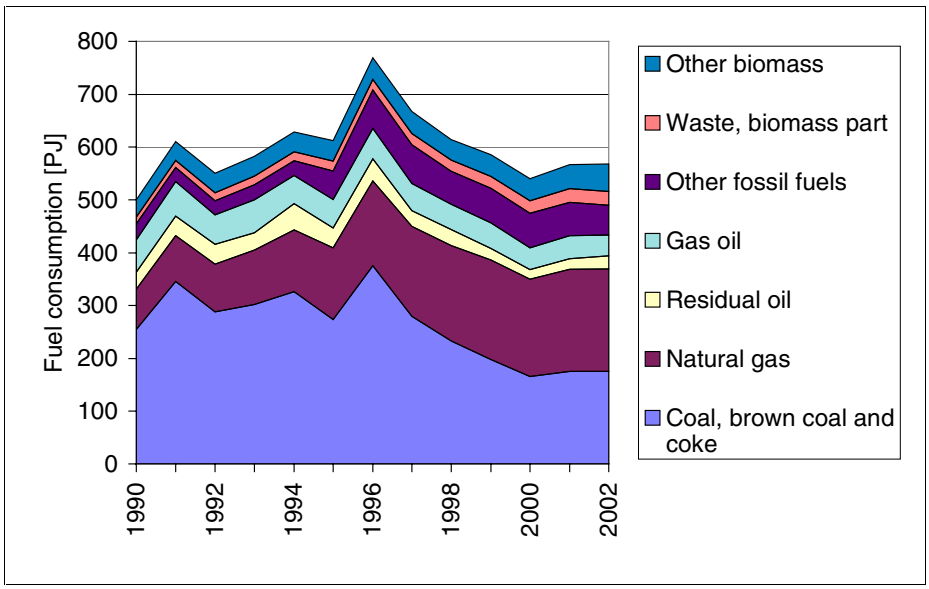


Figure 3 Fuel consumption time-series, stationary combustion (based on DEA 2003a).

The fluctuations in the time-series for fuel consumption are a result mainly 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 emission are illustrated and compared in Figure 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 2002 the net electricity export was 7453 TJ.

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

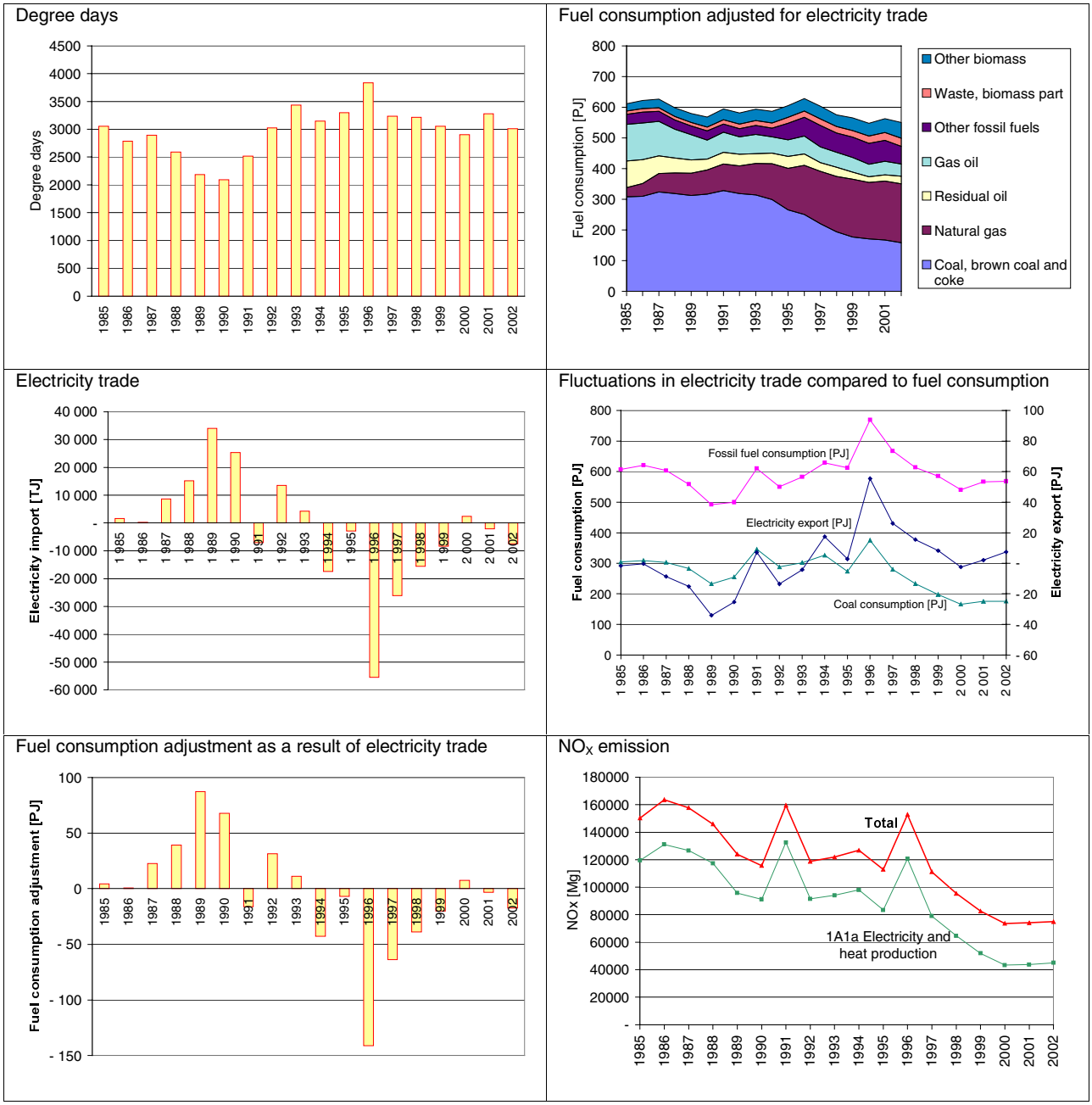


Figure 4 Comparison of time-series fluctuations for electricity trade, fuel consumption and NO_x emission (DEA 2003b).

5 Greenhouse gas emission

The total Danish greenhouse gas (GHG) emission in the year 2002 was 68.491 Gg CO_2 equivalent not including land-use change and forestry or 64.678 Gg CO_2 equivalent including land-use change and forestry. The greenhouse gas pollutants HFCs, PFCs and SF_6 are not emitted from combustion plants and, as such, only the pollutants CO_2, CH_4 and N_2O are considered below.

The global warming potentials of CH_4 and N_2O applied in greenhouse gas inventories refer to the second IPCC assessment report (IPCC 1995):

- 1 g CH_4 equals 21 g CO_2
- 1 g N_2O equals 310 g CO_2

The GHG emissions from stationary combustion are listed in Table 16. The emission from stationary combustion accounts for 55% of the total Danish GHG emission.

The CO_2 emission from stationary combustion plants accounts for 68% of the total Danish CO_2 emission (not including land-use change and forestry). CH_4 accounts for 9% of the total Danish CH_4 emission and N_2O for only 5% of the total Danish N_2O emission.

Table 16 Greenhouse gas emission for the year 2002 [1].

	CO_2	CH_4	N_2O
	Gg CO_2 equivalent		
1A1 Fuel consumption, Energy industries	26548	340	264
1A2 Fuel consumption, Manufac-turing Industries and Construction[1]	4815	34	53
1A4 Fuel consumption, Other sectors [1]	5510	159	66
Total emission from stationary combustion plants	**36873**	**533**	**383**
Total Danish emission (gross)	54164	5635	7976
		%	
Emission share for stationary combustion	68	9	5

1) Only stationary combustion sources of the sector is included

CO_2 is the most important GHG pollutant and accounts for 97,6% of the GHG emission (CO_2 eq.). This is a much higher share than for the total Danish GHG emissions where CO_2 only accounts for 80% of the GHG emission (CO_2 eq.).

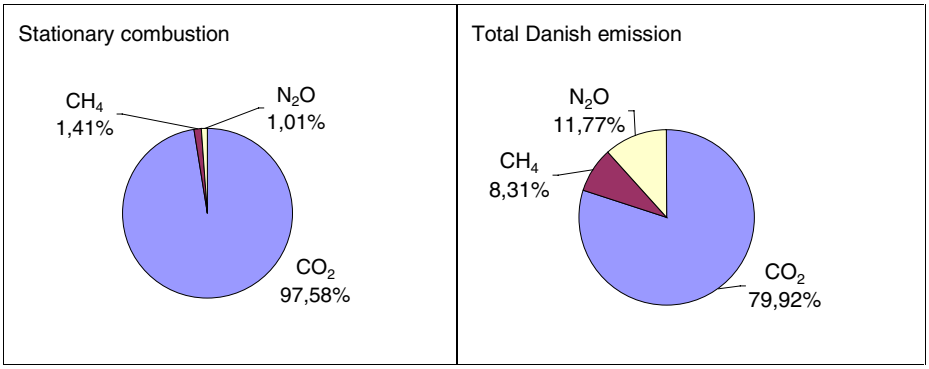


Figure 5 GHG emission (CO_2 equivalent), contribution from each pollutant.

Figure 6 depicts the time-series of GHG emission (CO_2 eq.) from stationary combustion and it can be seen that the GHG emission development follows the CO_2 emission development very closely. Both the CO_2 and the total GHG emission have decreased slightly from 1990 to 2002, CO_2 by 2,3% and GHG by 1,3%. However, fluctuations in the GHG emission level are large.

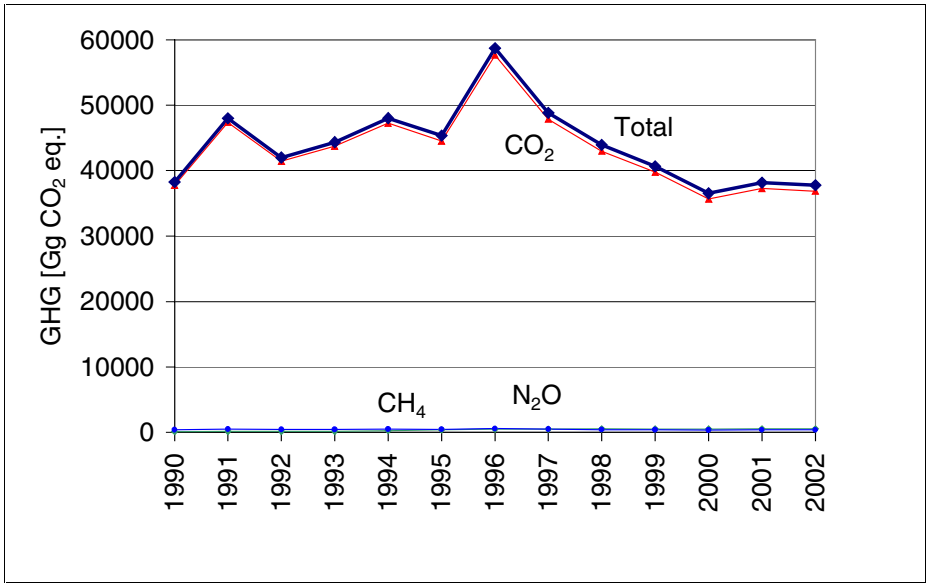


Figure 6 GHG emission time-series for stationary combustion.

The fluctuations in the time-series are mainly a result of electricity import/export activity, but also of outdoor temperature variations from year to year. The fluctuations follow the fluctuations in fuel consumption discussed in Chapter 4.

Figure 7 shows the corresponding time-series for degree days, electricity trade and CO_2 emission. As mentioned in Chapter 4, the Danish Energy Authority estimates a correction of the actual emissions without random variations in electricity imports/exports and in ambient temperature. This emission trend, which is smoothly decreasing, is also illustrated in Figure 7. The corrections are included here to explain the fluctuations in the emission time-series. The GHG emission corrected for electricity import/export and ambient temperature has decreased by 20% since 1990, and the CO_2 emission by 21%.

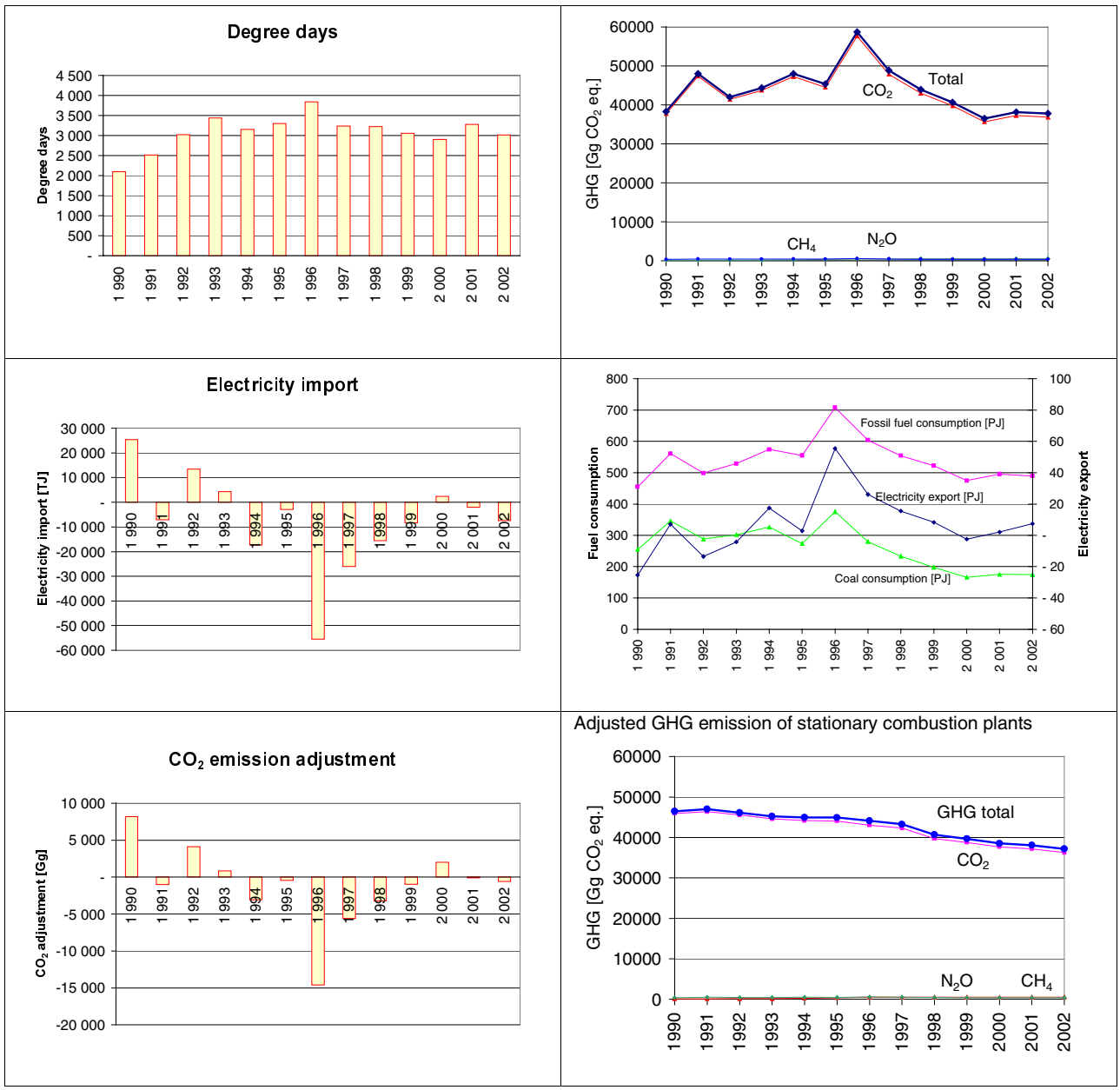


Figure 7 GHG emission time-series for stationary combustion, adjusted for electricity import/export and temperature variations (DEA 2003b).

5.1 CO_2

The CO_2 emission from stationary combustion plants is one of the most important GHG emission sources. Thus the CO_2 emission from stationary combustion plants accounts for 68% of the total Danish CO_2 emission. Table 17 lists the CO_2 emission inventory for stationary combustion plants for 2002. Figure 8 reveals that *Electricity and heat production* accounts for 65% of the CO_2 emission from stationary combustion. This share is somewhat higher than the fossil fuel consumption share for this sector, which is 61% (Figure 1). Other large CO_2 emission sources are industrial plants and residential plants. These are the sectors, which also account for a considerable share of fuel consumption.

Table 17 CO_2 emission from stationary combustion plants 2002 [1)]

CO_2	2002	
1A1a Electricity and heat production	24083	Gg
1A1b Petroleum refining	948	Gg
1A1c Solid fuel transf. and other energy industries	1517	Gg
1A2f Industry	4815	Gg
1A4a Commercial / Institutional	800	Gg
1A4b Residential	3979	Gg
1A4c Agriculture / Forestry / Fishing	731	Gg
Total	**36873**	**Gg**

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

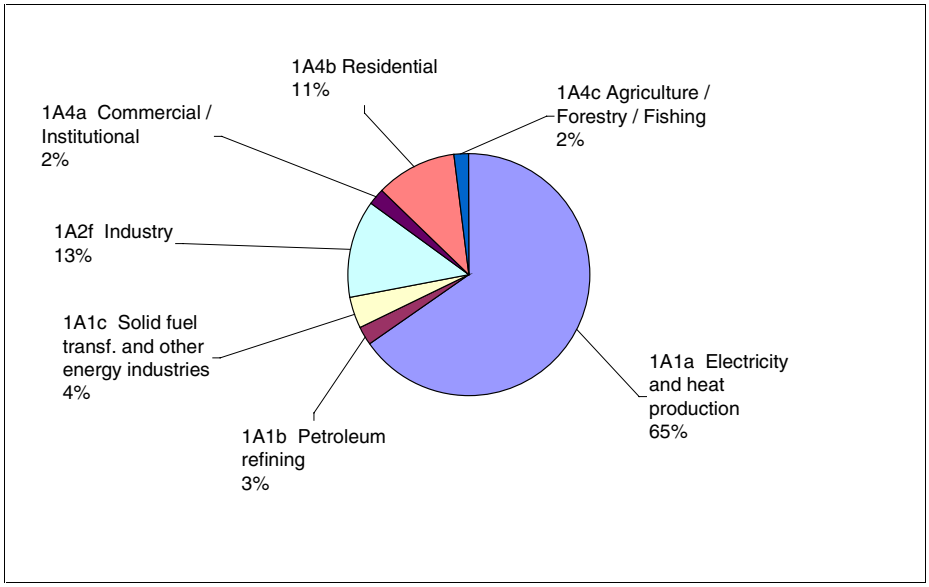


Figure 8 CO_2 emission sources, stationary combustion plants, 2002.

The sector *Electricity and heat production* consists of the SNAP source sectors: *Public power* and *District heating*. The CO_2 emissions from each of these sub-sectors are listed in Table 18. The most important subsector is power plant boilers >50MW.

Table 18 CO_2 emission from subsectors to *1A1a Electricity and heat production*.

SNAP source	SNAP name	2002	
0101	Public power	0	Gg
010101	Combustion plants ≥ 300MW (boilers)	18823	Gg
010102	Combustion plants ≥ 50MW and < 300 MW (boilers)	971	Gg
010103	Combustion plants <50 MW (boilers)	172	Gg
010104	Gas turbines	2247	Gg
010105	Stationary engines	1608	Gg
0102	District heating plants	-	Gg
010201	Combustion plants ≥ 300MW (boilers)	-	Gg
010202	Combustion plants ≥ 50MW and < 300 MW (boilers)	39	Gg
010203	Combustion plants <50 MW (boilers)	223	Gg
010204	Gas turbines	-	Gg
010205	Stationary engines	0	Gg

CO_2 emission from combustion of biomass fuels is not included in the total CO_2 emission data, because biomass fuels are considered CO_2 neutral. The CO_2 emission from biomass combustion is reported as a memo item in Climate Convention reporting. In 2002 the CO_2 emission from biomass combustion was 8454 Gg.

In Figure 9 the fuel consumption share (fossil fuels) is compared to the CO_2 emission share disaggregated to fuel origin. Due to the higher CO_2 emission factor for coal than oil and gas, the CO_2 emission share from coal combustion is higher than the fuel consumption share. Coal accounts for 36% of the fossil fuel consumption and for 46% of the CO_2 emission. Natural gas accounts for 39% of the fossil fuel consumption but only 30% of the CO_2 emission.

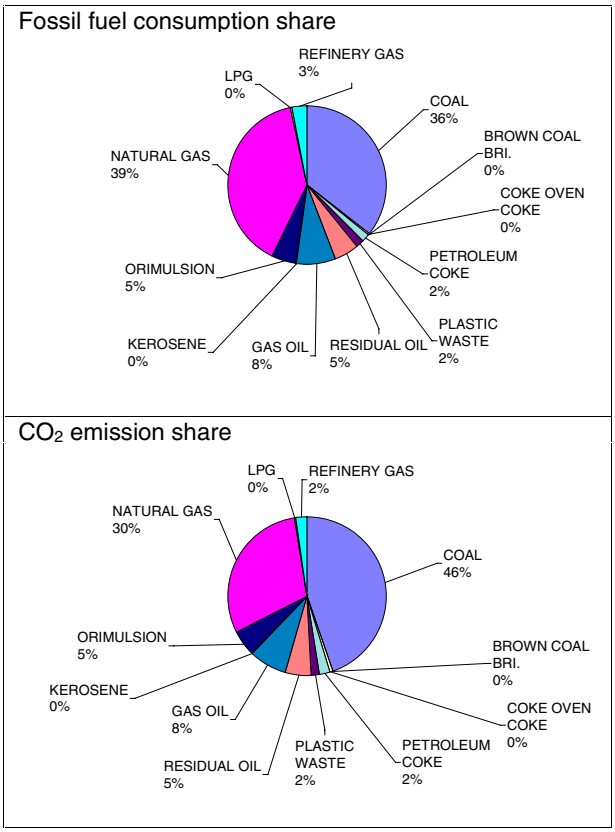


Figure 9 CO_2 emission, fuel origin.

Time-series for CO_2 emission are provided in Figure 10. Despite an increase in fuel consumption of 14% since 1990, CO_2 emission from stationary combustion has decreased by 2,3% due to of the change in fuel type used.

The fluctuations in total CO_2 emission follow the fluctuations in CO_2 emission from *Electricity and heat production* (Figure 10) and in coal consumption (Figure 11). The fluctuations are a result of electricity import/export activity as discussed in Chapter 5.

Figure 11 compares time-series for fossil fuel consumption and the CO_2 emission. As mentioned above, the consumption of coal has decreased whereas the consumption of natural gas, with a lower CO_2 emission factor, has increased. Total fossil fuel use increased by 8% between 1990 and 2002.

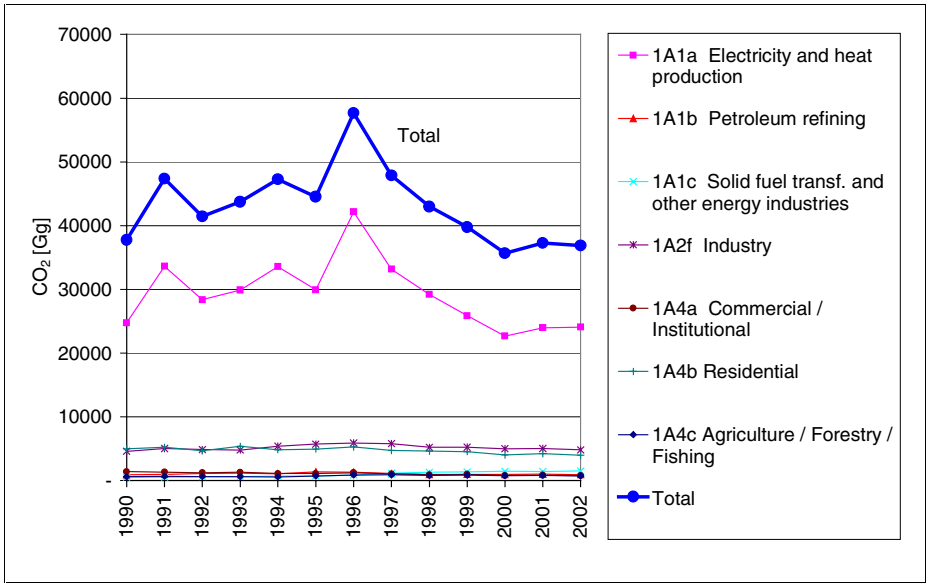


Figure 10 CO_2 emission time-series for stationary combustion plants.

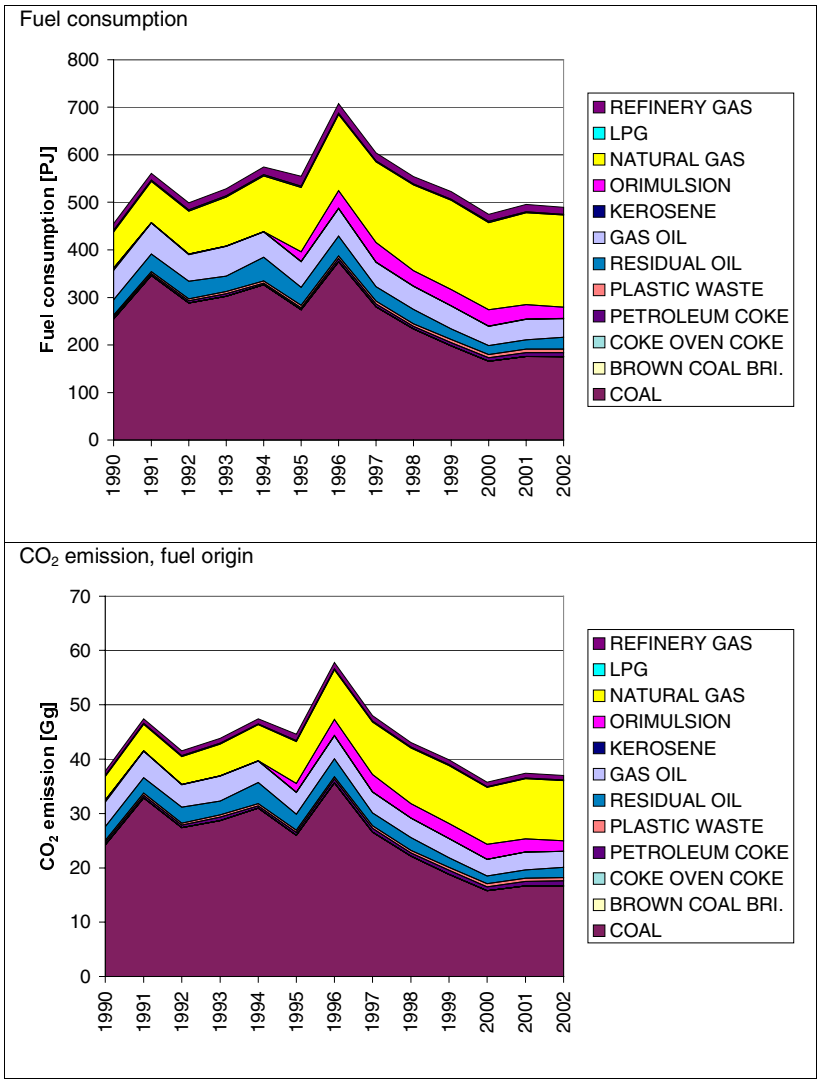


Figure 11 Fossil fuel consumption and CO_2 emission time-series for stationary combustion.

5.2 CH_4

CH_4 emission from stationary combustion plants accounts for 9% of the total Danish CH_4 emission. Table 19 lists the CH_4 emission inventory for stationary combustion plants in 2002. Figure 12 reveals that *Electricity and heat production* accounts for 63% of the CH_4 emission from stationary combustion, this being closely aligned with fuel consumption share.

Table 19 CH_4 emission from stationary combustion plants 2002 [1)].

CH_4	2002	
1A1a Electricity and heat production	16005	Mg
1A1b Petroleum refining	2	Mg
1A1c Solid fuel transf. and other energy industries	177	Mg
1A2f Industry	1635	Mg
1A4a Commercial / Institutional	974	Mg
1A4b Residential	4479	Mg
1A4c Agriculture / Forestry / Fishing	2112	Mg
Total	25384	Mg

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

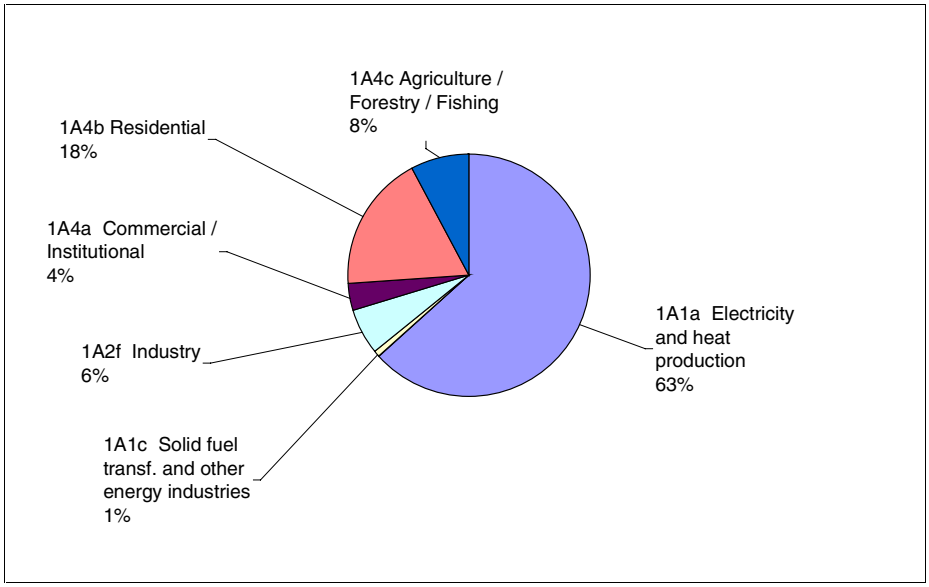


Figure 12 CH_4 emission sources, stationary combustion plants, 2002.

The CH_4 emission factor for reciprocating gas engines is much higher than for other combustion plants due to the continuous ignition/burn-out of the gas. Lean-burn gas engines have an especially high emission factor as discussed in Chapter 4.5.2. A considerable number of lean-burn gas engines are in operation in Denmark and these plants account for 75% of the CH_4 emission from stationary combustion plants (Figure 13). The engines are installed in CHP plants and the fuel used is either natural gas or biogas.

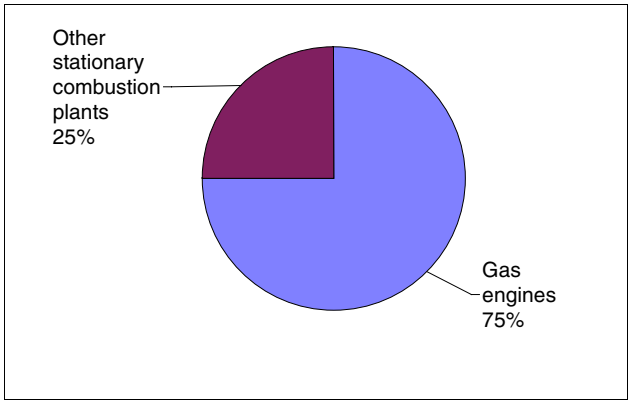


Figure 13 Gas engine CH_4 emission share, 2002.

The CH_4 emission from stationary combustion increased by a factor of 4,5 since 1990 (Figure 14). This results from the considerable number of lean-burn gas engines installed in CHP plants in Denmark in this period. Figure 15 provides time-series for the fuel consumption rate in gas engines and the corresponding increase of CH_4 emission.

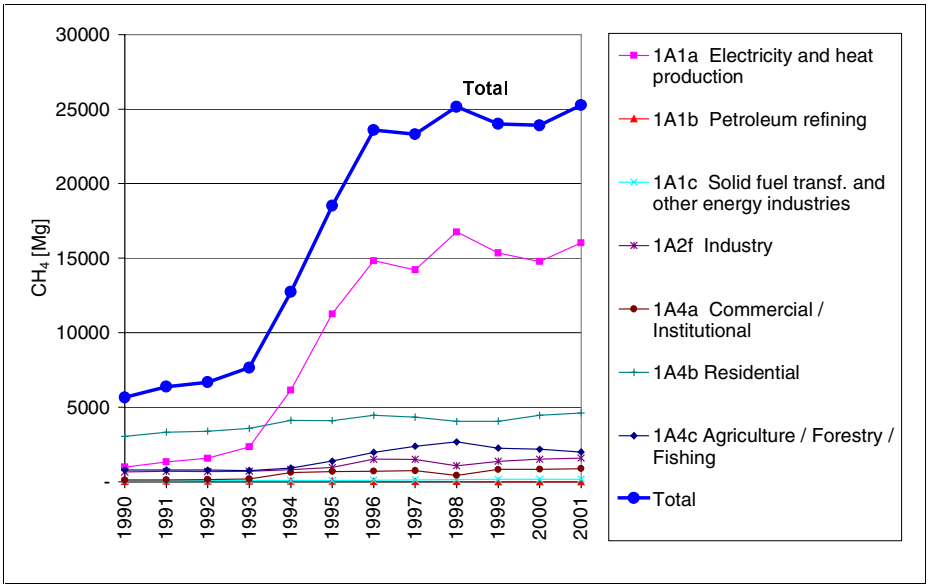


Figure 14 CH_4 emission time-series for stationary combustion plants.

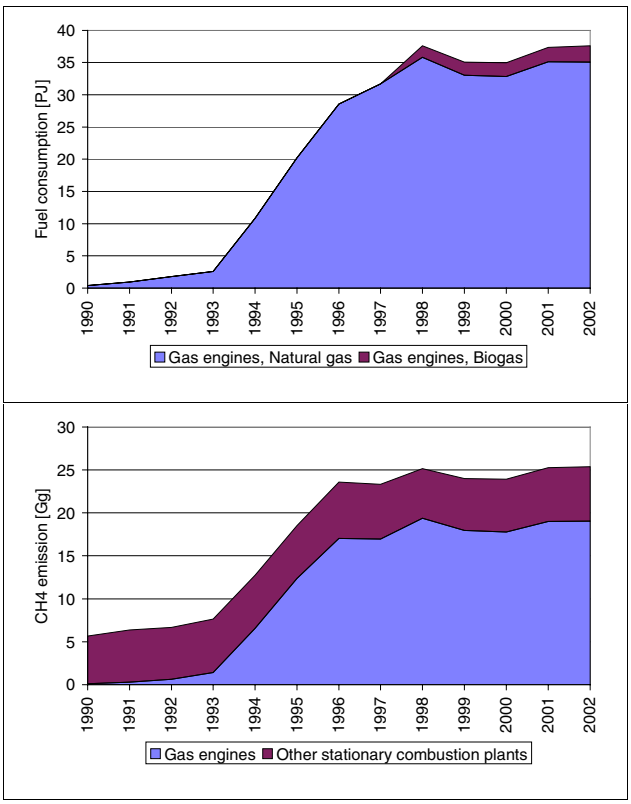


Figure 15 Fuel consumption and CH_4 emission from gas engines, time-series.

5.3 N_2O

The N_2O emission from stationary combustion plants accounts for 5% of the total Danish N_2O emission. Table 20 lists the N_2O emission inventory for stationary combustion plants in the year 2002. Figure 16 reveals that *Electricity and heat production* accounts for 64% of the N_2O emission from stationary combustion. This is only a little higher than the fuel consumption share.

Table 20 N_2O emission from stationary combustion plants 2002 [1)].

N_2O	2002	
1A1a Electricity and heat production	793	Mg
1A1b Petroleum refining	32	Mg
1A1c Solid fuel transf. and other energy industries	27	Mg
1A2f Industry	170	Mg
1A4a Commercial / Institutional	23	Mg
1A4b Residential	163	Mg
1A4c Agriculture / Forestry / Fishing	26	Mg
Total	1234	Mg

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

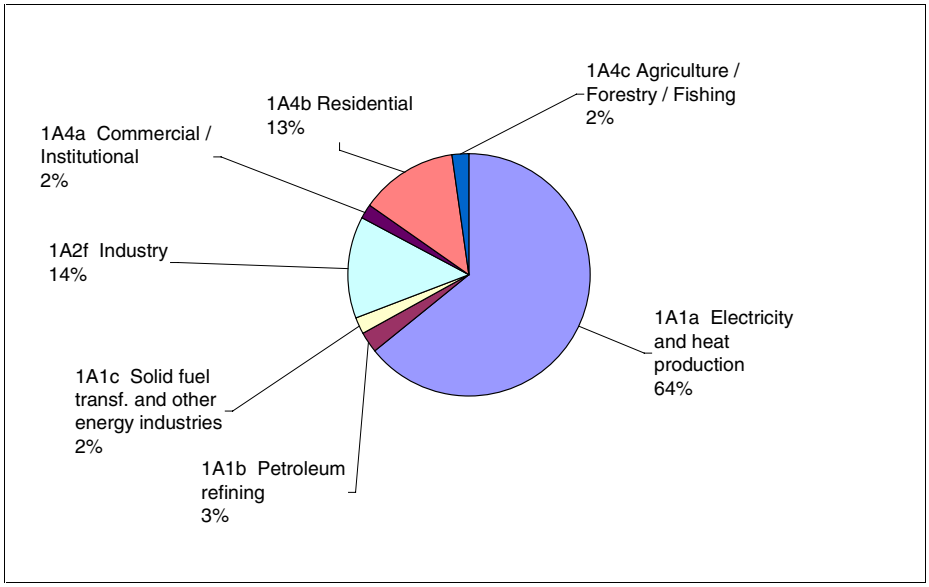


Figure 16 N_2O emission sources, stationary combustion plants, 2002.

Figure 17 shows time-series for N_2O emission. The N_2O emission from stationary combustion decreased by 3,6% from 1990 to 2002, but again fluctuations in emission level due to electricity import/export are considerable.

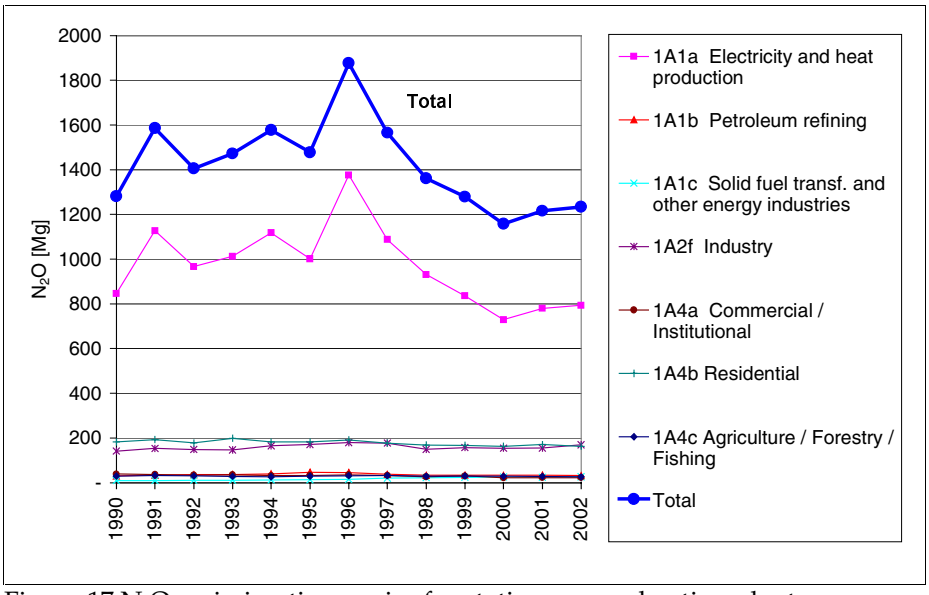


Figure 17 N_2O emission time-series for stationary combustion plants.

6 SO_2, NO_X, NMVOC and CO

The emissions of SO_2, NO_X, NMVOC and CO from Danish stationary combustion plants 2002 are presented in Table 21. The emission of these pollutants is reported to the LRTAP Convention and the pollutants are also included in the report to the Climate Convention.

SO_2 from stationary combustion plants accounts for 83% of the total Danish emission. NO_X, CO and NMVOC account for 37%, 29% and 15% of total Danish emissions, respectively.

Table 21 SO_2, NO_X, NMVOC and CO emission from stationary combustion 2002 [1].

Pollutant	NO_X Gg	CO Gg	NMVOC Gg	SO_2 Gg
1A1 Fuel consumption, Energy industries	53,1	12,5	4,3	10,9
1A2 Fuel consumption, Manufacturing Industries and Construction (Stationary combustion)	14,4	5,2	0,9	6,6
1A4 Fuel consumption, Other sectors (Stationary combustion)	7,4	149,4	13,4	3,6
Total emission from stationary combustion plants	**74,9**	**167,2**	**18,6**	**21,1**
Total Danish emission (gross)	200	577	124	25
		%		
Emission share for stationary combustion	37,4	29,0	15,0	83,3

1) Only emissions from stationary combustion plants in the sectors are included

6.1 SO_2

Stationary combustion is the most important emission source for SO_2 accounting for 85% of the total Danish emission. Table 22 and Figure 18 present the SO_2 emission inventory for the stationary combustion subsectors.

Electricity and heat production is the largest emission source accounting for 48% of the emission, however, the SO_2 emission share is somewhat smaller than the fuel consumption share for this sector, which is 59%. This is possibly due to effective flue gas desulphurisation equipment installed in power plants combusting coal. Figure 19 shows the SO_2 emission from *Electricity and heat production* on a disaggregated level. Power plants >300MW_{th} represent the main emission source, accounting for 73% of the emission.

The fuel origin of the SO_2 emission is shown in Figure 20. Disaggregation of total emissions from point sources using several fuels is based on emission factors. As expected the emission from natural gas is negligible and the emission from coal combustion is considerable (44%). Most remarkably is the emission share from residual oil combustion, which is 24%. This emission is very high compared to the fuel consumption share of 4%. The emission factor for residual oil combusted in the industrial sector is uncertain because knowledge of the applied flue gas cleaning technology in this sector is insufficient. Based on the apparent very large emission from residual oil the emission factors will be further analysed prior to the next emission reporting.

The SO_2 emission from *Industry* is 31%, 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 and from industrial combustion of petroleum coke also constitute considerable emission sources. Some years ago, SO_2 emission from the industrial sector only accounted for a small portion of the total emission, but as a result of reduced emissions from power plants the share has now increased.

Time-series for SO_2 emission from stationary combustion are shown in Figure 21. The SO_2 emission from stationary combustion plants has decreased by 95% from 1980 and 83% from 1995. 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 48% of the total emission from stationary combustion, as mentioned above. The emission from other sectors also decreased considerably since 1980.

Table 22 SO_2 emission from stationary combustion plants 2002 [1)].

SO_2	2002	
1A1a Electricity and heat production	9936	Mg
1A1b Petroleum refining	927	Mg
1A1c Solid fuel transf. and other energy industries	9	Mg
1A2f Industry	6563	Mg
1A4a Commercial / Institutional	553	Mg
1A4b Residential	1787	Mg
1A4c Agriculture / Forestry / Fishing	1284	Mg
Total	21058	Mg

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

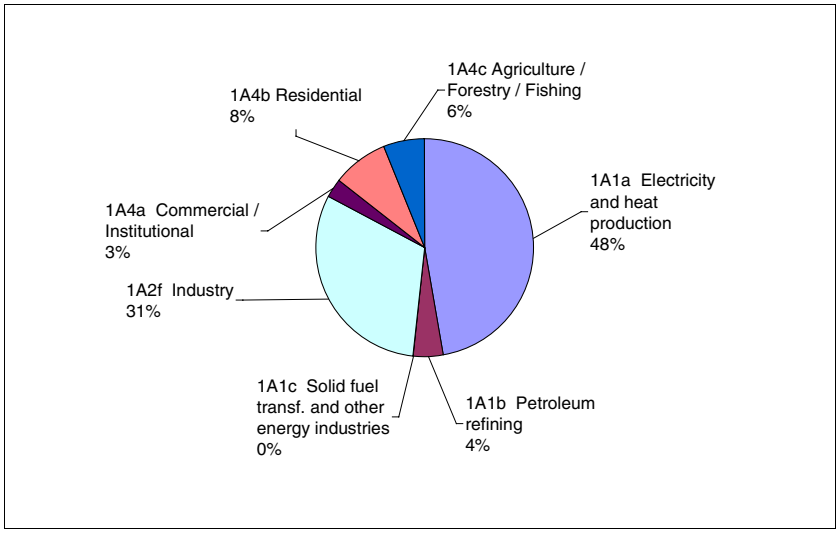


Figure 18 SO_2 emission sources, stationary combustion plants, 2002.

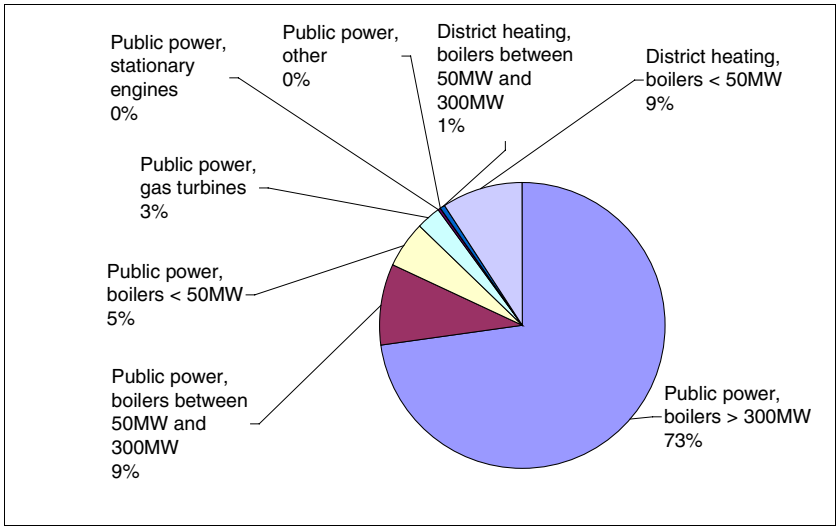


Figure 19 Disaggregated SO_2 emissions from *Energy and heat production.*

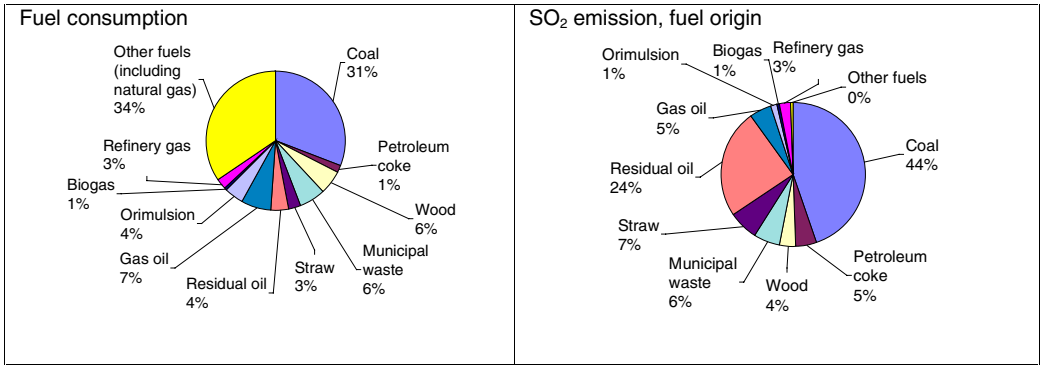


Figure 20 Fuel origin of the SO_2 emission from stationary combustion plants.

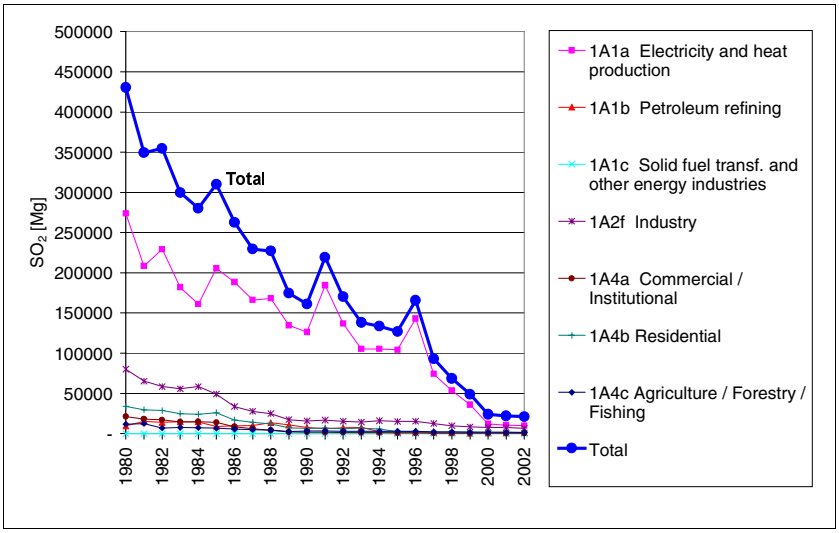


Figure 21 SO_2 emission time-series for stationary combustion.

6.2 NO_x

Stationary combustion accounts for 37% of the total Danish NO_x emission. Table 23 and Figure 22 show the NO_x emission inventory for stationary combustion subsectors.

Electricity and heat production is the largest emission source accounting for 60% of the emission from stationary combustion plants. Power plants >50MW_{th} are the main emission source in this sector accounting for 68% of the emission.

Figure 23 shows fuel origin of the NO_x emission from sector 1A1a Electricity and heat production. The fuel origin of the NO_x emission is almost the same as the fuel consumption in this plant category. The emission from coal combustion is, however, somewhat higher than the fuel consumption share.

Industrial combustion plants are also an important emission source accounting for 19% of the emission. The main industrial emission source is cement production, accounting for 62% of the emission.

Residential plants accounts for 7% of the NO_x emission. The fuel origin of this emission is mainly wood, gas oil and natural gas accounting for 36%, 31% and 22% of the residential plant emission, respectively.

Time-series for NO_x emission from stationary combustion are shown in Figure 24. NO_x emission from stationary combustion plants has decreased by 50% from 1985 and 34% from 1995. 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. The NO_x emission from all subsectors has decreased since 1985.

Table 23 NO_x emission from stationary combustion plants 2002 [1)].

	2002	
1A1a Electricity and heat production	44964	Mg
1A1b Petroleum refining	1554	Mg
1A1c Solid fuel transf. and other energy industries	6555	Mg
1A2f Industry	14412	Mg
1A4a Commercial / Institutional	1077	Mg
1A4b Residential	4909	Mg
1A4c Agriculture / Forestry / Fishing	1460	Mg
Total	74931	Mg

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

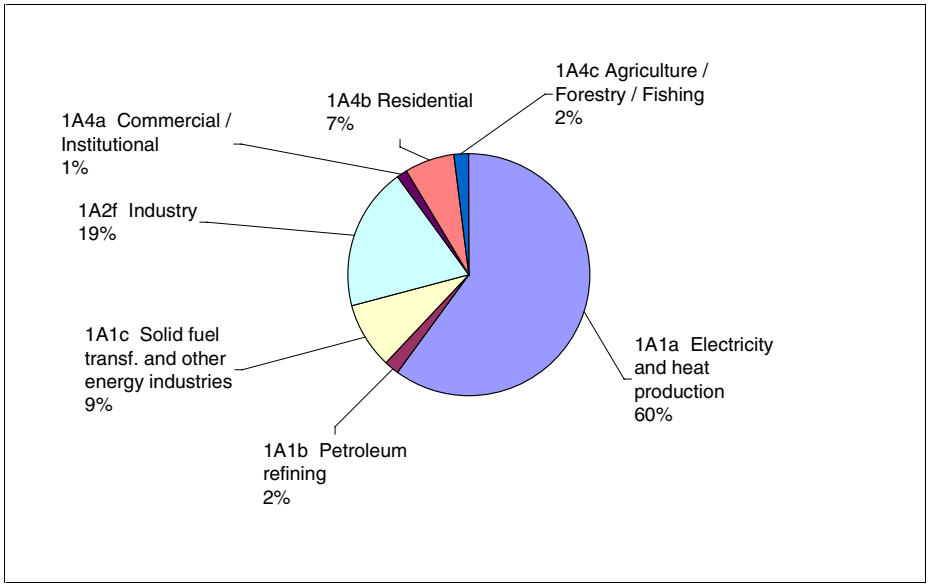


Figure 22 NO_x emission sources, stationary combustion plants, 2002.

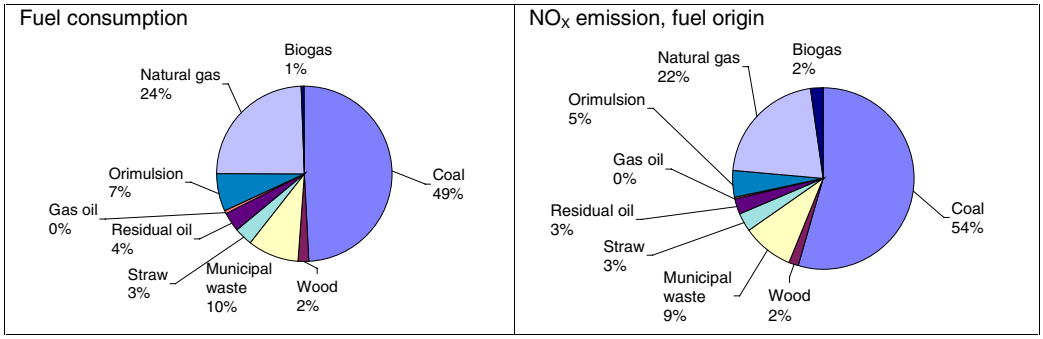


Figure 23 NO_x emissions from 1A1a Electricity and heat production, fuel origin.

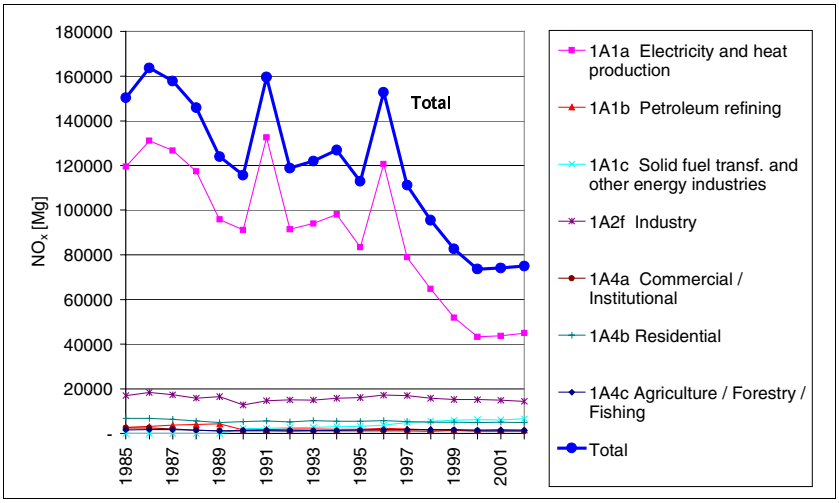


Figure 24 NO_x emission time-series for stationary combustion.

6.3 NMVOC

Stationary combustion plants account for 15% of the total Danish NMVOC emission. Table 24 and Figure 25 present the NMVOC emission inventory for the stationary combustion subsectors.

Residential plants are the largest emission source accounting for 59% of the total emission from stationary combustion plants. For residential plants NMVOC is mainly emitted from wood and straw combustion, see Figure 26.

Electricity and heat production is also a considerable emission source, accounting for 23% of the total emission. Lean-burn gas engines have a relatively high NMVOC emission factor and are the most important emission source in this subsector (see Figure 26). The gas engines are either natural gas or biogas fuelled.

Time-series for NMVOC emission from stationary combustion are shown in Figure 27. The emission has increased by 40% from 1985 and 14% from 1995. The increased emission is mainly a result of the increased use of lean-burn gas engines in CHP plants as discussed in Chapter 7.2.

The emission from residential plants is relatively constant, but the NMVOC emission from wood combustion almost doubled since 1990 due to increased wood consumption. However the emission from straw combustion in farmhouse boilers has decreased over this period.

The use of wood in residential boilers and stoves is relatively low in 1998-99 resulting in a sharp decrease in emission levels over these years.

Fuel consumption rates 1985-1989 for the sector agriculture/forestry/fishing have not been updated according to the new energy statistics. This leads to an apparent sudden increase in emission between, 1989 and 1990, which, in fact, is not correct.

Table 24 NMVOC emission from stationary combustion plants 2002 [1].

		2002	
1A1a	Electricity and heat production	4240	Mg
1A1b	Petroleum refining	4	Mg
1A1c	Solid fuel transf. and other energy industries	55	Mg
1A2f	Industry	926	Mg
1A4a	Commercial / Institutional	748	Mg
1A4b	Residential	10964	Mg
1A4c	Agriculture / Forestry / Fishing	1657	Mg
Total		18594	Mg

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

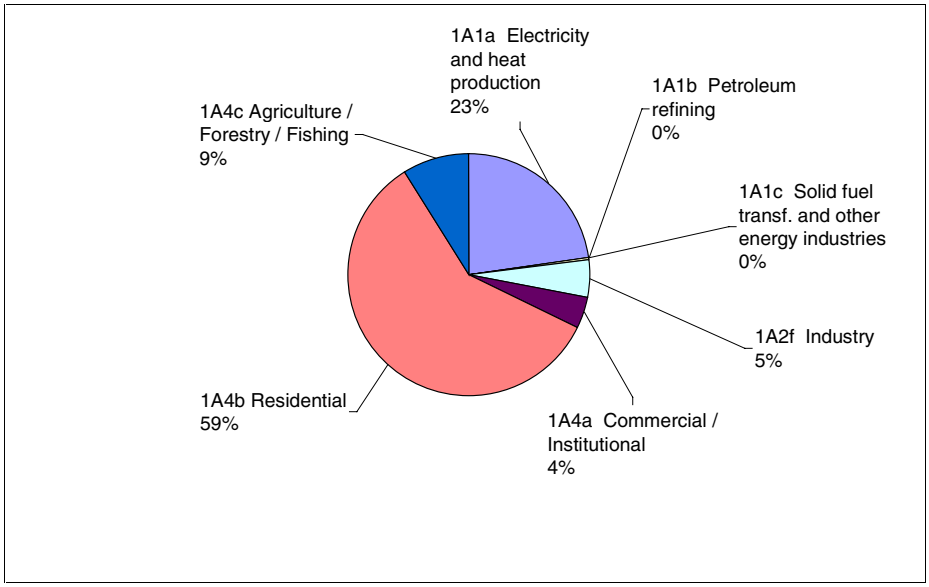


Figure 25 NMVOC emission sources, stationary combustion plants, 2002.

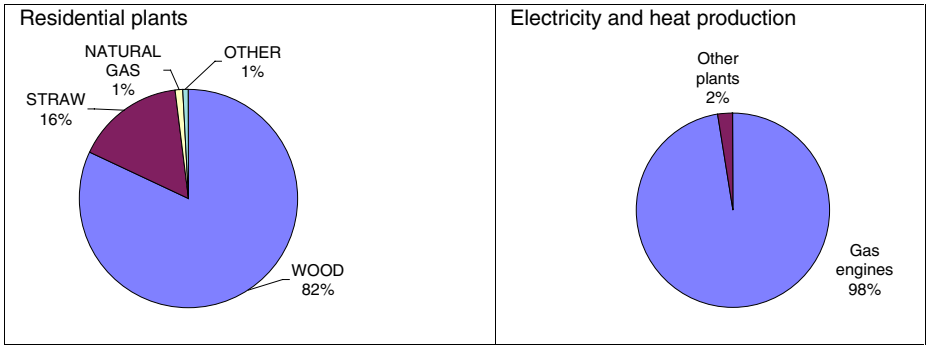


Figure 26 NMVOC emission from residential plants and from electricity and heat production, 2002.

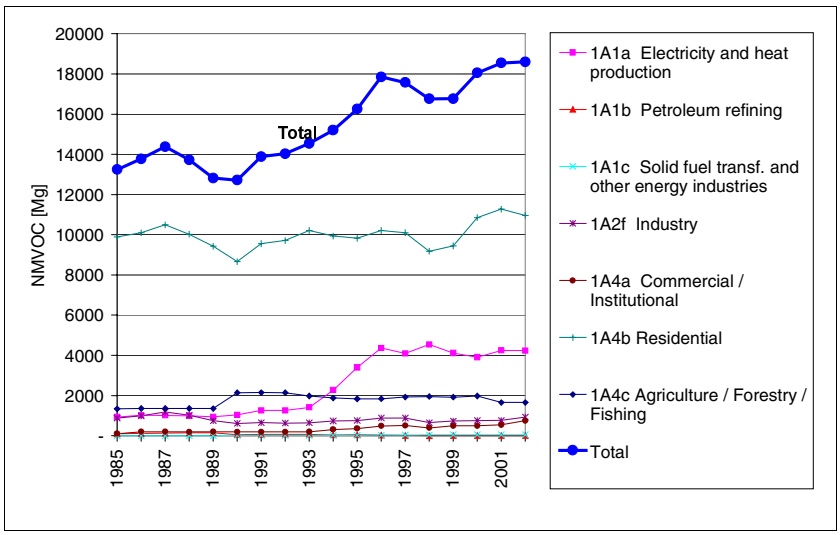


Figure 27 NMVOC emission time-series for stationary combustion.

6.4 CO

Stationary combustion accounts for 29% of the total Danish CO emission. Table 25 and Figure 28 presents the CO emission inventory for stationary combustion subsectors.

Residential plants are the largest emission source, accounting for 88% of the emission. Wood combustion accounts for 90% of the emission from residential plants, see Figure 29. This is in spite of the fact that the fuel consumption share is only 19%. 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 30. The emission has increased by 40% from 1985 and 6% from 1995. The time-series for CO from stationary combustion plants follows the time-series for CO emission from residential plants.

The consumption of wood in residential plants has increased by 65% since 1990 leading to an increase in the CO emission. The increase in CO emission from residential plants is lower than the increase in wood consumption, because CO emission from straw-fired farmhouse boilers has decreased considerably. Both the annual straw consumption in residential plants and the CO emission factor for farmhouse boilers have decreased.

Table 25 CO emission from stationary combustion plants 2002 [1)].

	2002	
1A1a Electricity and heat production	11528	Mg
1A1b Petroleum refining	263	Mg
1A1c Solid fuel transf. and other energy industries	749	Mg
1A2f Industry	5203	Mg
1A4a Commercial / Institutional	909	Mg
1A4b Residential	147045	Mg
1A4c Agriculture / Forestry / Fishing	1480	Mg
Total	167176	Mg

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

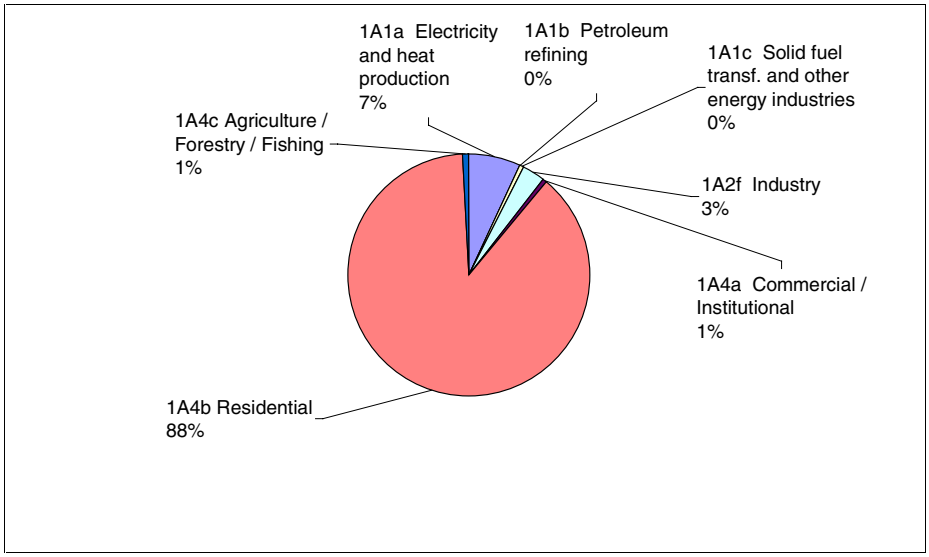


Figure 28 CO emission sources, stationary combustion plants, 2002.

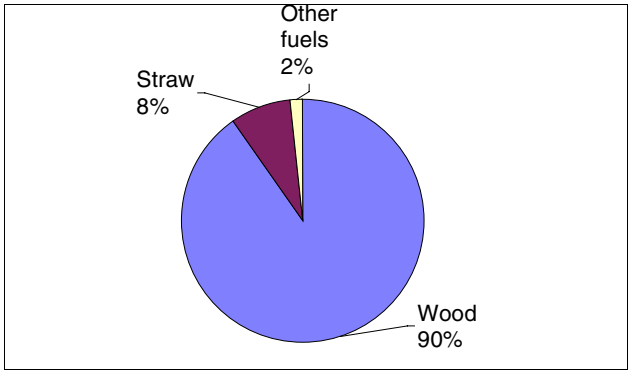


Figure 29 CO emission sources, residential plants, 2002.

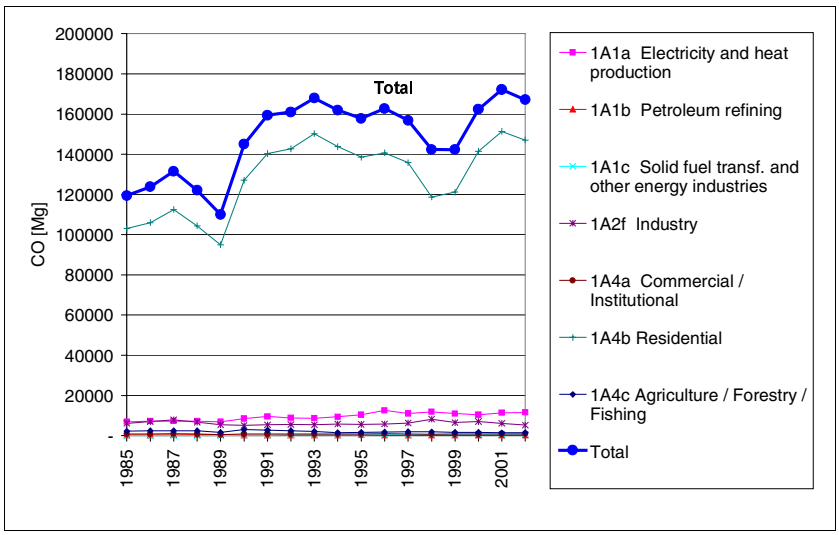


Figure 30 CO emission time-series for stationary combustion.

7 Particulate matter (PM)

The emission of total suspended particulates (TSP), PM_{10} and $PM_{2.5}$ from Danish stationary combustion plants 2002 is presented in Table 26. The PM emission is reported to the LRTAP Convention.

To date, only PM emissions from stationary combustion, transport, agriculture and part of the industrial sector have been included in the Danish inventory. TSP from stationary combustion accounts for 16% of the total Danish emission. The emission shares for PM_{10} and $PM_{2.5}$ are 22% and 30%, respectively.

Table 26 Danish PM emissions 2002.

Pollutant	TSP Mg	PM_{10} Mg	$PM_{2.5}$ Mg
1A1 Fuel combustion, Energy industries	1332	1074	903
1A2 Fuel combustion, Manufacturing Industries and Construction (Stationary combustion) 1)	655	519	333
1A4 Fuel combustion, Other sectors (Stationary combustion) 1)	3415	3223	3026
Total emission from stationary combustion plants	**5402**	**4816**	**4261**
Total Danish emission (gross)	33788	22112	14316
		%	
Emission share for stationary combustion	16,0	21,8	29,8

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

Table 27 and Figure 31 show the PM emission inventory for the stationary combustion subsectors. Residential plants are the largest emission source accounting for 65% 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 47% of the $PM_{2.5}$ emission from stationary combustion is emitted from residential wood combustion. This corresponds to 14% of the overall Danish emission. A literature review (Nielsen et al. 2003) has demonstrated that the uncertainty surrounding the emission factors for residential combustion of wood in stoves and boilers is extremely high. Results from a Nordic project attended by NERI (Sternhufvud et al. 2004) are planned to be implemented in the PM emission inventory next year.

In Figure 32 the fuel consumption and the $PM_{2.5}$ emission of residential plants is shown. Wood combustion accounts for 72% of the $PM_{2.5}$ emission from residential plants in spite of the limited wood consumption share.

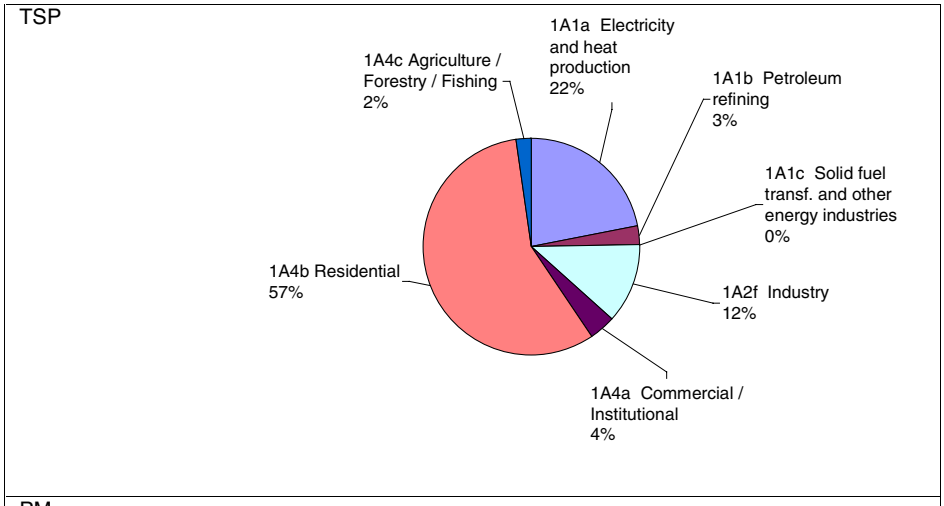
Emission inventories for PM have only been reported for the years 2000-2002 and the short time-series for TSP, PM_{10} and $PM_{2.5}$ emission is shown in Figure 33.

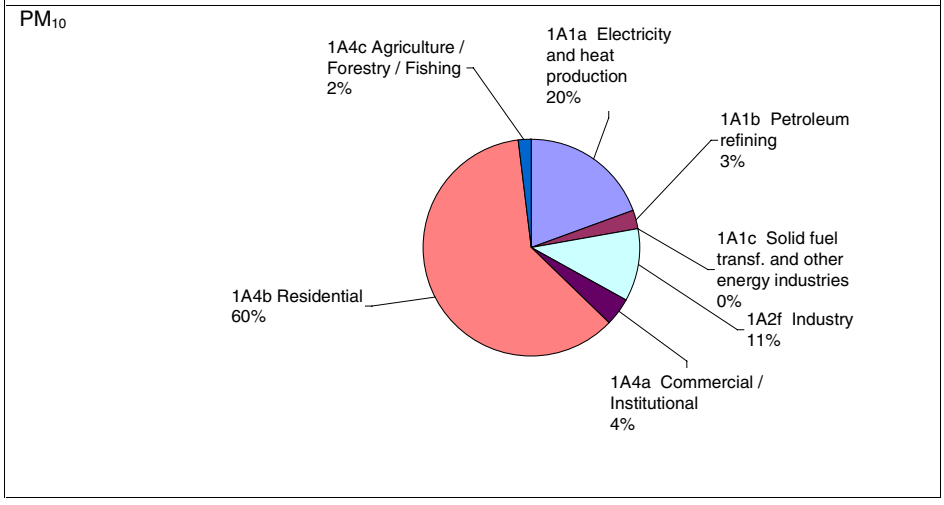
In the fall 2004 a new methodology has been developed to estimate the PM emission from the residential sector (Illerup & Nielsen, 2004). The revised PM emission estimates result in a considerably higher $PM_{2.5}$ emission compared to the emission presented in this report. The improved PM emission inventory will be implemented in the next official Danish inventory, which is going to be submitted in February 2005 to the LRTAP Convention.

Table 27 PM emission from stationary combustion plants, 2002 [1)].

	TSP	PM_{10}	$PM_{2.5}$	
1A1a Electricity and heat production	1187	943	778	Mg
1A1b Petroleum refining	142	128	122	Mg
1A1c Solid fuel transf. and other energy industries	3	3	3	Mg
1A2f Industry	655	519	333	Mg
1A4a Commercial / Institutional	204	195	181	Mg
1A4b Residential	3096	2936	2770	Mg
1A4c Agriculture / Forestry / Fishing	115	92	75	Mg
Total	5402	4816	4261	Mg

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





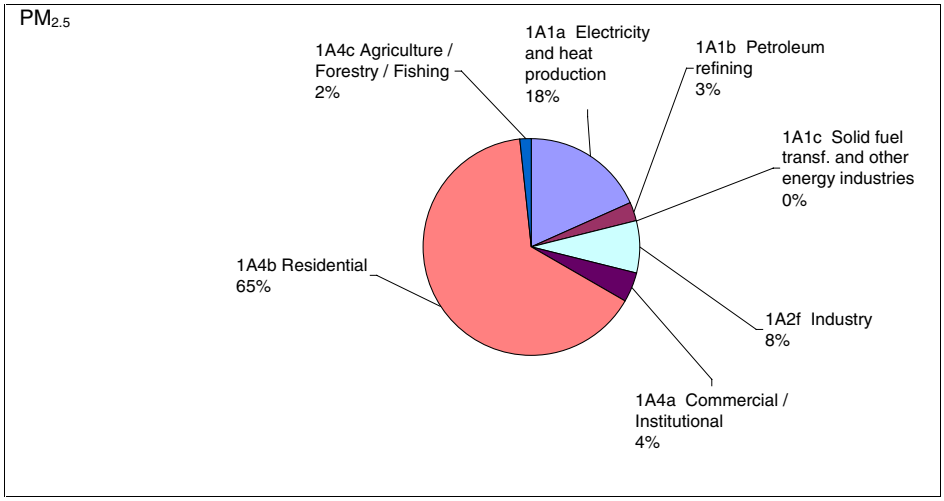


Figure 31 PM emission sources, stationary combustion plants, 2002.

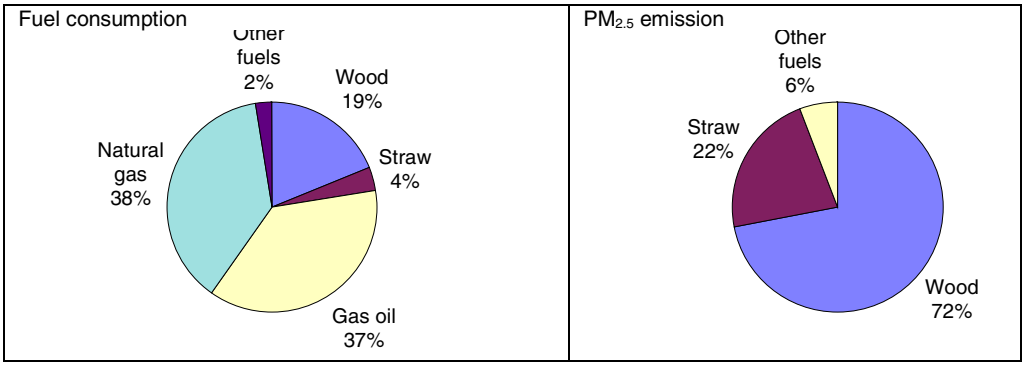


Figure 32 Fuel consumption and $PM_{2.5}$ emission from residential plants.

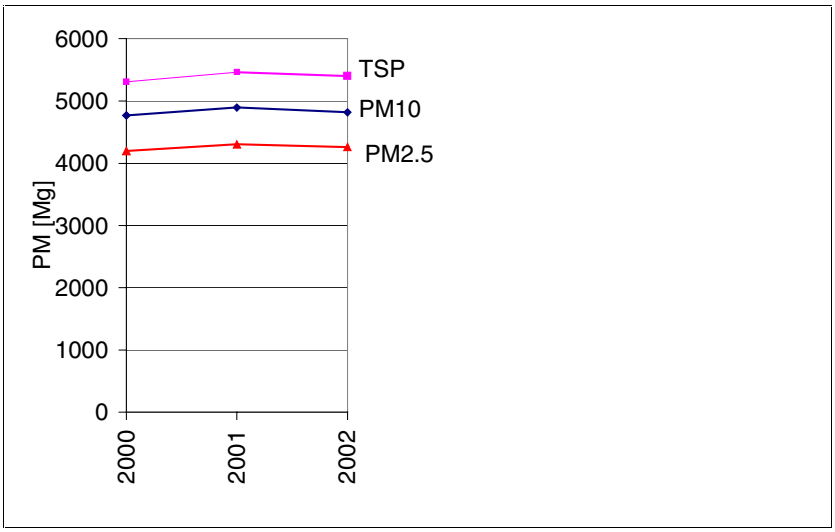


Figure 33 PM emission time-series for stationary combustion.

8 Heavy metals

Emission inventories for 9 heavy metals are reported to the LRTAP Convention. Three of the metals are considered priority metals: Pb, Cd and Hg. The 2002 emissions are presented in Table 28.

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 50%, see Table 28.

Table 28 The emission of heavy metals in 2002, reported to the LRTAP Convention in 2004.

Pollutant	Pb Mg	Cd Mg	Hg Mg	As Mg	Cr Mg	Cu Mg	Ni Mg	Se Mg	Zn Mg
1A1 Fuel combustion, Energy industries	2,33	0,23	0,66	0,41	0,51	0,65	4,53	0,73	13,64
1A2 Fuel combustion, Manufacturing Industries and Construction (Stationary combustion)	0,29	0,20	0,28	0,19	0,31	0,22	5,36	0,13	1,60
1A4 Fuel combustion, Other sectors (Stationary combustion)	0,23	0,15	0,22	0,08	0,11	0,19	1,24	0,19	2,64
Total emission from stationary combustion plants	**2,85**	**0,58**	**1,16**	**0,68**	**0,93**	**1,05**	**11,13**	**1,06**	**17,88**
Total Danish emission (gross)	5,25	0,66	1,19	0,77	1,64	8,68	13,38	1,88	23,54
					%				
Emission share for stationary combustion	54,2	86,8	98,1	89,1	56,9	12,1	83,2	56,1	75,9

Table 29 and Figure 34 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 80%, 37% and 56% of the emission of the priority metals Pb, Cd and Hg, respectively.

Table 30 presents the emission share for the two most important emission source categories: Power plants >25MW_e and municipal waste incineration plants.

Table 29 Heavy metal emission from stationary combustion plants, 2002 [1].

	As	Cd	Cr	Cu	Hg	Ni	Pb	Se	Zn	
1A1a Electricity and heat production	395	211	466	628	658	3651	2299	714	13632	kg
1A1b Petroleum refining	19	18	45	18	6	875	32	17	4	kg
1A1c Solid fuel transf. and other energy industries	0	0	0	0	0	0	0	0	0	kg
1A2f Industry	187	199	314	219	276	5363	287	135	1601	kg
1A4a Commercial / Institutional	20	14	20	20	43	233	46	23	185	kg
1A4b Residential	38	111	35	141	156	118	134	138	2377	kg
1A4c Agriculture / Forestry / Fishing	25	22	51	27	25	888	50	29	81	kg
Total	**684**	**576**	**932**	**1052**	**1163**	**11129**	**2848**	**1055**	**17880**	**kg**

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

Table 30 Heavy metal emission share for large power plants and municipal waste incineration plants, 2002.

Pollutant	Emission share of plant category	
	Municipal waste incineration, CHP and district heating	Power plants >25MW$_e$
As	31	32
Cd	23	9
Cr	16	32
Cu	33	28
Hg	28	22
Ni	3	26
Pb	62	18
Se	0	65
Zn	57	30

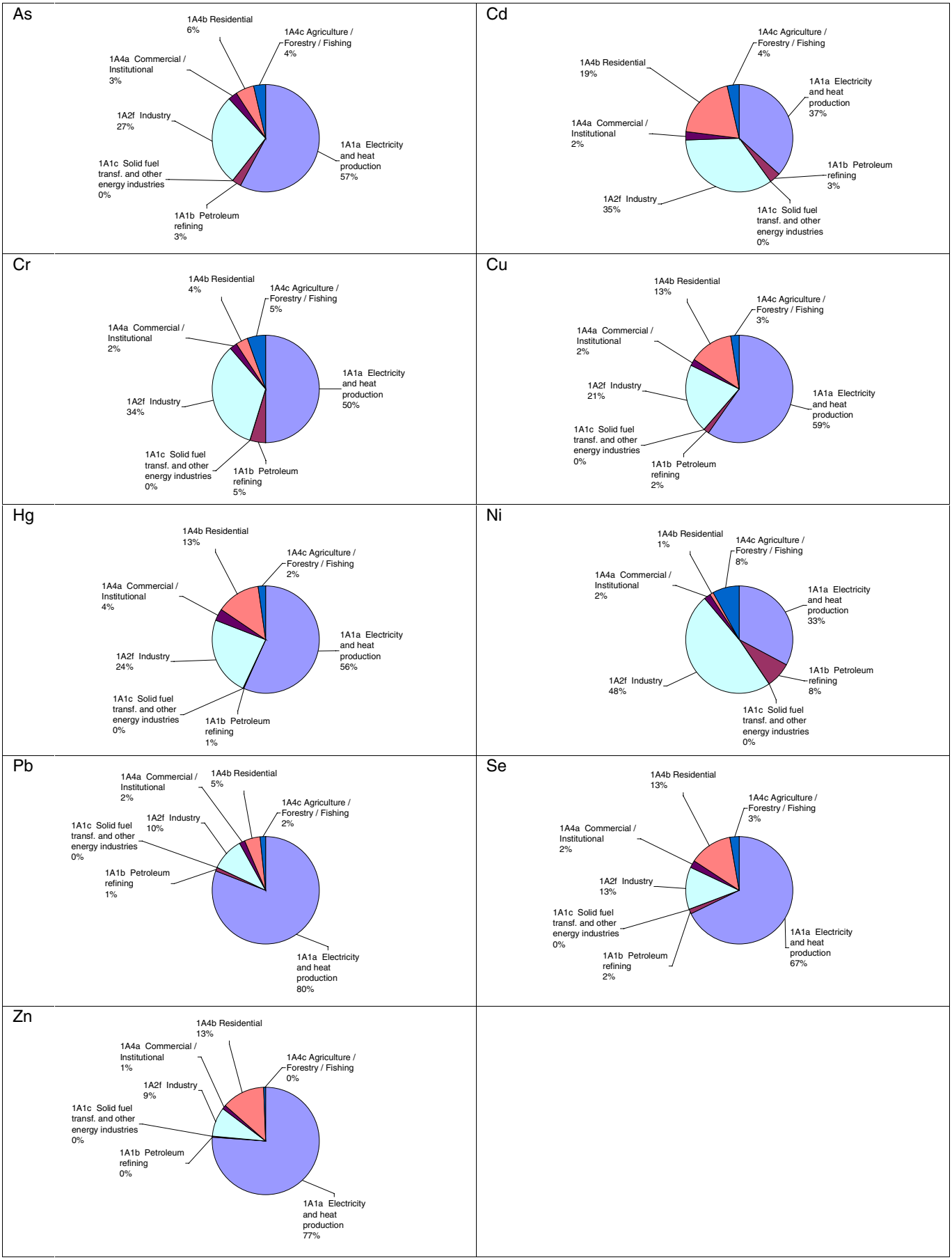


Figure 34 Heavy metal emission sources, stationary combustion plants, 2002.

Time-series for heavy metal emissions are provided in Figure 35. Time-series are only shown for total emission from stationary combustion and for the two most important sectors: *Electricity and heat production* and *Industry-other*. Heavy metal emissions have decreased considerably since 1990, see Table 31. 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 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 31 Decrease in heavy metal emission 1990-2002.

Pollutant	Decrease since 1990
As	51%
Cd	45%
Cr	84%
Cu	71%
Hg	64%
Ni	47%
Pb	80%
Se	70%
Zn	8%

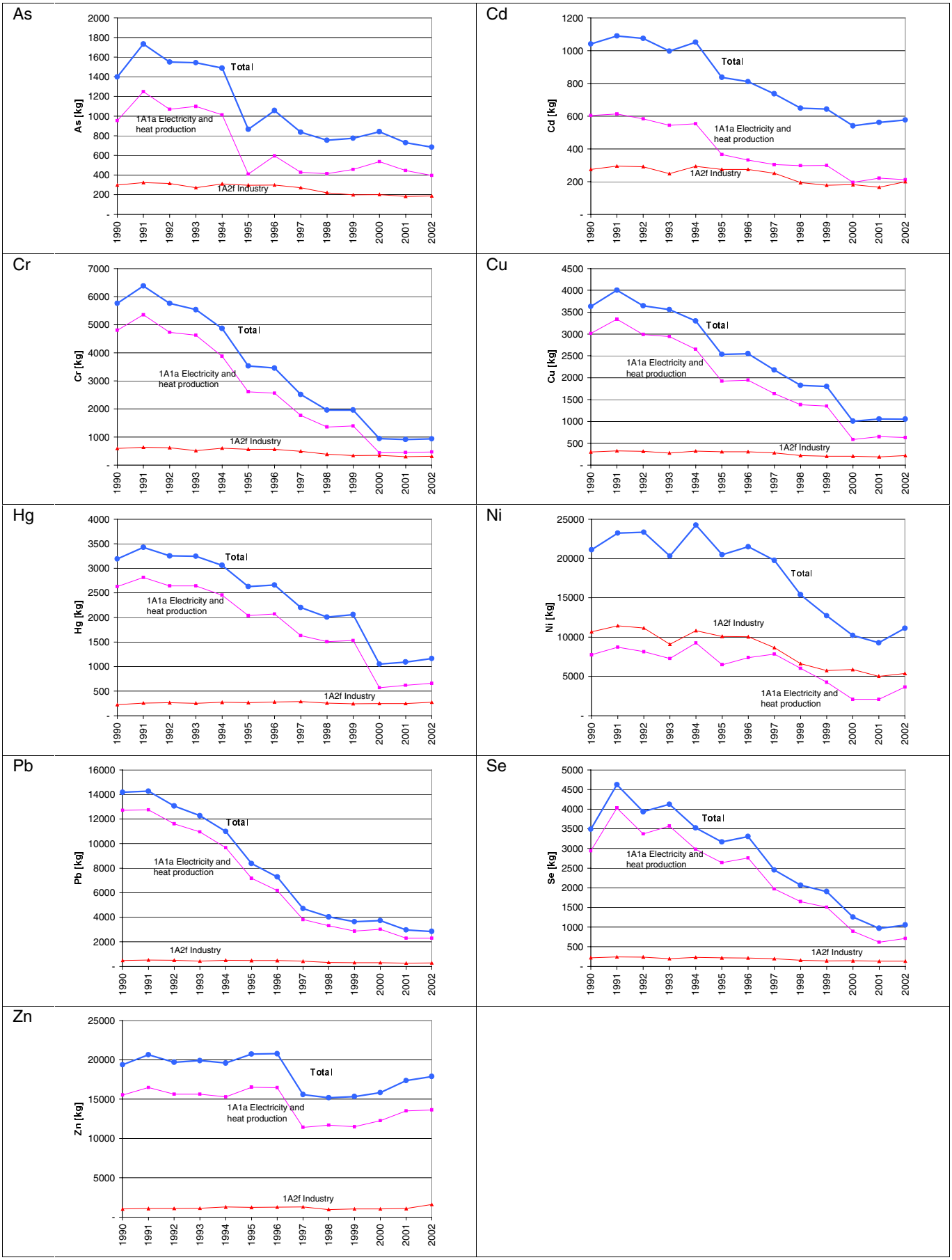


Figure 35 Heavy metal emission time-series, stationary combustion plants.

9 PAH and dioxin

Emission inventories for 4 PAHs and for dioxin are reported to the LRTAP Convention. Dioxin emission inventories are estimated by COWI for the Danish Environmental Protection Agency (Hansen & Hansen 2003). The emission inventories for PAH are presented in Table 32. Stationary combustion plants account for more than 90% of the PAH emissions.

Table 32 The emission for the year 2002 reported to the LRTAP Convention in 2004.

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	0,04	0,02	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)	2,80	3,65	1,21	2,04
Total emission from stationary combustion plants	**2,84**	**3,79**	**1,24**	**2,06**
Total Danish emission (gross)	2,89	3,87	1,33	2,13
Emission share for stationary combustion	98,1	97,9	93,6	96,6

Table 33 and Figure 37 present the PAH emission inventory for the stationary combustion subsectors. Residential combustion is the largest emission source. Combustion of wood is the predominant source, accounting for more than 97% of the emission in residential plants, see Figure 36.

Time-series for PAH emission are presented in Figure 38. The increasing emission trend 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 38.

Table 33 PAH emission from stationary combustion plants, 2002.

	Benzo(a)-pyrene Mg	Benzo(b)-fluoranthene Mg	Benzo(k)-fluoranthene Mg	Indeno(1,2,3-c,d)pyrene Mg
1A1a Electricity and heat production	10	40	16	11
1A1b Petroleum refining	0	1	0	0
1A1c Solid fuel transf. and other energy industries	0	0	0	0
1A2f Industry	26	97	22	8
1A4a Commercial / Institutional	164	216	72	117
1A4b Residential	2534	3319	1107	1789
1A4c Agriculture / Forestry / Fishing	105	117	28	131
Total	2840	3790	1244	2056

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

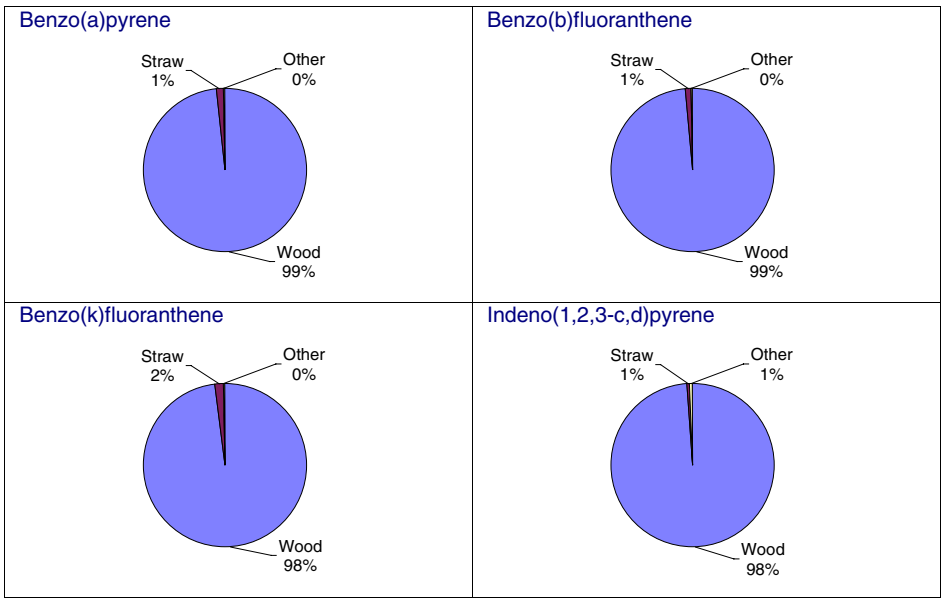


Figure 36 PAH emission from residential combustion plants (stationary), fuel origin.

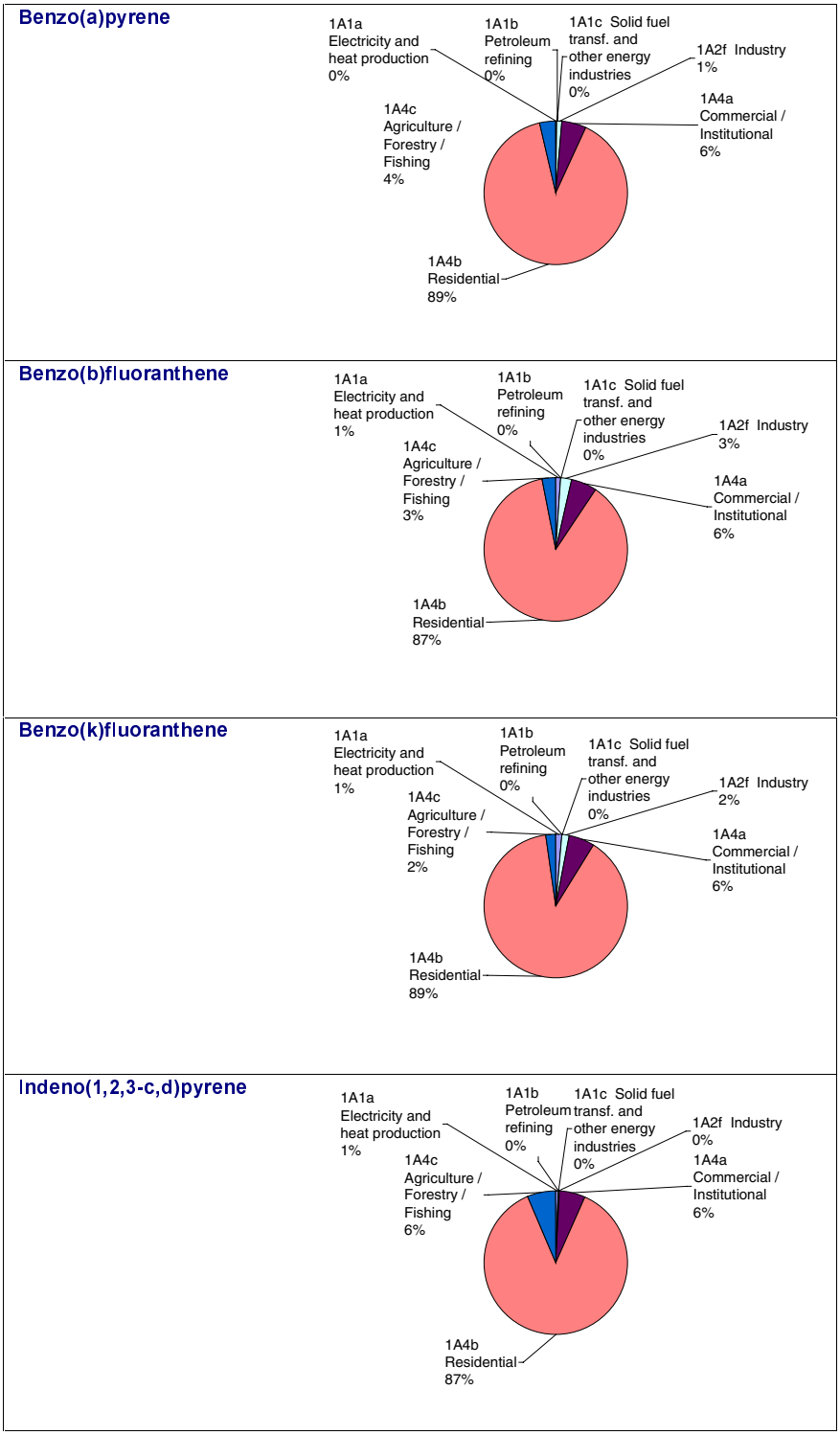


Figure 37 PAH emission sources, stationary combustion plants, 2002.

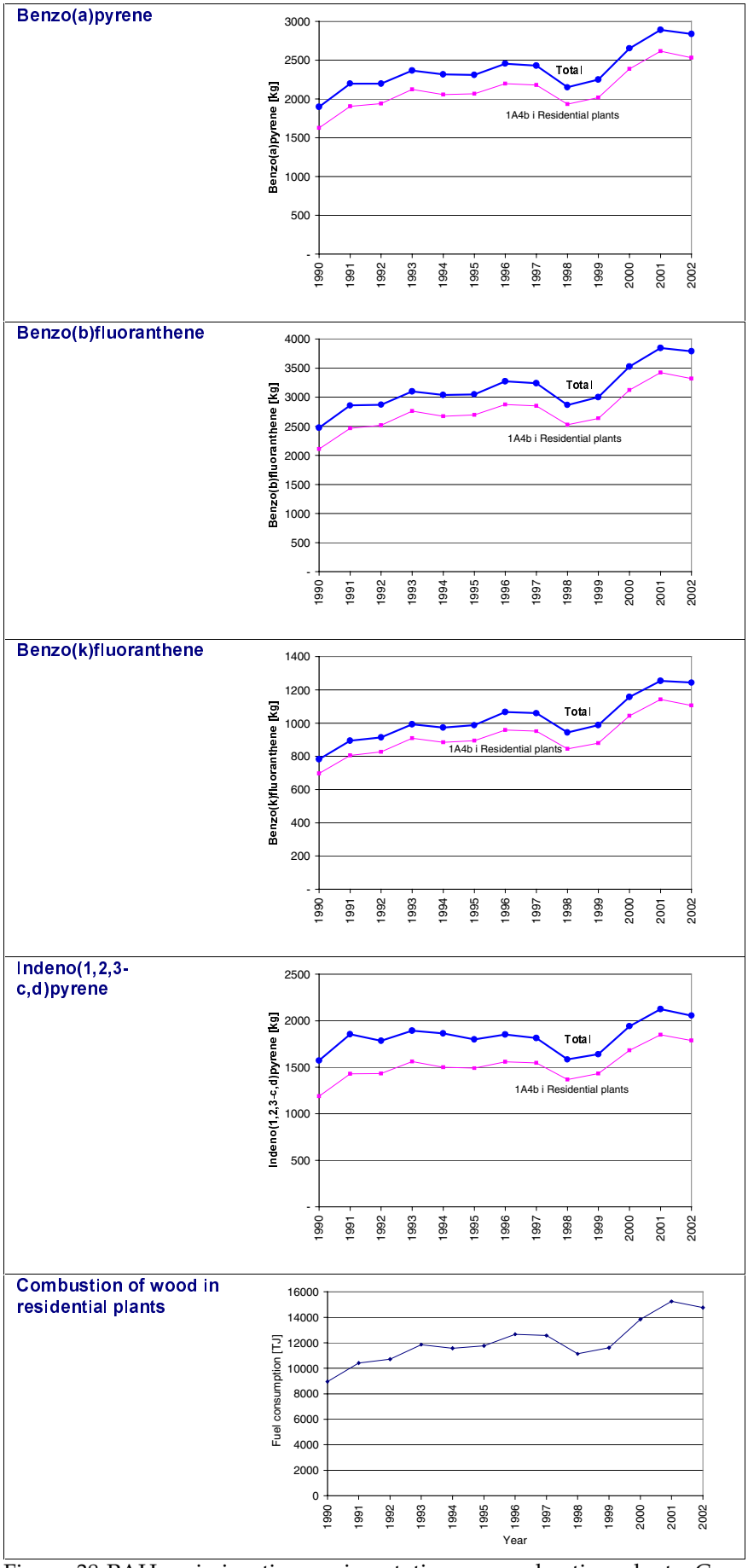


Figure 38 PAH emission time-series, stationary combustion plants. Comparison with wood consumption in residential plants.

10 QA/QC and validation

A formal QA/QC plan has not yet been developed, but a number of quality control (QC) procedures are performed. The QC procedures for stationary combustion include:

- 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 2,0% (1990-2002). The reference approach is further discussed below.
- 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.
- QA/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: E2 and Elsam both obtained the ISO 14001 certification for an environmental management system. Danish Gas Technology Centre and dk-Teknik both run accredited laboratories for emission measurements.

10.1 Reference approach

In addition to the sector-specific CO_2 emission inventories (the national approach), the CO_2 emission is also estimated using the reference approach described in the IPCC Reference Manual (IPCC 1996). The reference approach is based on data for fuel production, import, export and stock change. The CO_2 emission inventory based on the reference approach is reported to the Climate Convention and used for verification of the official data in the national approach.

Data for import, export and stock change used in the reference approach originate from the annual "basic data" table prepared by the Danish Energy

Authority and published on their home page (DEA 2003b). The fraction of carbon oxidised has been assumed to be 1,00. The carbon emission factors are default factors originating from the IPCC Reference Manual (IPCC 1996). The country-specific emission factors are not used in the reference approach, the approach being for the purposes of verification.

The Climate Convention reporting tables include a comparison of the national approach and the reference approach estimates. To make results comparable, the CO_2 emission from incineration of the plastic content of municipal waste is added in the reference approach. Further consumption for non-energy purposes is subtracted in the reference approach, because non-energy use of fuels is not, as yet, included in the Danish national approach.

Three fuels are used for non-energy purposes: lube oil, bitumen and white spirit. The total consumption for non-energy purposes is relatively low – 10,9 PJ in 2002.

In 2002 the fuel consumption rates in the two approaches differ by 0,05% and the CO_2 emission differs by 0,24%. In the period 1990-2002 fuel consumption differs by less than 1,96%, and the CO_2 emission by less than 1,92%. According to IPCC Good Practice Guidance (IPCC 2000) the difference should be within 2%. The reference approach for 2002 and the comparison with the Danish national approach are provided in Appendix 14. The appendix also includes a correspondence list for the fuel categories (Danish Energy Authority/IPCC reference approach).

A comparison of the national approach and the reference approach is illustrated in Figure 39.

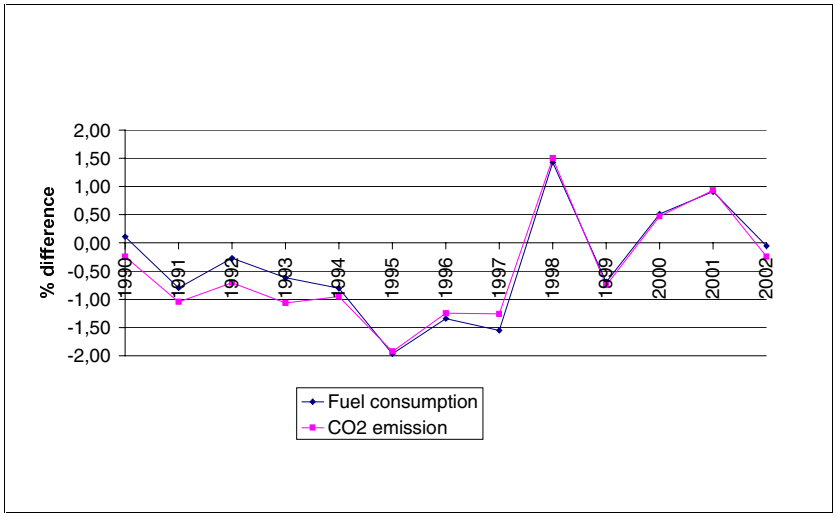


Figure 39 Comparison of the reference approach and the national approach.

10.2 External review

This report has been reviewed by Jan Erik Johnsson, Technology University of Denmark. The review was performed after the reporting of emission data to the Climate Convention and the LRTAP Convention. Thus only the suggested improvements of the documentation is reflected in this report, whereas the suggested improvements of emission factors will be included the next emission inventory that will be reported in 2005.

11 Uncertainty

According to the IPCC Good Practice Guidance (IPCC 2000) uncertainty estimates should be included in the annual National Inventory Report. Likewise, uncertainty estimates for the LRTAP Convention inventories are included in the report for these inventories.

Uncertainty estimates include uncertainty with regard to the total emission inventory as well as uncertainty with regard to trends. The GHG emission from stationary combustion plants has been estimated with an uncertainty interval of ±10% and the decrease in the GHG emission since 1990 has been estimated to be 1,3% ± 1,8 %-age-points.

11.1 Methodology

The Danish uncertainty estimates for GHGs are based on a methodology included in IPCC Good Practice Guidance (IPCC 2000). The estimates are based on uncertainties for emission factors and fuel consumption rates, respectively. The input data required for the uncertainty calculations are:

- Emission data for the base year and the last year
- Uncertainty for activity rates
- Uncertainty for emission factors

11.1.1 Greenhouse gases

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

- CO_2 emission from each of the applied fuel categories [1]
- CH_4 emission from gas engines
- CH_4 emission from all other stationary combustion plants
- N_2O emission from all stationary combustion plants

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

Most of the applied uncertainty estimates for activity rates and emission factors are default values from the IPCC Reference Manual. A few of the uncertainty estimates are, however, based on national estimates.

[1] Brown coal and coke is included in the fuel category coal

Table 34 Uncertainty rates for activity rates and emission factors.

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

1) IPCC Reference Manual (default value)
2) Kristensen (2003)
3) Jensen & Lindroth (2002)
4) NERI assumption

11.1.2 Other pollutants

With regard to other pollutants, IPCC methodologies for uncertainty estimates have been adopted for the LRTAP Convention reporting activities (Pulles & Aardenne 2002). The Danish uncertainty estimates are based on the simple tier 1 approach.

The uncertainty estimates are based on emission data for the base year and year 2002 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 2002. 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 35. The uncertainty for fuel consumption in stationary combustion plants was assumed to be 2%.

Table 35 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

11.2 Results

The uncertainty estimates for stationary combustion emission inventories are shown in Table 36. Detailed calculation sheets are provided in Appendix 9.

The uncertainty interval for GHG is estimated to be ±10% and the uncertainty for the trend in GHG emission is ±1,8%-age points. The main sources of uncertainty for GHG emission are N_2O emission (all plants) and CO_2 emission from coal combustion. The main source of uncertainty in the trend in GHG emission is CO_2 emission from the combustion of natural gas and coal.

The total emission uncertainty is 7% for SO_2, 16% for NO_X, 38% for NMVOC and 45% for CO. For PM, heavy metals and PAH the uncertainty estimate is greater than 100%.

Table 36 Danish uncertainty estimates, 2002.

Pollutant	Uncertainty Total emission	Trend 1990-2002	Uncertainty Trend
	[%]	[%]	[%-age points]
GHG	10,4	-1,3	± 1,8
CO_2	2,6	-2,3	± 1,8
CH_4	39	349	± 351
N_2O	1000	-3,6	± 3,0
SO_2	7	-87	±0,6
NO_X	16	-35	±2,5
NMVOC	38	46	±15
CO	45	15	±3
TSP [1)]	295	1,5	±3,3
PM_{10} [1)]	320	1,0	±2,7
$PM_{2.5}$ [1)]	345	1,5	±4,1
As	130	-50	±14
Cd	246	-43	±61
Cr	101	-78	±14
Cu	175	-69	±27
Hg	200	-63	±34
Ni	125	-46	±12
Pb	94	-77	±5
Se	125	-59	±21
Zn	163	-9	±6
Benzo(b)fluoranthene	972	52	±9
Benzo(k)fluoranthene	970	59	±22
Benzo(a)pyrene	987	50	±5
Indeno(1,2,3-c,d)	991	31	±6

1. The base year for PM is year 2000

12 Geographical distribution of the emissions

Geographical distribution of emissions has been reported to the LRTAP Convention for the years 1990, 1995 and 2000 (Illerup et al. 2002). The emissions are disaggregated to a grid of 50x50 km^2. Gridded data are reported for SO_2, NO_X, NMVOC, CO, PM, heavy metals and PAH. The assumptions and methodology will not be discussed here, but gridded emission data for SO_2 from stationary combustion plants are illustrated in Figure 40. 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.

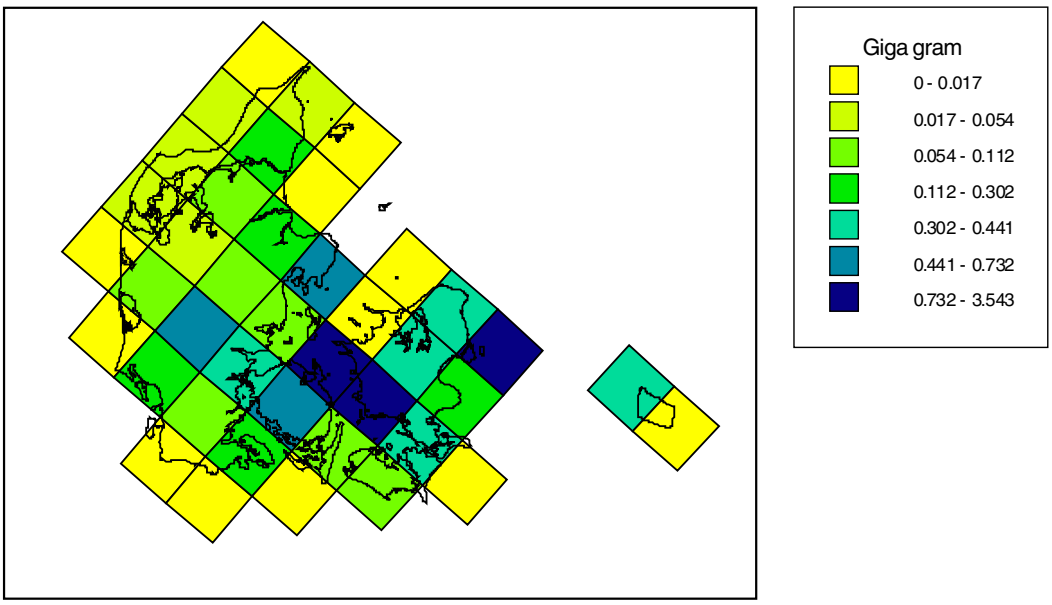


Figure 40 Gridded SO_2 emission from stationary combustion, 2000 (Hansen & Illerup 2002).

13 Improvements/recalculations since reporting in 2003

Recalculations since the 2003 emission inventory reporting include:

- The CO_2 emission factors for municipal waste, refinery gas and petroleum coke have been changed for certain years.
    - Petroleum coke: The same CO_2 emission factor (92 kg/GJ) is applied for all years now. In earlier inventories a higher emission factor was applied for 1990-1997. The reference for the emission factor is, however, based on a fuel analysis carried out in 1993 and, thus, the higher emission factor was not correct.
    - Refinery gas: To improve time-series consistency the same emission factor (56,9 kg/GJ) is now applied for all years. In the inventory reported in 2003 the emission factor 57,1 kg/GJ was applied for 2000 and 2001.
    - Municipal waste: An improved CO_2 emission factor for municipal waste has been estimated. See Chapter 3.5.1 for details.
- Fuel consumption rates for a few stationary combustion sectors have been recalculated as a result of a new estimate for off-road machinery. The fuel consumption of gas oil and LPG in the SNAP sectors 0203 and 0301 (stationary combustion) is calculated as total emission of the sectors minus off-road consumption.
- Emission factors for combined heat and power plants have been improved based on a Danish project including collection of existing emission data and performance of a large number of new emission measurements (Nielsen & Illerup 2003). The emission measurements included CH_4, N_2O, SO_2, NO_X, NMVOC, CO, PM, heavy metals and PAH.
- Centralised power plants have been included in the emission databases as point sources in 1993-1994 (and were already included as point sources all other years). Plant-specific SO_2 and NO_X emission factors are applied. However, the area source emission factor applied in former inventories took into account the plant-specific data and as a result of this, the estimated emission has not changed considerably.
- The SO_2 and NO_X emission factors have been examined and time-series inconsistencies have been corrected.
- HM emission factors for power plants have been changed for the years 1991-1993 due to inconsistencies with emission factors applied for 1990 and 1994.
- The fuel consumption rate for residential wood combustion has been updated according to the new energy statistics.
- PM emissions from refineries 2001 have been added.

Furthermore, a few minor errors for large point sources have been corrected. These corrections do not affect greenhouse gases.

14 Future improvements

Some planned improvements of the emission inventories are discussed below.

1) Disaggregation of fuel consumption in the industrial sector

To date the Danish energy statistics aggregated to SNAP sectors have not specified fuel consumption rates for specific industries. Disaggregation in this regard is expected to be implemented in the reporting activities in 2005.

2) Energy statistics update

A full update of fuel consumption rates according to the updated energy statistics have not been carried out for a few years. A full update is expected to be part of the next emission inventory.

3) Improved documentation for CO_2 emission factors

The CO_2 emission factors applied for the Danish inventories are considered accurate, but documentation will be improved in future inventories.

4) Improved documentation for other emission factors

Reporting of and references for the applied emission factors have been improved in the current year and will be further developed in future inventories.

5) QA/QC and validation

The QA/QC and validation of the inventories for stationary combustion will be improved as part of the work that has been initiated for the Danish inventory as a whole.

6) Uncertainty estimates

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

7) Other improvements

- The criteria for including a plant as a point source should be defined and the list of plants updated annually.
- Improved emission factors for fish oil/rape oil should be estimated. So far the emission factors for straw have been applied.
- HM emission factors should be compared to new Danish legislation and updated if relevant.
- As a result of the external review of this report a few emission factors might be changed. The changes will, however, not increase or decrease the estimated total emission considerably.

15 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 14% - fossil fuel consumption, however, by only 8%. 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 total Danish emission for the following pollutants: SO_2, CO_2, heavy metals and PAH. Furthermore, the emission from stationary combustion plants accounts for more than 10% of the total Danish emission for the following pollutants: NO_X, CO, NMVOC and particulate matter. Stationary combustion plants account for less than 10% of the total Danish CH_4 and N_2O emission.

Public power plants are the most important stationary combustion emission source for SO_2, CO_2, NO_X and heavy metals.

Lean-burn gas engines installed in decentralised CHP plants are the largest stationary combustion emission source for CH_4. Furthermore, these plants are also a considerable emission source for NMVOC.

Residential plants represent the most important stationary combustion source for CO, NMVOC, particulate matter and PAH. Wood combustion in residential plants is the predominant emission source.

The greenhouse gas emission (GHG) development follows the CO_2 emission development closely. Both the CO_2 and the total GHG emission decreased slightly from 1990 to 2002, CO_2 by 2,3% and GHG by 1,3%. However fluctuations in the GHG emission level are great. The fluctuations in the time-series are a result of electricity import/export and of outdoor temperature variations from year to year.

The CH_4 emission from stationary combustion has increased by a factor of 4,5 since 1990. This is a result of the considerable number of lean-burn gas engines installed in CHP plants in Denmark during this period.

SO_2 emission from stationary combustion plants has decreased by 95% from 1980 and by 83% from 1995. 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 50% since 1985 and 34% since 1995. 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 has increased by 65% from 1990 to 2002 leading to an increased CO emission. The increase in CO emission from

residential plants is less than the increase in wood consumption, because CO emission from straw-fired farmhouse boilers has decreased considerably.

The NMVOC emission from stationary combustion plants has increased by 40% from 1985 and 14% from 1995. The increased NMVOC emission is mainly a result of the increased use of lean-burn gas engines. The emission from residential plants is relatively constant, but the emission from wood combustion increased considerably and the emission from straw combustion decreased.

All the heavy metal emissions decreased considerably since 1990 – between 8% and 84%. This is a result of the installation and improved performance of gas cleaning devices in municipal waste incineration plants and large power plants.

The PAH emission has increased since 1990 due to the increased consumption of wood in residential plants.

The uncertainty level of the Danish greenhouse gas emission from stationary combustion is estimated to be within a range of ±10% and the trend uncertainty within a range of ±1,8%-age points. The sources contributing the most to the uncertainty estimates are the N_2O emission (all plants) and the CO_2 emission from coal combustion.

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Appendix

Appendix 1: The Danish emission inventory for the year 2002 reported to the Climate Convention in 2004

Appendix 2: Emission inventory for the year 2002 reported to the LRTAP Convention in 2004

Appendix 3: IPCC/SNAP source correspondence list

Appendix 4: Fuel rate

Appendix 5: Emission factors

Appendix 6: Implied emission factors for power plants and municipal waste incineration plants

Appendix 7: Large point sources

Appendix 8: Uncertainty estimates

Appendix 9: Lower Calorific Value (LCV) of fuels

Appendix 10: Adjustment of CO_2 emission

Appendix 11: Reference approach

Appendix 12: Emission inventory 2002 based on SNAP sectors

Appendix 1 The Danish emission inventory for the year 2002 reported to the Climate Convention

Table 37 The Danish emission inventory for the year 2002 reported to the Climate Convention in 2004 (Illerup et al. 2004a).

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 [1]	CH_4	N_2O	HFCs	PFCs	SF_6	Total
	CO_2 equivalent (Gg)						
Total (Net Emissions) [1]	**50.350,92**	**5.634,72**	**7.976,44**	**672,10**	**22,17**	**21,63**	**64.677,98**
1. Energy	**52.457,27**	**739,38**	**832,02**				**54.028,68**
A. Fuel Combustion (Sectoral Approach)	51.921,90	607,59	829,13				53.358,61
1. Energy Industries	26.548,40	339,86	264,23				27.152,50
2. Manufacturing Industries and Construction	5.557,12	37,43	62,44				5.656,99
3. Transport	12.300,06	66,07	407,17				12.773,31
4. Other Sectors	7.427,53	164,13	94,01				7.685,68
5. Other	88,78	0,09	1,27				90,13
B. Fugitive Emissions from Fuels	535,37	131,80	2,90				670,07
1. Solid Fuels	0,00	62,28	0,00				62,28
2. Oil and Natural Gas	535,37	69,52	2,90				607,79
2. Industrial Processes	**1.594,90**	**0,00**	**774,07**	**672,10**	**22,17**	**21,63**	**3.084,87**
A. Mineral Products	1.591,78	0,00	0,00				1.591,78
B. Chemical Industry	3,12	0,00	774,07	0,00	0,00	0,00	777,19
C. Metal Production	0,00	0,00	0,00		0,00	0,00	0,00
D. Other Production	NE						0,00
E. Production of Halocarbons and SF_6				0,00	0,00	0,00	0,00
F. Consumption of Halocarbons and SF_6				672,10	22,17	21,63	715,89
G. Other	0,00	0,00	0,00	0,00	0,00	0,00	0,00
3. Solvent and Other Product Use	**111,75**		**0,00**				**111,75**
4. Agriculture	**0,00**	**3.764,05**	**6.370,35**				**10.134,40**
A. Enteric Fermentation		2.797,90					2.797,90
B. Manure Management		966,15	605,36				1.571,50
C. Rice Cultivation		0,00					0,00
D. Agricultural Soils [2]		0,00	5.765,00				5.765,00
E. Prescribed Burning of Savannas		0,00	0,00				0,00
F. Field Burning of Agricultural Residues		0,00	0,00				0,00
G. Other		0,00	0,00				0,00
5. Land-Use Change and Forestry [1]	**-3.813,00**	**0,00**	**0,00**				**-3.813,00**
6. Waste	**0,00**	**1.131,28**	**0,00**				1.131,28
A. Solid Waste Disposal on Land	0,00	1.131,28					1.131,28
B. Wastewater Handling		0,00	0,00				0,00
C. Waste Incineration	0,00	0,00	0,00				0,00
D. Other	0,00	0,00	0,00				0,00
7. Other *(please specify)*	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**
							0,00
Memo Items:							
International Bunkers	**5.018,91**	**2,23**	**80,26**				**5.101,41**
Aviation	2.053,39	0,82	22,17				2.076,38
Marine	2.965,52	1,41	58,09				3.025,03
Multilateral Operations	**0,00**	**0,00**	**0,00**				**0,00**
CO_2 Emissions from Biomass	**8.453,62**						**8.453,62**

[1] For CO_2 emissions from Land-Use Change and Forestry the net emissions are to be reported. Please note that for the purposes of reporting, the signs for uptake are always (-) and for emissions (+).
[2] See footnote 4 to Summary 1.A of this common reporting format.

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 emissions	CO_2 removals	Net CO_2 emissions / removals	CH_4	N_2O	Total emissions
Land-Use Change and Forestry	CO_2 equivalent (Gg)					
A. Changes in Forest and Other Woody Biomass Stocks	0,00	-3.813,00	-3.813,00			-3.813,00
B. Forest and Grassland Conversion	0,00		0,00	0,00	0,00	0,00
C. Abandonment of Managed Lands	0,00	0,00	0,00			0,00
D. CO_2 Emissions and Removals from Soil	0,00	0,00	0,00			0,00
E. Other	0,00	0,00	0,00	0,00	0,00	0,00
Total CO_2 Equivalent Emissions from Land-Use Change and Forestry	0,00	-3.813,00	-3.813,00	0,00	0,00	-3.813,00

Total CO_2 Equivalent Emissions without Land-Use Change and Forestry [a]	68.490,98
Total CO_2 Equivalent Emissions with Land-Use Change and Forestry [a]	64.677,98

GREENHOUSE GAS SOURCE AND SINK CATEGORIES		CO_2 emissions	CO_2 removals	CH_4	N_2O	HFCs[1]		PFCs[1]		SF_6		NO_x	CO	NMVOC	SO_2
						P	A	P	A	P	A				
		(Gg)				CO_2 equivalent (Gg)				(Gg)					
Total National Emissions and Removals		**54.163,92**	**-3.813,00**	**268,32**	**25,73**	**1.281,10**	**672,10**	**13,62**	**22,17**	**1,40**	**0,00**	**200,29**	**576,63**	**123,77**	**25,28**
1. Energy		**52.457,27**		**35,21**	**2,68**							**199,87**	**576,63**	**83,98**	**25,28**
A. Fuel Combustion	Reference Approach[2]	51.196,34													
	Sectoral Approach[2]	51.921,90		28,93	2,67							197,12	553,59	77,46	24,87
B. Fugitive Emissions from Fuels		535,37		6,28	0,01							2,75	23,05	6,52	0,40
2. Industrial Processes		**1.594,90**		**0,00**	**2,50**	**1.281,10**	**672,10**	**13,62**	**22,17**	**1,40**	**0,00**	**0,43**	**0,00**	**0,58**	**0,00**
3. Solvent and Other Product Use		**111,75**			**0,00**							**0,00**	**0,00**	**38,01**	**0,00**
4. Agriculture [3]		**0,00**	**0,00**	**179,24**	**20,55**							**0,00**	**0,00**	**1,21**	**0,00**
5. Land-Use Change and Forestry		[4] **0,00**	[4] **-3.813,00**	**0,00**	**0,00**							**0,00**	**0,00**	**0,00**	**0,00**
6. Waste		**0,00**		**53,87**	**0,00**							**0,00**	**0,00**	**0,00**	**0,00**
7. Other		**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**
Memo Items:															
International Bunkers		**5.018,91**		**0,11**	**0,26**							**90,00**	**8,52**	**2,55**	**39,68**
Aviation		2.053,39		0,04	0,07							8,71	1,60	0,38	0,07
Marine		2.965,52		0,07	0,19							81,29	6,91	2,17	39,61
Multilateral Operations		**0,00**		**0,00**	**0,00**							**0,00**	**0,00**	**0,00**	**0,00**
CO_2 Emissions from Biomass		**8.453,62**													

Appendix 2 Emission inventory for the year 2002 reported to the LRTAP Convention in 2004

Table 38 Emission inventory for the year 2002 reported to the LRTAP in 2004 (a) (Illerup et al. 2004b).

	NO_x Gg NO_2	CO Gg	NMVOC Gg	SO_x Gg SO_2	TSP Mg	PM_{10} Mg	$PM_{2.5}$ Mg
1 A 1 a Public Electricity and Heat Production	44,96	11,53	4,24	9,94	1187,44	942,70	778,29
1 A 1 b Petroleum refining	1,55	0,26	0,00	0,93	142,10	128,47	121,66
1 A 1 c Manufacture of Solid Fuels and Other Energy Industries	6,55	0,75	0,05	0,01	2,76	2,66	2,65
1 A 2 Manufacturing Industries and Construction	16,18	14,80	3,88	5,83	1314,75	1160,34	1039,63
1 A 2 a Iron and Steel	IE	IE	IE	IE	174,60	52,38	7,86
1 A 2 b Non-ferrous Metals	IE	IE	IE	IE	32,65	29,40	13,48
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)	9,32	1,18	0,10	1,00	441,91	383,89	234,62
1 A 3 a ii Civil Aviation (Domestic, LTO)	0,23	0,76	0,13	0,00	1,55	1,55	1,55
1 A 3 a ii Civil Aviation (Domestic, Cruise)	0,44	0,11	0,02	0,00	1,67	1,67	1,67
1 A 3 b Road Transportation	-	-	-	-	-	-	-
1 A 3 b i R.T., Passenger cars	32,43	247,45	19,80	0,20	723,49	723,49	723,49
1 A 3 b ii R.T., Light duty vehicles	10,15	16,45	1,91	0,06	1564,34	1564,34	1564,34
1 A 3 b iii R.T., Heavy duty vehicles	24,06	6,17	2,74	0,09	1166,66	1166,66	1166,66
1 A 3 b iv R.T., Mopeds & Motorcycles	0,11	13,84	2,90	0,00	53,18	53,18	53,18
1 A 3 b v R.T., Gasoline evaporation	NO	NO	7,46	NO	NO	NO	NO
1 A 3 b vi R.T., Automobile tyre and brake wear	NO	NO	NO	NO	1371,20	1027,77	559,72
1 A 3 b vii R.T., Automobile road abrasion	NO	NO	NO	NO	962,14	481,07	259,78
1 A 3 c Railways	3,39	0,64	0,25	0,01	124,95	124,95	124,95
1 A 3 d ii National Navigation	8,64	20,02	11,37	2,02	604,09	575,05	547,46
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
1 A 3 e ii Other mobile sources and machinery	NO	NO	NO	NO	NO	NO	NO
1 A 4 a Commercial / Institutional	1,08	0,91	0,75	0,55	203,70	195,34	180,80
1 A 4 b Residential	-	-	-	-	-	-	-
1 A 4 b i Residential plants	4,91	147,05	10,96	1,79	3096,18	2936,18	2770,17
1 A 4 b ii Household and gardening (mobile)	0,24	47,60	4,16	0,00	25,97	25,97	25,97
1 A 4 c Agriculture / Forestry / Fishing	-	-	-	-	-	-	-
1 A 4 c i Stationary	1,46	1,48	1,66	1,28	114,65	91,70	75,27
1 A 4 c ii Off-road Vehicles and Other Machinery	19,97	20,78	4,51	0,38	2012,45	1912,46	1818,47
1A 4 c iii National Fishing	11,04	1,50	0,49	0,78	348,45	331,04	314,51
1 A 5 a Other, Stationary (including Military)	-	-	-	-	-	-	-
1 A 5 b Other, Mobile (Including military)	0,42	0,32	0,06	0,00	20,34	20,34	20,34
1B1 Fugitive Emissions from Solid Fuels	-	-	-	-	-	-	-
1 B 1 a Coal Mining and Handling	NA	21,26	NA	NA	939,30	375,72	37,57
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	-	-	-	-	-	-	-
1 B 2 a Oil	-	-	-	-	-	-	-
1 B 2 a i Exploration Production, Transport	NO	NO	IE	IE	NO	NO	NO
1 B 2 a iv Refining / Storage	NO	NO	4,30	0,33	NO	NO	NO
1 B 2 a v Distribution of oil products	NO	NO	1,04	NO	NO	NO	NO
1 B 2 a vi Other	NO	NO	NO	NO	NO	NO	NO
1 B 2 b Natural gas	-	NA	0,41	0,00	NA	NA	NA
1 B 2 c Venting and flaring	2,79	1,79	0,78	0,07	2,92	2,92	2,92
2 A MINERAL PRODUCTS (b)	-	-	-	-	-	-	-
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	NE	NE	NE	NE	NE	NE
2 A 6 Road Paving with Asphalt	NE	NE	NE	NE	NE	NE	NE
2 A 7 Other including Non Fuel Mining & Construction (Please specify in a covering note)	NE	NE	0,02	NE	172,00	43,00	6,88
2 B CHEMICAL INDUSTRY	-	-	-	-	-	-	-
2 B 1 Ammonia Production	NO	NO	NO	NO	NO	NO	NO
2 B 2 Nitric Acid Production	0,40	NE	NE	NE	310,00	248,00	186,00
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)	0,03	NE	0,03	NE	19,00	15,00	11,00
2 C METAL PRODUCTION	NA	NE	NE	NA	-	-	-
2 D OTHER PRODUCTION (b)	-	-	-	-	-	-	-
2 D 1 Pulp and Paper	NE	NE	NE	NE	NE	NE	NE
2 D 2 Food and Drink	NE	NE	0,53	NE	NE	NE	NE
2 G OTHER (Please specify in a covering note)	-	-	-	-	-	-	-

Table 38 (a) continued.

	NO_x Gg NO_2	CO Gg	NMVOC Gg	SO_x Gg SO_2	TSP Mg	PM_{10} Mg	$PM_{2.5}$ Mg
3 A PAINT APPLICATION	NO	NO	23,22	-	-	-	-
3 B DEGREASING AND DRY CLEANING	NO	NO	NO	NO	NO	NO	NO
3 C CHEMICAL PRODUCTS, MANUFACTURE AND PROCESSING	NO	NO	2,14	NO	-	-	-
3 D OTHER including products containing HMs and POPs (Please specify in a covering note)	NO	NO	12,64	NO	NO	NO	NO
4 B MANURE MANAGEMENT (c)	-	-	-	-	-	-	-
4 B 1 Cattle	IE	IE	IE	IE	IE	IE	IE
4 B 1 a Dairy	NA	NO	NA	NO	587,41	264,32	58,77
4 B 1 b Non-Dairy	NA	NO	NA	NO	1143,33	514,47	114,38
4 B 2 Buffalo	NO	NO	NO	NO	NO	NO	NO
4 B 3 Sheep	NA	NO	NA	NO	NE	NE	NE
4 B 4 Goats	NA	NO	NA	NO	NE	NE	NE
4 B 5 Camels and Llamas	NO	NO	NO	NO	NO	NO	NO
4 B 6 Horses	NA	NO	NA	NO	NE	NE	NE
4 B 7 Mules and Asses	NO	NO	NO	NO	NO	NO	NO
4 B 8 Swine	NA	NO	NA	NO	12380,63	5571,54	1237,55
4 B 9 Poultry	NA	NO	NA	NO	2541,93	1144,22	253,99
4 B 13 Other	NA	NO	NA	NO	NE	NE	NE
4 C RICE CULTIVATION	NO	NO	NO	NO	NO	NO	NO
4 D AGRICULTURAL SOILS	-	-	-	-	-	-	-
4 D 1 Direct Soil Emission	NA	NO	1,21	NO	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	NO	NO	NE	NO	NE	NE	NE
6 B WASTE-WATER HANDLING	NO	NO	NE	NO	NO	NO	NO
6 C WASTE INCINERATION (e)	NO	NO	NO	NO	NO	NO	NO
6 D OTHER WASTE (f)	NE	NE	NE	NE	NE	NE	NE
7 OTHER	NO	NO	NO	NO	NO	NO	NO
National Total	**200,33**	**576,64**	**123,76**	**25,28**	**33788**	**22112**	**14316**
Memo Items							
International Aviation (LTO)	1,01	0,64	0,12	0,01	3,63	3,63	3,63
International Aviation (Cruise)	7,70	0,96	0,26	0,06	29,53	29,53	29,53
International Navigation	81,29	6,91	2,17	39,61	4427,68	4206,30	3995,98
5 E Other	-	-	-	-	-	-	-
X (11 08 Volcanoes)	-	-	-	-	-	-	-

Table 38 (b).

	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	2,30	0,21	0,66	0,40	0,47	0,63	3,65	0,71	13,63
1 A 1 b Petroleum refining	0,03	0,02	0,01	0,02	0,05	0,02	0,87	0,02	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	0,26	0,18	0,11	0,13	0,30	0,54	5,32	0,12	1,67
1 A 2 a Iron and Steel	0,63	0,01	NE	0,03	0,10	NE	0,11	0,44	0,44
1 A 2 b Non-ferrous Metals	0,01	0,00	NE	NE	NE	0,00	NE	NE	-
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)	0,20	0,04	0,17	0,07	0,40	0,12	0,35	0,29	0,16
1 A 3 a ii Civil Aviation (Domestic, LTO)	1,33	0,00	-	-	0,00	0,02	0,00	0,00	0,01
1 A 3 a ii Civil Aviation (Domestic, Cruise)	-	0,00	-	-	0,00	0,06	0,00	0,00	0,03
1 A 3 b Road Transportation	-	-	-	-	-	-	-	-	-
1 A 3 b i R.T., Passenger cars	0,05	0,02	NE	NE	0,10	3,48	0,14	0,02	2,05
1 A 3 b ii R.T., Light duty vehicles	0,00	0,01	NE	NE	0,03	1,06	0,04	0,01	0,62
1 A 3 b iii R.T., Heavy duty vehicles	0,00	0,01	NE	NE	0,04	1,51	0,06	0,01	0,89
1 A 3 b iv R.T., Mopeds & Motorcycles	0,00	0,00	NE	NE	0,00	0,04	0,00	0,00	0,02
1 A 3 b v R.T., Gasoline evaporation	NO	NO	NO	NO	NO	NO	NO	NO	NO
1 A 3 b vi R.T., Automobile tyre and brake wear	NO	NO	NO	NO	NO	NO	NO	NO	NO
1 A 3 b vii R.T., Automobile road abrasion	NO	NO	NO	NO	NO	NO	NO	NO	NO
1 A 3 c Railways	-	0,00	-	-	0,00	0,11	0,00	0,00	0,07
1 A 3 d ii National Navigation	0,02	0,00	0,01	0,03	0,02	0,10	1,52	0,04	0,13
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	0,05	0,01	0,04	0,02	0,02	0,02	0,23	0,02	0,19
1 A 4 b Residential	-	-	-	-	-	-	-	-	-
1 A 4 b i Residential plants	0,13	0,11	0,16	0,04	0,04	0,14	0,12	0,14	2,38
1 A 4 b ii Household and gardening (mobile)	0,00	0,00	NE	NE	0,00	0,04	0,00	0,00	0,03
1 A 4 c Agriculture / Forestry / Fishing	-	-	-	-	-	-	-	-	-
1 A 4 c i Stationary	0,05	0,02	0,02	0,02	0,05	0,03	0,89	0,03	0,08
1 A 4 c ii Off-road Vehicles and Other Machinery	0,00	0,00	-	-	0,02	0,66	0,03	0,00	0,39
1A 4 c iii National Fishing	0,02	0,00	0,01	0,01	0,01	0,01	0,02	0,04	0,10
1 A 5 a Other, Stationary (including Military)	-	-	-	-	-	-	-	-	-
1 A 5 b Other, Mobile (Including military)	0,11	0,00	-	-	0,00	0,05	0,00	0,00	0,03
1B1 Fugitive Emissions from Solid Fuels	-	-	-	-	-	-	-	-	-
1 B 1 a Coal Mining and Handling	NO	NO	NO	NO	NO	NO	NO	NO	NO
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	NO	NO	NO	NO	NO	NO	NO	NO	NO
1 B 2 a iv Refining / Storage	NO	NO	NO	NO	NO	NO	NO	NO	NO
1 B 2 a v Distribution of oil products	NO	NO	NO	NO	NO	NO	NO	NO	NO
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	-	-	-	-	-	-	-	-	-
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	NE	NE	NE	NE	NE	NE	NE	NE	NE
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)	-	-	-	-	-	-	-	-	-
3 A PAINT APPLICATION	-	-	-	-	-	-	-	-	-
3 B DEGREASING AND DRY CLEANING	NO	NO	NO	NO	NO	NO	NO	NO	NO
3 C CHEMICAL PRODUCTS, MANUFACTURE AND PROCESSING	-	-	-	-	-	-	-	-	-
3 D OTHER including products containing HMs and POPs (Please specify in a covering note)	NO	NO	NO	NO	NO	NO	NO	NO	NO

Table 38 (b) continued.

	Pb Mg	Cd Mg	Hg Mg	As Mg	Cr Mg	Cu Mg	Ni Mg	Se Mg	Zn Mg
4 B MANURE MANAGEMENT (c)	-	-	-	-	-	-	-	-	-
4 B 1 Cattle	IE	IE	IE	IE	IE	IE	IE	IE	IE
4 B 1 a Dairy	NO	NO	NO	NO	NO	NO	NO	NO	NO
4 B 1 b Non-Dairy	NO	NO	NO	NO	NO	NO	NO	NO	NO
4 B 2 Buffalo	NO	NO	NO	NO	NO	NO	NO	NO	NO
4 B 3 Sheep	NO	NO	NO	NO	NO	NO	NO	NO	NO
4 B 4 Goats	NO	NO	NO	NO	NO	NO	NO	NO	NO
4 B 5 Camels and Llamas	NO	NO	NO	NO	NO	NO	NO	NO	NO
4 B 6 Horses	NO	NO	NO	NO	NO	NO	NO	NO	NO
4 B 7 Mules and Asses	NO	NO	NO	NO	NO	NO	NO	NO	NO
4 B 8 Swine	NO	NO	NO	NO	NO	NO	NO	NO	NO
4 B 9 Poultry	NO	NO	NO	NO	NO	NO	NO	NO	NO
4 B 13 Other	NO	NO	NO	NO	NO	NO	NO	NO	NO
4 C RICE CULTIVATION	NO	NO	NO	NO	NO	NO	NO	NO	NO
4 D AGRICULTURAL SOILS	-	-	-	-	-	-	-	-	-
4 D 1 Direct Soil Emission	NO	NO	NO	NO	NO	NO	NO	NO	NO
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	NO	NO	NO	NO	NO	NO	NO	NO	NO
6 B WASTE-WATER HANDLING	NO	NO	NO	NO	NO	NO	NO	NO	NO
6 C WASTE INCINERATION (e)	NO	NO	NO	NO	NO	NO	NO	NO	NO
6 D OTHER WASTE (f)	NE	NE	NE	NE	NE	NE	NE	NE	NE
7 OTHER	NO	NO	NO	NO	NO	NO	NO	NO	NO
National Total	**5,25**	**0,66**	**1,19**	**0,77**	**1,64**	**8,68**	**13,38**	**1,88**	**23,54**
Memo Items									
International Aviation (LTO)	0,11	0,00	-	-	0,00	0,12	0,00	0,00	0,07
International Aviation (Cruise)	-	0,01	-	-	0,03	0,99	0,04	0,01	0,58
International Navigation	0,14	0,02	0,03	0,24	0,11	0,24	12,91	0,27	0,64
5 E Other	-	-	-	-	-	-	-	-	-
X (11 08 Volcanoes)	-	-	-	-	-	-	-	-	-

Table 38 (c).

	Dioxin g I-tec	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	4,700	0,010	0,040	0,016	0,011
1 A 1 b Petroleum refining	-	0,000	0,001	0,000	0,000
1 A 1 c Manufacture of Solid fuels and Other Energy Indus-	-	0,000	0,000	0,000	0,000
1 A 2 Manufacturing Industries and Construction	-	0,004	0,024	0,022	0,007
1 A 2 a Iron and Steel	1,460	-	-	-	-
1 A 2 b Non-ferrous Metals	0,400	-	-	-	-
1 A 2 c Chemicals	0,004	-	-	-	-
1 A 2 d Pulp, Paper and Print	-	-	-	-	-
1 A 2 e Food Processing, Beverages & Tobacco	-	-	-	-	-
1 A 2 f Other (Please specify in a covering note)	0,070	0,024	0,077	0,004	0,003
1 A 3 a ii Civil Aviation (Domestic, LTO)	-	0,000	0,000	0,000	0,000
1 A 3 a ii Civil Aviation (Domestic, Cruise)	-	-	-	-	-
1 A 3 b Road Transportation	0,200	-	-	-	-
1 A 3 b i R.T., Passenger cars	-	0,027	0,028	0,027	0,031
1 A 3 b ii R.T., Light duty vehicles	-	0,014	0,013	0,012	0,013
1 A 3 b iii R.T., Heavy duty vehicles	-	0,003	0,019	0,027	0,005
1 A 3 b iv R.T., Mopeds & Motorcycles	-	0,001	0,001	0,001	0,001
1 A 3 b v R.T., Gasoline evaporation	-	-	-	-	-
1 A 3 b vi R.T., Automobile tyre and brake wear	-	-	-	-	-
1 A 3 b vii R.T., Automobile road abrasion	-	-	-	-	-
1 A 3 c Railways	0,007	0,000	0,001	0,001	0,000
1 A 3 d ii National Navigation	1,300	0,001	0,003	0,002	0,005
1 A 3 e Other (Please specify in a covering note)	-	-	-	-	-
1 A 3 e i Pipeline compressors	-	-	-	-	-
1 A 3 e ii Other mobile sources and machinery	-	-	-	-	-
1 A 4 a Commercial / Institutional	-	0,164	0,216	0,072	0,117
1 A 4 b Residential	-	-	-	-	-
1 A 4 b i Residential plants	18,850	2,534	3,319	1,107	1,789
1 A 4 b ii Household and gardening (mobile)	3,300	0,000	0,000	0,000	0,000
1 A 4 c Agriculture / Forestry / Fishing	-	-	-	-	-
1 A 4 c i Stationary	-	0,105	0,117	0,028	0,131
1 A 4 c ii Off-road Vehicles and Other Machinery	-	0,004	0,008	0,008	0,004
1A 4 c iii National Fishing	-	0,001	0,005	0,002	0,010
1 A 5 a Other, Stationary (including Military)	-	-	-	-	-
1 A 5 b Other, Mobile (Including military)	-	0,000	0,000	0,000	0,000
1B1 Fugitive Emissions from Solid Fuels	-	-	-	-	-
1 B 1 a Coal Mining and Handling	-	-	-	-	-
1 B 1 b Solid fuel transformation	-	-	-	-	-
1 B 1 c Other (Please specify in a covering note)	-	-	-	-	-
1 B 2 Oil and natural gas	-	-	-	-	-
1 B 2 a Oil	-	-	-	-	-
1 B 2 a i Exploration Production, Transport	-	-	-	-	-
1 B 2 a iv Refining / Storage	-	-	-	-	-
1 B 2 a v Distribution of oil products	-	-	-	-	-
1 B 2 a vi Other	-	-	-	-	-
1 B 2 b Natural gas	-	-	-	-	-
1 B 2 c Venting and flaring	-	-	-	-	-
2 A MINERAL PRODUCTS (a)	-	-	-	-	-
2 A 1 Cement Production	0,800	-	-	-	-
2 A 2 Lime Production	-	-	-	-	-
2 A 3 Limestone and Dolomite Use	-	-	-	-	-
2 A 4 Soda Ash Production and use	-	-	-	-	-
2 A 5 Asphalt Roofing	-	-	-	-	-
2 A 6 Road Paving with Asphalt	0,041	-	-	-	-
2 A 7 Other including Non Fuel Mining & Construction	0,160	-	-	-	-
2 B CHEMICAL INDUSTRY	-	-	-	-	-
2 B 1 Ammonia Production	-	-	-	-	-
2 B 2 Nitric Acid Production	-	-	-	-	-
2 B 3 Adipic Acid Production	-	-	-	-	-
2 B 4 Carbide Production	-	-	-	-	-
2 B 5 Other (Please specify in a covering note)	-	-	-	-	-
2 C METAL PRODUCTION	-	-	-	-	-
2 D OTHER PRODUCTION (a)	-	-	-	-	-
2 D 1 Pulp and Paper	-	-	-	-	-
2 D 2 Food and Drink	-	-	-	-	-
2 G OTHER (Please specify in a covering note)	-	-	-	-	-
3 A PAINT APPLICATION	-	-	-	-	-
3 B DEGREASING AND DRY CLEANING	-	-	-	-	-
3 C CHEMICAL PRODUCTS, MANUFACTURE AND	-	-	-	-	-
3 D OTHER including products containing HMs and POPs	13,250	-	-	-	-

Table 38 (c) continued.

	Dioxin g I-tec	Benzo(a)-pyrene Mg	Benzo(b)-fluoranthene Mg	Benzo(k)-fluoranthene Mg	Indeno(1,2,3-c,d)pyrene Mg
4 B MANURE MANAGEMENT (b)	-	-	-	-	-
4 B 1 Cattle	-	-	-	-	-
4 B 1 a Dairy	-	-	-	-	-
4 B 1 b Non-Dairy	-	-	-	-	-
4 B 2 Buffalo	-	-	-	-	-
4 B 3 Sheep	-	-	-	-	-
4 B 4 Goats	-	-	-	-	-
4 B 5 Camels and Llamas	-	-	-	-	-
4 B 6 Horses	-	-	-	-	-
4 B 7 Mules and Asses	-	-	-	-	-
4 B 8 Swine	-	-	-	-	-
4 B 9 Poultry	-	-	-	-	-
4 B 13 Other	-	-	-	-	-
4 C RICE CULTIVATION	-	-	-	-	-
4 D AGRICULTURAL SOILS	-	-	-	-	-
4 D 1 Direct Soil Emission	-	-	-	-	-
4 F FIELD BURNING OF AGRICULTURAL WASTES	-	-	-	-	-
4 G OTHER (c)	-	-	-	-	-
5 B FOREST AND GRASSLAND CONVERSION	-	-	-	-	-
6 A SOLID WASTE DISPOSAL ON LAND	5,150	-	-	-	-
6 B WASTEWATER HANDLING	0,002	-	-	-	-
6 C WASTE INCINERATION (d)	17,700	-	-	-	-
6 D OTHER WASTE (e)	-	-	-	-	-
7 OTHER	10,250	-	-	-	-
National Total	**77,644**	**2,894**	**3,872**	**1,329**	**2,127**
Memo Items:					
International Aviation (LTO)	NO	0,000	0,000	0,000	0,000
International Aviation (Cruise)	NO	-	-	-	-
International Marine (b)	NO	0,004	0,017	0,008	0,029
5 E Other	NO	-	-	-	-
X (11 08 Volcanoes)	NO	NO	NO	NO	NO

Appendix 3 IPCC/SNAP source correspondence list

Table 39 Correspondence list for IPCC source categories 1A1, 1A2 and 1A4 and SNAP (EMEP/CorinAir 2003).

SNAP_id	SNAP_name	IPCC source
01	Combustion in energy and transformation industries	
0101	Public power	1A1a
010101	Combustion plants >= 300 MW (boilers)	1A1a
010102	Combustion plants >= 50 and < 300 MW (boilers)	1A1a
010103	Combustion plants < 50 MW (boilers)	1A1a
010104	Gas turbines	1A1a
010105	Stationary engines	1A1a
0102	District heating plants	1A1a
010201	Combustion plants >= 300 MW (boilers)	1A1a
010202	Combustion plants >= 50 and < 300 MW (boilers)	1A1a
010203	Combustion plants < 50 MW (boilers)	1A1a
010204	Gas turbines	1A1a
010205	Stationary engines	1A1a
0103	Petroleum refining plants	1A1b
010301	Combustion plants >= 300 MW (boilers)	1A1b
010302	Combustion plants >= 50 and < 300 MW (boilers)	1A1b
010303	Combustion plants < 50 MW (boilers)	1A1b
010304	Gas turbines	1A1b
010305	Stationary engines	1A1b
010306	Process furnaces	1A1b
0104	Solid fuel transformation plants	1A1c
010401	Combustion plants >= 300 MW (boilers)	1A1c
010402	Combustion plants >= 50 and < 300 MW (boilers)	1A1c
010403	Combustion plants < 50 MW (boilers)	1A1c
010404	Gas turbines	1A1c
010405	Stationary engines	1A1c
010406	Coke oven furnaces	1A1c
010407	Other (coal gasification, liquefaction, ...)	1A1c
0105	Coal mining, oil/gas extraction, pipeline compressors	
010501	Combustion plants >= 300 MW (boilers)	1A1c
010502	Combustion plants >= 50 and < 300 MW (boilers)	1A1c
010503	Combustion plants < 50 MW (boilers)	1A1c
010504	Gas turbines	1A1c
010505	Stationary engines	1A1c
02	Non-industrial combustion plants	
0201	Commercial and institutional plants (t)	1A4a
020101	Combustion plants >= 300 MW (boilers)	1A4a
020102	Combustion plants >= 50 and < 300 MW (boilers)	1A4a
020103	Combustion plants < 50 MW (boilers)	1A4a
020104	Stationary gas turbines	1A4a
020105	Stationary engines	1A4a
020106	Other stationary equipments (n)	1A4a
0202	Residential plants	1A4b
020201	Combustion plants >= 50 MW (boilers)	1A4b
020202	Combustion plants < 50 MW (boilers)	1A4b
020203	Gas turbines	1A4b
020204	Stationary engines	1A4b
020205 [2)]	Other equipments (stoves, fireplaces, cooking,...) [2)]	1A4b
0203	Plants in agriculture, forestry and aquaculture	1A4c
020301	Combustion plants >= 50 MW (boilers)	1A4c
020302	Combustion plants < 50 MW (boilers)	1A4c
020303	Stationary gas turbines	1A4c
020304	Stationary engines	1A4c
020305	Other stationary equipments (n)	1A4c
03	Combustion in manufacturing industry	
0301	Comb. in boilers, gas turbines and stationary	1A2f
030101	Combustion plants >= 300 MW (boilers)	1A2f
030102	Combustion plants >= 50 and < 300 MW (boilers)	1A2f
030103	Combustion plants < 50 MW (boilers)	1A2f
030104	Gas turbines	1A2f
030105	Stationary engines	1A2f
030106	Other stationary equipments (n)	1A2f
0302	Process furnaces without contact	
030203	Blast furnace cowpers	1A2a

030204	Plaster furnaces	1A2f
030205	Other furnaces	1A2f
0303	Processes with contact	
030301	Sinter and pelletizing plants	1A2a
030302	Reheating furnaces steel and iron	1A2a
030303	Gray iron foundries	1A2a
030304	Primary lead production	1A2b
030305	Primary zinc production	1A2b
030306	Primary copper production	1A2b
030307	Secondary lead production	1A2b
030308	Secondary zinc production	1A2b
030309	Secondary copper production	1A2b
030310	Secondary aluminium production	1A2b
030311	Cement (f)	1A2f
030312	Lime (includ. iron and steel and paper pulp 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 4 Fuel rate

Table 40 Fuel consumption rate of stationary combustion plants [GJ].

Fuel id	Fuel	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
102	Coal	254836476	345917382	288115109	302081632	326290582	273898654	375387102	280010525	233354509	197985454	165920864	175451125	174639322
106	Brown coal briquettes	0	0	0	0	0	0	0	0	0	0	0	0	18922
107	Coke	0	0	0	0	0	0	0	0	0	0	0	0	1068454
110	Petroleum coke	4459475	4403578	4562877	5928457	3806509	4598627	6130172	6271959	5546731	7032313	7040383	8062464	8281655
111	Wood and simil.	18239133	20313133	21410173	22701233	23886440	23537165	25253215	25607369	22545580	23329536	25990200	28363689	32754200
114	Municipal waste	16384900	17727900	18829500	20469900	21468400	24152480	26146928	27925960	27322665	28522787	30265050	33037670	33972344
115	Industrial waste	0	0	0	0	0	0	33813	0	0	0	0	0	0
116	Wood waste	0	0	0	0	0	0	0	0	0	607044	0	0	0
117	Straw	13225200	14050200	14624200	14103200	12757200	13074202	13475808	13358144	13363126	14370434	13053790	13698057	15732839
118	Sewage sludge	0	0	0	0	0	0	0	0	0	0	40162	0	64508
203	Residual oil	32115775	37019669	37331722	32497828	49806706	37527011	41791443	30158107	30173567	22563263	18860843	19702838	24648453
204	Gas oil	61673820	65349403	55972785	62122851	53198037	53923308	57846146	51497273	48357982	48060167	41016114	43806222	39462159
206	Kerosene	5086000	943300	783700	771300	649600	580700	539700	436570	414294	255606	169963	286786	256128
215	Fish and rape oil	0	0	0	0	0	0	0	0	0	0	0	191475	127243
225	Orimulsion	0	0	0	0	0	19968824	36885721	40611318	32580001	34190630	34148181	30243687	23846400
301	Natural gas	76099387	86421571	90523947	103173352	117014079	135645220	160599207	169726176	180201988	187958727	183757321	193449631	193610189
303	LPG	2979387	2747776	2403579	2425299	2399108	2491400	2693594	2227826	2399970	2143219	1985058	1732002	1598822
308	Refinery gas	14169000	14537000	14865000	15405000	16390999	21005286	20271224	17091995	15224935	15724000	15219727	15534154	14792686
309	Biogas	751600	910100	898900	1076800	1409100	2055800	2244826	2714861	2662881	2640444	2980430	3046907	3331097
Total		**500020152**	**610341012**	**550321492**	**582756852**	**629076761**	**612458677**	**769298899**	**667638083**	**614148228**	**585383624**	**540448085**	**566606707**	**568205421**

Table 41 Detailed fuel consumption data for stationary combustion plants [GJ]

ipcc_id	fuel	fuel_gr_abbr	SNAP_id	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
1A1a	102	COAL	010101	219780959	303105248	252745120	269458670	294708124	241921428	346038108	254306486	210718948	176640613	146911420	158990462	161608383
1A1a	102	COAL	010102	10643051	15546752	12426136	10490330	10438182	11678411	8910896	8671430	8884368	8238010	6224846	4970502	4684578
1A1a	102	COAL	010103							1760100	-	-	33747	35480	24354	779
1A1a	102	COAL	0102	6017000	6635000	5173000	3581000	1661900	1213900	454200	-					
1A1a	102	COAL	010202											371	1494	363
1A1a	102	COAL	010203									9000	6562	3551	439	-
1A1a	110	PETROLEUM COKE	010102				1239200									
1A1a	111	WOOD AND SIMIL.	010101									263719	-		920	65930
1A1a	111	WOOD AND SIMIL.	010102			172000	515200	943000	643600	335925	453186	528441	705526	1090331	1181886	892421
1A1a	111	WOOD AND SIMIL.	010103							306000	332100	41468	327025	297612	341452	1049148
1A1a	111	WOOD AND SIMIL.	010104													117062
1A1a	111	WOOD AND SIMIL.	010105											428	60394	-
1A1a	111	WOOD AND SIMIL.	0102	3217000	3648000	4096000	3750500	3556400	3775100	4185900	4217100					
1A1a	111	WOOD AND SIMIL.	010202										193908	179937	249689	227284
1A1a	111	WOOD AND SIMIL.	010203									4699721	3911382	3882223	4300369	4451351
1A1a	111	WOOD AND SIMIL.	010205											53040	-	-
1A1a	114	MUNICIP. WASTES	010101									1288015	1278184	1230861	2809020	3502130
1A1a	114	MUNICIP. WASTES	010102		1300000	2005000	3990000	4904200	5881780	7152947	10831534	11023094	17039832	18305718	17902293	19002825
1A1a	114	MUNICIP. WASTES	010103							738400	-	3027000	5911296	8361289	8343163	7236828
1A1a	114	MUNICIP. WASTES	010104											416975	-	-
1A1a	114	MUNICIP. WASTES	010105											-	756908	-
1A1a	114	MUNICIP. WASTES	0102	15470800	15416500	15753900	15381300	15339500	13702100	11824900	10622800					
1A1a	114	MUNICIP. WASTES	010202						3254000	4612251	4649086	4617704				
1A1a	114	MUNICIP. WASTES	010203							582330	630840	6492514	2809156	1395589	2302823	2430354
1A1a	115	INDUSTR. WASTES	010202							33813						
1A1a	116	WOOD WASTES	010102										607044			
1A1a	117	STRAW	010101								740153	1013770	1339800	1119600	1587710	2643060
1A1a	117	STRAW	010102	479000	985000	1487000	1643200	1846200	2612602	1503708	1306291	1751935	2429408	1826796	1746030	1640945
1A1a	117	STRAW	010103							2176100	1715900	958000	1058701	640340	1905033	1890837
1A1a	117	STRAW	010104												101730	1215692
1A1a	117	STRAW	0102	4268000	4587000	4659000	4606000	3700000	3893600	3871000	3670800					
1A1a	117	STRAW	010202										141564	150510	97600	64873
1A1a	117	STRAW	010203									3889315	3639251	3290636	3418313	3435882
1A1a	203	RESIDUAL OIL	0101											17206	533	656
1A1a	203	RESIDUAL OIL	010101	7171573	10052580	8691120	8420050	22142392	10770398	15795457	7447256	11369048	6955499	4045724	5869702	5018057
1A1a	203	RESIDUAL OIL	010102	826465	390420	1778880	774628	306421	600920	382538	333923	353400	755210	513002	235650	232919
1A1a	203	RESIDUAL OIL	010103							453500	535000			82101	117384	75269
1A1a	203	RESIDUAL OIL	010104										14114	117319	1767903	6684079
1A1a	203	RESIDUAL OIL	0102	2046900	2326800	1286200	1059500	1802400	1970500	1852700	1681400					
1A1a	203	RESIDUAL OIL	010202							22250	66495	492445	135957	58729	86854	121947
1A1a	203	RESIDUAL OIL	010203									1097303	956510	650393	611104	453278
1A1a	204	GAS OIL	0101											6427	4864	2497
1A1a	204	GAS OIL	010101									112000	537423	135602	138238	92395
1A1a	204	GAS OIL	010102	300000	474940	698630	294270	286600	342600	16653	18113	13235	302722	278595	89748	107821
1A1a	204	GAS OIL	010103							486000	465100	15405	40495	-	66635	17133
1A1a	204	GAS OIL	010104		18060	22370	30730					148871	61852	91382	38714	75233
1A1a	204	GAS OIL	010105									130410	104311	74249	79770	64070
1A1a	204	GAS OIL	0102	1941000	813000	744000	947000	1034200	803700	1183200	999900					
1A1a	204	GAS OIL	010202							152994	73314	426455	257831	399458	826687	166763
1A1a	204	GAS OIL	010203									788287	296697	230214	354986	808046

1A1a	204	GAS OIL	010205												190	-	-
1A1a	215	RAPE & FISH OIL	010203													190810	126336
1A1a	225	ORIMULSION	010101						19913424	36885721	40611318	32580001	34190630	34148181	30243687	23846400	
1A1a	225	ORIMULSION	010102						55400								
1A1a	301	NATURAL GAS	0101												14558	11364	2
1A1a	301	NATURAL GAS	010101	4005028	4394781	3279455	4422200	6283990	10453816	12217008	10956960	20808855	21307826	23541558	20514966	19246614	
1A1a	301	NATURAL GAS	010102	115700	766090	3257796	6479498	7524400	6751996	1346036	5620044	10551198	2416632	1456749	4258088	2893865	
1A1a	301	NATURAL GAS	010103							11131660	11810929	691382	926574	680624	739539	654790	
1A1a	301	NATURAL GAS	010104	2107800	2107800	2107800	2614600	6012900	4839582	6245516	6875564	7759802	21656759	22973678	25003005	30027783	
1A1a	301	NATURAL GAS	010105	313500	814300	1639900	2401700	8490200	16758500	22539550	24339600	28976521	26619884	25826778	28098555	27998258	
1A1a	301	NATURAL GAS	0102	11033000	13655000	12350000	11420000	7488700	6618900	4207670	2592500	15753					
1A1a	301	NATURAL GAS	010202							381483	466411	539227	270693	217700	286968	291201	
1A1a	301	NATURAL GAS	010203									2999618	1889688	1416762	1762910	1482478	
1A1a	303	LPG	010102		1000	1000	3000		600								
1A1a	303	LPG	010103							-							
1A1a	303	LPG	0102	9000	13000	10000	-	2700	100		-						
1A1a	303	LPG	010203											246	-	-	
1A1a	308	REFINERY GAS	010102			132300	221400		156700								
1A1a	308	REFINERY GAS	010103							35200	40100						
1A1a	308	REFINERY GAS	0102								-						
1A1a	309	BIOGAS	010102	235600	393800	359500	537400	639700	666100	94326	40561	50269	29597	25771	23338	20466	
1A1a	309	BIOGAS	010103							742600	1028200		103711	134968	123991	89445	
1A1a	309	BIOGAS	010105									1515688	1500477	1548734	1589322	1757220	
1A1a	309	BIOGAS	0102	57500	69800	131500	149500	159900	286900	272200	393300						
1A1a	309	BIOGAS	010203									194984		21733	11129	12650	
1A1b	203	RESIDUAL OIL	0103	1309200	2038100	3568700	3490200		-								
1A1b	203	RESIDUAL OIL	010303								1005700	32049	16612	-	-	-	
1A1b	203	RESIDUAL OIL	010306					3336717	2333787	2244019	616254	1073951	1073388	1322995	1442929	1362640	
1A1b	204	GAS OIL	0103		40000	44500	29100	49300	33300								
1A1b	204	GAS OIL	010303							21700	87000						
1A1b	301	NATURAL GAS	010304											-	-	-	
1A1b	303	LPG	0103		-	4600		8000	15000								
1A1b	303	LPG	010303							20700	18000						
1A1b	308	REFINERY GAS	0103	13978100	14411900	14630500	15075200										
1A1b	308	REFINERY GAS	010303							1340730	1866363	511593	1518794	1170793	1300559	995654	
1A1b	308	REFINERY GAS	010304					2386000	2289723	2524072	2361788	2484108	2654000	2400233	2457089	2455232	
1A1b	308	REFINERY GAS	010306					14004999	18548164	16336522	12771044	12202506	11551206	11648701	11776506	11341800	
1A1c	204	GAS OIL	010406									15603					
1A1c	204	GAS OIL	010505													150	
1A1c	301	NATURAL GAS	010405											-	-	-	
1A1c	301	NATURAL GAS	010406									911835					
1A1c	301	NATURAL GAS	010502	8751400	8961800	10382600	10499400	11997600	12589447	14994291	19586715	21938219	23580170	25026374	24383156	26226872	
1A1c	301	NATURAL GAS	010504	376300	376900	376900	376900	349800	411700	338690	392000	126150	274178	164410	232982	246307	
1A1c	301	NATURAL GAS	010505	4900	9500	9500	9500	3500	12700	9080	8100	8790	13883	13250	11887	11470	
1A1c	309	BIOGAS	010405											-	-	-	
1A1c	309	BIOGAS	010502					6800	56500	64800	61900						
1A1c	309	BIOGAS	010505										29028	32507	28627	39855	
1A2f	102	COAL	0301	10023993	10334985	7832879	8789663	9412925	8446538	8041600	6908700	4469247	5126053	4849360	4465330	2316222	
1A2f	102	COAL	030102						1051344	1449890	1466575	1405667	1411682	1063375	997381	808823	
1A2f	102	COAL	030103									206631					
1A2f	102	COAL	030311	5018873	6048697	6577274	6602369	6913652	7224934	7067609	7209034	6627624	5638061	5708047	4718458	4348589	
1A2f	107	COKE OVEN COKE	0301													1065641	
1A2f	110	PETROLEUM COKE	0301	300246	-	56107	122868	-	98156	110000	33600	25858	38999	285426	127924	223785	
1A2f	110	PETROLEUM COKE	030311	2499252	2991306	3234048	3230652	3469025	3707398	4966161	5229890	4774684	6398880	6474743	7656733	7543476	

1A2f	111	WOOD AND SIMIL.	0301	5776000	5961000	6130000	6303000	7484200	6954700	7142500	7393900	4729903	3997800	3836511	4310038	7474992
1A2f	111	WOOD AND SIMIL.	030102									228152	1424571	1557075	1411227	2148172
1A2f	111	WOOD AND SIMIL.	030103									322116	413749	439542	428603	424290
1A2f	114	MUNICIP. WASTES	0301					-								
1A2f	114	MUNICIP. WASTES	030102									481				-
1A2f	114	MUNICIP. WASTES	030311											505233	795492	1787613
1A2f	117	STRAW	030102										1496	-	-	-
1A2f	117	STRAW	030105											386	91	-
1A2f	118	SEWAGE SLUDGE	030311											40162	-	64508
1A2f	203	RESIDUAL OIL	0301	16487584	17678972	17238144	14022407	16716100	15349840	14900000	12921800	9365957	7921335	8241264	7292390	7435663
1A2f	203	RESIDUAL OIL	030102						201556	513500	418614	747697	770215	648553	306379	736719
1A2f	203	RESIDUAL OIL	030103									63565	128184	139691	89445	64340
1A2f	203	RESIDUAL OIL	030104										6787	-	-	-
1A2f	203	RESIDUAL OIL	030105												22	10
1A2f	203	RESIDUAL OIL	030311	1762853	2152997	2366678	2397243	2618777	2840311	1771379	1863965	2538540	885967	858853	784	591804
1A2f	204	GAS OIL	0301	665870	1575591	1361528	1007507	525669	1594421	2155217	2092813	1730029	2537653	2212978	3188376	2618024
1A2f	204	GAS OIL	030102											3138	5071	222
1A2f	204	GAS OIL	030103									1965	64	82107	19	165
1A2f	204	GAS OIL	030104											51	-	897
1A2f	204	GAS OIL	030105											103	511	-
1A2f	204	GAS OIL	030106	6098	-	8644	2762	9433	-	-	8178	15604	70265	8070	10000	7066
1A2f	206	KEROSENE	0301	69600	45700	38300	35500	30500	24500	30900	27800	13363	8909	7552	25543	2993
1A2f	215	RAPE & FISH OIL	030105													242
1A2f	301	NATURAL GAS	0301	23284500	24940500	25814500	27902100	33016700	33445300	32857200	34089100	34898549	32466636	28746747	32058619	31365984
1A2f	301	NATURAL GAS	030102						2661779	2464665	2971625	2961903	3100115	2690206	2869052	1190136
1A2f	301	NATURAL GAS	030103									542888	126872	116411	117965	14626
1A2f	301	NATURAL GAS	030104	-				150300	838200	2971200	3941400	2141369	6486855	6756339	6138931	6723657
1A2f	301	NATURAL GAS	030105	2600	2600	2600	2600	23500	224500	1144400	1251500	679952	1224637	1556394	1641970	1545295
1A2f	301	NATURAL GAS	030106	136059	-	37696	70154	53489	-	-	5228	31735	38608	50809	83000	25558
1A2f	303	LPG	0301	1482591	1561267	1410087	1238800	1311475	1465219	1616519	1256440	1267455	970603	621768	370289	287019
1A2f	303	LPG	030106												11000	-
1A2f	308	REFINERY GAS	0301	190900	125100	102200	108400	-	10700	34700	52700	26728				
1A2f	309	BIOGAS	0301	10000	10000	10000	10000	32600	269700	210100	255100	83042	32727	54758	28077	36860
1A2f	309	BIOGAS	030102									4943	16116	15755	58579	70934
1A2f	309	BIOGAS	030103									2122				
1A2f	309	BIOGAS	030105									193	269	1487	23805	18344
1A4a	102	COAL	0201	88600	10700	95900	84100	91100	66700	41700	43400	2306				
1A4a	110	PETROLEUM COKE	0201	62000	104200	90200	96400	92000	70400	90500	97800	70544	50434	12070	12086	5355
1A4a	111	WOOD AND SIMIL.	0201	204500	204500	204500	204500	270200	334700	527200	555200	510825	540696	575926	632817	972070
1A4a	111	WOOD AND SIMIL.	020105												97	598
1A4a	114	MUNICIP. WASTES	0201	914100	1011400	1070600	1098600	1224700	1314600	1236100	1191700	873857	1476975	35615	115302	-
1A4a	114	MUNICIP. WASTES	020103										7344	13770	12669	12594
1A4a	117	STRAW	0201										2057	-	-	-
1A4a	203	RESIDUAL OIL	0201	1070600	865200	600300	516900	846600	780300	718800	729300	418154	485684	342842	203459	348147
1A4a	203	RESIDUAL OIL	020105										66	-	-	-
1A4a	204	GAS OIL	0201	11794800	10622900	9062300	9007000	7158100	6579100	6704500	6184200	5496730	5788419	4957566	4736649	4031234
1A4a	204	GAS OIL	020103									3303	39101	71306	44010	43890
1A4a	204	GAS OIL	020105											859	673	488
1A4a	206	KEROSENE	0201	569100	209800	207000	188900	154600	124300	103300	96459	127964	117233	63008	79642	145428
1A4a	301	NATURAL GAS	0201	6357600	7223900	7348100	9497400	7098800	7807000	10221840	7523200	7272911	6653203	5854391	6431733	6679517
1A4a	301	NATURAL GAS	020103									55495	10802	43211	67208	49523
1A4a	301	NATURAL GAS	020104		-			16900	35800	44200	37300	21153	30736	23335	31001	42862
1A4a	301	NATURAL GAS	020105	26200	55700	92400	110800	710800	770500	866640	1056400	342953	985737	967874	1048143	1098129
1A4a	303	LPG	0201	82800	77100	76500	122200	125200	131000	138000	128600	84733	110343	121621	119345	136552

1A4a	309	BIOGAS	0201	448500	436500	397900	379900	557700	751900	835600	913700	452365	366842	423606	396023	396057
1A4a	309	BIOGAS	020103									4557	71845	86680	84512	74286
1A4a	309	BIOGAS	020105									272454	433844	504895	501385	487668
1A4b	102	COAL	0202	746200	1290600	1008800	947100	757700	487800	169700	161700	127147	182354	45201	48680	15370
1A4b	106	BROWN COAL BRI.	0202													18922
1A4b	107	COKE OVEN COKE	0202													2813
1A4b	110	PETROLEUM COKE	0202	760877	697484	709922	739137	245484	483073	677611	588069	474591	454761	261990	262393	509008
1A4b	111	WOOD AND SIMIL.	0202	8954433	10412433	10720473	11859633	11564240	11760665	12668890	12569083	11134265	11615183	13847545	15248320	14760273
1A4b	117	STRAW	0202	5086900	5086900	5086900	4712400	4326600	3940800	3555000	3551500	3446584	3443104	3611833	2901450	2901450
1A4b	203	RESIDUAL OIL	0202	216900	218600	167700	129900	95200	62800	66300	45900	43266	50365	35611	26881	148870
1A4b	204	GAS OIL	0202	46463200	50638400	42913600	49967100	43678600	43287900	45295600	39595500	37849748	35675468	30275667	31506271	28997757
1A4b	206	KEROSENE	0202	4404800	659600	512000	520800	437800	410800	382600	287211	251843	118954	91190	159051	99599
1A4b	301	NATURAL GAS	0202	17362100	20432600	21436600	24900900	23928600	26141800	29457418	27737600	27650326	29396072	27562772	29557603	28080877
1A4b	301	NATURAL GAS	020202									14779	31289	55319	69007	30105
1A4b	301	NATURAL GAS	020204	-	-	3100	3100	1171200	1189400	1602560	1622500	1706977	1531350	1439173	1450266	1391882
1A4b	303	LPG	0202	1119162	825126	680245	929257	834898	758090	788512	725371	928931	987953	1179124	1185770	1144455
1A4b	309	BIOGAS	0202	-	-	-	-		-	-	-	10000				
1A4c	102	COAL	0203	2517800	2945400	2256000	2128400	2307000	1807600	1453300	1243200	903571	708372	1079213	1234026	856215
1A4c	110	PETROLEUM COKE	0203	837100	610588	472600	500200	-	239600	285900	322600	201054	89239	6154	3328	31
1A4c	111	WOOD AND SIMIL.	0203	87200	87200	87200	68400	68400	68400	86800	86800	86970	199696	230030	197877	170609
1A4c	117	STRAW	0203	3391300	3391300	3391300	3141600	2884400	2627200	2370000	2373500	2297722	2309253	2407889	1934300	1934300
1A4c	117	STRAW	020302									5800	5800	5800	5800	5800
1A4c	203	RESIDUAL OIL	0203	1223700	1296000	1634000	1687000	1942100	2616600	3071000	2492500	2578192	2407370	1782543	1644780	1368564
1A4c	203	RESIDUAL OIL	020302												2069	2170
1A4c	203	RESIDUAL OIL	020304											4017	4570	3321
1A4c	204	GAS OIL	0203	502852	1166512	1117213	837382	456135	1282287	1830282	1973155	1610337	2347866	2183377	2712277	2423485
1A4c	204	GAS OIL	020304											4774	2723	4824
1A4c	206	KEROSENE	0203	42500	28200	26400	26100	26700	21100	22900	25100	21124	10510	8213	22550	8108
1A4c	215	RAPE & FISH OIL	020304												665	665
1A4c	301	NATURAL GAS	0203	2156400	2613800	2318700	2393800	2244200	2816600	3153760	3374200	2421915	3618456	3467279	3662566	3188151
1A4c	301	NATURAL GAS	020303						-	7760	34400	37904	77171	61906	59503	64369
1A4c	301	NATURAL GAS	020304	66300	66300	66300	68700	448500	1277700	2396580	3432900	4093829	3223901	3032714	2859644	3039877
1A4c	303	LPG	0203	285834	270283	221147	132042	116835	121391	129863	99415	118851	74320	62299	45598	30796
1A4c	309	BIOGAS	0203					12400	24700	25200	22100	60000	14684	64084	69300	115430
1A4c	309	BIOGAS	020304									12264	41304	65452	108819	211882
TOTAL				**500020152**	**610341012**	**550321492**	**582756852**	**629076761**	**612458677**	**769298899**	**667638083**	**614148228**	**585383624**	**540448085**	**566606707**	**568205421**

Appendix 5 Emission factors

Table 42 CO_2 emission factors.

Fuel	Emission factor		Unit	Reference type	CRF fuel
	Biomass	Fossil fuel			
Coal		95	kg/GJ	Country specific	Solid
Brown coal briquettes		94,6	kg/GJ	IPCC reference manual	Solid
Coke oven coke		108	kg/GJ	IPCC reference manual	Solid
Petroleum coke		92	kg/GJ	Country specific	Liquid
Wood	102		kg/GJ	Corinair	Biomass
Municipal waste	94,5	17,6	kg/GJ	Country specific	Biomass / Other fuels
Straw	102		kg/GJ	Country specific	Biomass
Residual oil		78	kg/GJ	Corinair	Liquid
Gas oil		74	kg/GJ	Corinair	Liquid
Kerosene		72	kg/GJ	Corinair	Liquid
Fish & rape oil	102		kg/GJ	Corinair	Biomass
Orimulsion		80	kg/GJ	Country specific	Liquid
Natural gas		57,28	kg/GJ	Country specific	Gas
LPG		65	kg/GJ	Corinair	Liquid
Refinery gas		56,9	kg/GJ	Country specific	Liquid
Biogas	83,6		kg/GJ	Country specific	Biomass

Time-series for natural gas and municipal waste are shown below. All other emission factors are the same for 1990-2002.

Table 43 CO_2 emission factors, time-series.

Year	Natural gas [kg/GJ]	Municipal waste, plastic [kg/GJ]	Municipal waste biomass [kg/GJ]
1990	56,9	22,5	+89,6
1991	56,9	22,5	+89,6
1992	56,9	20,5	+91,6
1993	56,9	19,6	+92,5
1994	56,9	19,6	+92,5
1995	56,9	18,5	+93,6
1996	56,9	17,6	+94,5
1997	56,9	17,6	+94,5
1998	56,9	17,6	+94,5
1999	56,6	17,6	+94,5
2000	57,1	17,6	+94,5
2001	57,25	17,6	+94,5
2002	57,28	17,6	+94,5

Table 44 CH_4 emission factors and references 2002.

Fuel	ipcc_id	SNAP_id	Emission factor [g/GJ]	Reference
COAL	1A1a	010101, 010102, 010103	1,5	EMEP/Corinair 2003
COAL	1A1a, 1A2f, 1A4b, 1A4c	010202, 010203, 0301, 0202, 0203	15	EMEP/Corinair 2003
BROWN COAL BRI.	all	all	15	EMEP/Corinair 2003, assuming same emission factor as for coal
COKE OVEN COKE	all	all	15	EMEP/Corinair 2003, assuming same emission factor as for coal
PETROLEUM COKE	all	all	15	EMEP/Corinair 2003
WOOD AND SIMIL.	1A1a	010102, 010103, 010104	2	Nielsen & Illerup 2003
WOOD AND SIMIL.	1A4b	0202	200	EMEP/Corinair 2003
WOOD AND SIMIL.	1A1a, 1A2f, 1A4a, 1A4c	all other	32	EMEP/Corinair 2003
MUNICIP. WASTES	1A1a	010102, 010103, 010104, 010105	0,59	Nielsen & Illerup 2003
MUNICIP. WASTES	1A1a, 1A2f, 1A4a	all other	6	EMEP/Corinair 2003
STRAW	1A1a	010102, 010103	0,5	Nielsen & Illerup 2003
STRAW	1A1a, 1A2f	010202, 010203, 030102, 030105	32	EMEP/Corinair 2003
STRAW	1A4a, 1A4b, 1A4c	0201, 0202, 0203, 020302	200	EMEP/Corinair 2003
RESIDUAL OIL	all	all	3	EMEP/Corinair 2003
GAS OIL	all	all	1,5	EMEP/Corinair 2003
KEROSENE	all	all	7	EMEP/Corinair 2003
FISH & RAPE OIL	1A1a	010203	32	EMEP/Corinair 2003, assuming same emission factor as straw
FISH & RAPE OIL	1A2f	030105	32	EMEP/Corinair 2003, assuming same emission factor as straw
FISH & RAPE OIL	1A4c	020304	200	EMEP/Corinair 2003, assuming same emission factor as straw
ORIMULSION	1A1a	010101	3	EMEP/Corinair 2003, assuming same emission factor as residual oil
NATURAL GAS	1A1a	0101, 010101, 010102, 010202	6	DGC 2001
NATURAL GAS	1A1a	010103, 010203	15	Gruijthuijsen & Jensen 2000
NATURAL GAS	1A1a, 1Ab, 1Ac, 1A2f, 1A4a, 1A4c	Gas turbines: 010104, 010304, 010504, 030104, 020104, 020303	1,5	Nielsen & Illerup 2003
NATURAL GAS	1A1a, 1A1c, 1A2f, 1A4a, 1A4b, 1A4c	Gas engines: 010105, 010405, 010505, 030105, 020105, 020204, 020304	520	Nielsen & Illerup 2003
NATURAL GAS	1A1c, 1A2f, 1A4a, 1A4b, 1A4c	010502, 0301, 0201, 0202, 0203	6	DGC 2001
NATURAL GAS	1A2f, 1A4a, 1A4b	030103, 030106, 020103, 020202	15	Gruijthuijsen & Jensen 2000
LPG	all	all	1	EMEP/Corinair 2003
REFINERY GAS	1A1b	010303, 010304	2	EMEP/Corinair 2003
BIOGAS	1A1a, 1A1c, 1A2f, 1A4a, 1A4c	Gas engines: 010105, 010405, 010505, 030105, 020105, 020304	323	Nielsen & Illerup 2003
BIOGAS	1A1a, 1A2f, 1A4a, 1A4c	all other	4	EMEP/Corinair 2003

Time-series for CH_4 emission factors for gas engines are shown below. All other CH_4 emission factors are the same for 1990-2002.

Table 45 CH_4 emission factors, time-series.

Year			1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
NATURAL GAS	1A1a, 1A1c, 1A2f, 1A4a, 1A4b, 1A4c	Gas engines: 010105, 010405, 010505, 030105, 020105, 020204, 020304	257	299	347	545	604	612	596	534	525	524	520	520	520
BIOGAS	1A1a, 1A1c, 1A2f, 1A4a, 1A4c	Gas engines: 010105, 010405, 010505, 030105, 020105, 020304									314	318	323	323	323

Table 46 N_2O emission factors and references 2002.

Fuel	ipcc_id	SNAP_id	Emission factor [g/GJ]	Reference
COAL	all	all	3	EMEP/Corinair 2003
BROWN COAL BRI.	all	all	3	EMEP/Corinair 2003
COKE OVEN COKE	all	all	3	EMEP/Corinair 2003
PETROLEUM COKE	all	all	3	EMEP/Corinair 2003
WOOD AND SIMIL.	1A1a	010102, 010103, 010104	0,8	Nielsen & Illerup 2003
WOOD AND SIMIL.	1A1a	010105, 010202, 010203, 010205	4	EMEP/Corinair 2003
WOOD AND SIMIL.	1A2f, 1A4a, 1A4b, 1A4c	all	4	EMEP/Corinair 2003
MUNICIP. WASTES	1A1a	010102, 010103, 010104, 010105	1,2	Nielsen & Illerup 2003
MUNICIP. WASTES	1A1a	010203	4	EMEP/Corinair 2003
MUNICIP. WASTES	1A2f, 1A4a	030102, 0201, 020103	4	EMEP/Corinair 2003
STRAW	1A1a	010102, 010103	1,4	Nielsen & Illerup 2003
STRAW	1A1a	010202, 010203	4	EMEP/Corinair 2003
STRAW	1A2f, 1A4a, 1A4b, 1A4c	all	4	EMEP/Corinair 2003
RESIDUAL OIL	all	all	2	EMEP/Corinair 2003
GAS OIL	all	all	2	EMEP/Corinair 2003
KEROSENE	all	all	2	EMEP/Corinair 2003
FISH & RAPE OIL	all	all	4	EMEP/Corinair 2003, assuming same emission factor as municipal waste
ORIMULSION	1A1a	010101	2	EMEP/Corinair 2003, assuming same emission factor as residual oil
NATURAL GAS	1A1a	0101, 010101, 010102, 010103, 010202, 010203	1	EMEP/Corinair 2003
NATURAL GAS	1A1a, 1Ab, 1Ac, 1A2f, 1A4a, 1A4c	Gas turbines: 010104, 010304, 010504, 030104, 020104, 020303	2,2	Nielsen & Illerup 2003
NATURAL GAS	1A1a, 1A1c, 1A2f, 1A4a, 1A4b, 1A4c	Gas engines: 010105, 010405, 010505, 030105, 020105, 020204, 020304	1,3	Nielsen & Illerup 2003
NATURAL GAS	1A1c, 1A2f, 1A4a, 1A4b, 1A4c	010502, 0301, 030103, 030106, 0201, 020103, 0202, 020202, 0203	1	EMEP/Corinair 2003
LPG	all	all	2	EMEP/Corinair 2003
REFINERY GAS	all	all	2	EMEP/Corinair 2003
BIOGAS	1A1a	010102, 010103, 010203	2	EMEP/Corinair 2003
BIOGAS	1A1a, 1A1c, 1A2f, 1A4a, 1A4c	010105, 010405, 010505, 030105, 020105, 020304	0,5	Nielsen & Illerup 2003
BIOGAS	1A2f, 1A4a, 1A4c	0301, 030102, 0201, 020103, 0203	2	EMEP/Corinair 2003

The same N_2O emission factors are applied for 1990-2002

Table 47 SO_2, NO_X, NMVOC and CO emission factors and references 2002.

Fuel	IPCC sector	SNAP	SO_2 [g/GJ]	Ref.	NO_X [g/GJ]	Ref.	NMVOC [g/GJ]	Ref.	CO [g/GJ]	Ref.
COAL	1A1a	010101, 010102, 010103	**45**	18	**130**	9	**1,5**	1	**10**	3
COAL	1A1a, 1A2f, 1A4b, 1A4c	010202, 010203, 0301, 0202, 0203	**574**	19	**95**	4	**15**	1	**10**	1
BROWN COAL BRI.	1A4b	0202	**574**	29	**95**	29	**15**	29	**10**	29
COKE OVEN COKE	1A2f, 1A4b	0301, 0202	**574**	29	**95**	29	**15**	29	**10**	29
PETROLEUM COKE	1A2f	0301	**573**	20	**50**	1	**1,5**	1	**61**	4
PETROLEUM COKE	1A4a, 1A4b, 1A4c	0201, 0202, 0203	**573**	20	**50**	1	**1,5**	1	**1000**	1
WOOD AND SIMIL.	1A1a	010102, 010103, 010104	**1,74**	31	**69**	31	**3,3**	31	**79**	31
WOOD AND SIMIL.	1A1a	010105	**25**	22, 21	**130**	22, 21, 4	**48**	1	**50**	3
WOOD AND SIMIL.	1A1a, 1A2f	010202, 010203, 010205, 0301, 030102, 030103	**25**	22, 21	**130**	22, 21, 4	**48**	1	**240**	4
WOOD AND SIMIL.	1A4a, 1A4c	0201, 020105, 0203	**25**	22, 21	**130**	22, 21, 4	**600**	1	**240**	4
WOOD AND SIMIL.	1A4b	0202	**25**	22, 21	**120**	22	**600**	1, 32	**9000**	12, 13
MUNICIP. WASTES	1A1a	010102, 010103, 010104, 010105	**23,9**	31	**124**	31	**0,98**	31	**7,4**	31
MUNICIP. WASTES	1A1a, 1A2f, 1A4a	010203, 030102, 0201, 020103	**67**	9	**164**	9	**9**	1	**10**	9
STRAW	1A1a	010102, 010103	**47,1**	31	**131**	31	**0,8**	31	**63**	31
STRAW	1A1a, 1A2f	010202, 010203, 030102, 030105	**130**	5	**153**	4, 28	**50**	1	**325**	4, 5
STRAW	1A4a, 1A4c	0201, 0203, 020302	**130**	5	**153**	4, 28	**600**	1	**325**	4, 5
STRAW	1A4b	0202	**130**	5	**153**	4, 28	**600**	1	**4000**	1, 6, 7
RESIDUAL OIL	1A1a	0101, 010101, 010102, 010103, 010104	**290**	9	**130**	18	**3**	1	**15**	3
RESIDUAL OIL	1A1a, 1A4b, 1A4c	010202, 010203, 0201, 0202, 0203, 020302	**344**	25, 10, 24	**142**	4	**3**	1	**30**	1
RESIDUAL OIL	1A2f	0301, 030102, 030103	**344**	25, 10, 24	**130**	28	**3**	1	**30**	1
RESIDUAL OIL	1A2f	030104	**344**	25, 10, 24	**130**	28	**3**	1	**15**	1
RESIDUAL OIL	1A2f	030105	**344**	25, 10, 24	**130**	28	**3**	1	**100**	1
RESIDUAL OIL	1A4a, 1A4c	020105, 020304	**344**	25, 10, 24	**142**	4	**3**	1	**100**	1
GAS OIL	1A1a	0101, 010101, 010102, 010103	**23**	27	**220**	9	**1,5**	1	**15**	3
GAS OIL	1A1a, 1A2f	Gas turbines: 010104, 030104	**23**	27	**350**	9	**2**	1	**15**	3
GAS OIL	1A1a, 1A1c, 1A2f, 1A4a, 1A4c	Engines: 010105, 010205, 010505, 030105, 020105, 020304	**23**	27	**700**	-	**100**	1	**100**	1
GAS OIL	1A1a, 1A2f	010202, 0301, 030102	**23**	27	**65**	28	**1,5**	1	**30**	1
GAS OIL	1A1a, 1A2f	010203, 030103, 030106	**23**	27	**52**	4	**1,5**	1	**30**	1
GAS OIL	1A4a, 1A4c	0201, 020103, 0203	**23**	27	**52**	4	**3**	1	**30**	1
GAS OIL	1A4b	0202	**23**	27	**52**	4	**3**	1	**43**	1
KEROSENE	all	all	**5**	30	**50**	1	**3**	1	**20**	1
FISH & RAPE OIL	1A1a	010203	**100**	15	**153**	15	**50**	15	**325**	15
FISH & RAPE OIL	1A2f	030105	**130**	15	**153**	15	**50**	15	**325**	15
FISH & RAPE OIL	1A4c	020304	**100**	15	**153**	15	**600**	15	**325**	15
ORIMULSION	1A1a	010101	**12**	9	**86**	9	**3**	16	**15**	16
NATURAL GAS	1A1a	0101, 010101, 010102, 010103	**0,3**	17	**115**	9	**2**	14	**15**	3
NATURAL GAS	1A1a, 1A1b, 1A1c, 1A2f, 1A4a, 1A4c	Gas turbines: 010104, 010304, 010504, 030104, 020104, 020303	**0,3**	17	**124**	31	**1,4**	31	**6,2**	31
NATURAL GAS	1A1a, 1A1c, 1A2f, 1A4a, 1A4b, 1A4c	Gas engines: 010105, 010405, 010505, 030105, 020105, 020204, 020304	**0,3**	17	**168**	31	**117**	31	**175**	31
NATURAL GAS	1A1a, 1A2f	010202, 010203, 0301, 030103, 030106	**0,3**	17	**50**	4	**2**	14	**28**	4
NATURAL GAS	1A1c	010502	**0,3**	17	**250**	1, 8, 32	**2**	14	**28**	4
NATURAL GAS	1A4a, 1A4c	0201, 020103, 0203	**0,3**	17	**30**	1, 4, 11	**2**	14	**28**	4
NATURAL GAS	1A4b	0202, 020202	**0,3**	17	**30**	1, 4, 11	**4**	11	**20**	11
LPG	1A1a, 1A2f	010203, 0301, 030106	**0,13**	-	**96**	32	**2**	1	**25**	1
LPG	1A4a, 1A4c	0201, 0203	**0,13**	-	**71**	32	**2**	1	**25**	1
LPG	1A4b	0202	**0,13**	-	**47**	32	**2**	1	**25**	1
REFINERY GAS	1A1b	010303	**0,3**	23	**100**	1	**4**	1	**15**	1
REFINERY GAS	1A1b	010304	**0,3**	23	**170**	9	**4**	1	**15**	1
BIOGAS	1A1a, 1A2f, 1A4a, 1A4c	010102, 010103, 010203, 0301, 0201, 020103, 0203	**11**	26	**31**	4	**4**	1	**36**	4
BIOGAS	1A1a, 1A1c, 1A2f, 1A4a, 1A4c	Gas engines: 010105, 010405, 010505, 030105, 020105, 020304	**19,2**	31	**540**	31	**14**	31	**273**	31
BIOGAS	1A2f	030102	**11**	26	**66**		**4**	1	**36**	4

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Time-series for emission factors for SO_2, NO_X, NMVOC and CO that are not the same in 1990-2002 are shown below. All other factors are constant in 1990-2002.

Table 48 SO_2, NO_X, NMVOC and CO emission factors time-series [g/GJ].

pollutant	fuel	fuel_gr_abbr	IPCC	SNAP	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
SO_2	102	COAL	1A1a	010101, 010102, 010103	506	571	454	386	343	312	420	215	263	193	64	47	45
SO_2	110	PETROLEUM COKE	1A2f, 1A4a, 1A4b, 1A4c	0301, 0201, 0202, 0203	745	745	745	745	745	745	745	745	745	745	745	573	573
SO_2	114	MUNICIP. WASTES	1A1a	010102, 010103		116	95	73	52	30				25	23,9	23,9	23,9
SO_2	114	MUNICIP. WASTES	1A1a, 1A2f, 1A4a	0102, 010203, 030102, 0201, 020103	138	131	124	117	110	103	95	88	81	74	67	67	67
SO_2	203	RESIDUAL OIL	1A1a	0101											403	315	290
SO_2	203	RESIDUAL OIL	1A1a	010101										369	403	315	290
SO_2	203	RESIDUAL OIL	1A1a	010102	446	470	490	475	1564	351				369	403	315	290
SO_2	203	RESIDUAL OIL	1A1a	010103							408	344			403	315	290
SO_2	203	RESIDUAL OIL	1A1a	010104											403	315	290
SO_2	203	RESIDUAL OIL	1A1a	0102	495	495	495	495	495	495	495	344					
SO_2	203	RESIDUAL OIL	1A1b	0103	5869	3021	2048	2155		495							
SO_2	203	RESIDUAL OIL	1A2f 1A4a 1A4b 1A4c	0301 0201 0202 0203	495	495	495	495	495	495	495	344	344	344	344	344	344
SO_2	204	GAS OIL	all	all	94	94	94	94	94	23	23	23	23	23	23	23	23
SO_2	225	ORIMULSION	1A1a	010101							147	149				10	12
NO_x	102	COAL	1A1a	010101	342	384	294	289	267	239	250	200	177	152	129	122	130
NO_x	102	COAL	1A1a	010102	342	384	294	289	267	239	250	200	177	152	129	122	130
NO_x	102	COAL	1A1a	010103							200	200	177	152	129	122	130

NO_x	102	COAL	1A1a	010203									200	200	95	95	95
NO_x	102	COAL	1A2f	0301	200	200	200	200	200	200	200	200	200	200	95	95	95
NO_x	102	COAL	1A4b	0202	200	200	200	200	200	200	200	200	200	200	95	95	95
NO_x	102	COAL	1A4c	0203	200	200	200	200	200	200	200	200	200	200	95	95	95
NO_x	203	RESIDUAL OIL	1A1a	0101											129	122	130
NO_x	203	RESIDUAL OIL	1A1a	010101										152	129	122	130
NO_x	203	RESIDUAL OIL	1A1a	010102	342	384	294	289	267	239				152	129	122	130
NO_x	203	RESIDUAL OIL	1A1a	010103							250	200			129	122	130
NO_x	203	RESIDUAL OIL	1A1a	010104											129	122	130
NO_x	204	GAS OIL	1A1a	0102	100	95	90	85	52	52	52	52					
NO_x	204	GAS OIL	1A1b	0103		95	90	85	80	75							
NO_x	204	GAS OIL	1A2f	0301	100	95	90	85	52	52	70	65	65	65	65	65	65
NO_x	225	ORIMULSION	1A1a	010101							139	138				88	86
NO_x	301	NATURAL GAS	1A1a	010104	161	157	153	149	145	141		134	131	127	124	124	124
NO_x	301	NATURAL GAS	1A1a	010105	276	241	235	214	199	194	193	170	167	167	168	168	168
NO_x	301	NATURAL GAS	1A1c	010504	161	157	153	149	145	141	138	134	131	127	124	124	124
NO_x	301	NATURAL GAS	1A1c	010505	276	241	235	214	199	194	193	170	167	167	168	168	168
NO_x	301	NATURAL GAS	1A2f	030104	161				145	141	138	134	131	127	124	124	124
NO_x	301	NATURAL GAS	1A2f	030105	276	241	235	214	199	194	193	170	167	167	168	168	168
NO_x	301	NATURAL GAS	1A4a	020104		157			145	141	138	134	131	127	124	124	124
NO_x	301	NATURAL GAS	1A4a	020105	276	241	235	214	199	194	193	170	167	167	168	168	168
NO_x	301	NATURAL GAS	1A4b	020204	276	241	235	214	199	194	193	170	167	167	168	168	168
NO_x	301	NATURAL GAS	1A4c	020303						141	138	134	131	127	124	124	124
NO_x	301	NATURAL GAS	1A4c	020304	276	241	235	214	199	194	193	170	167	167	168	168	168
NO_x	309	BIOGAS	1A1a	010105									578	559	540	540	540
NO_x	309	BIOGAS	1A1c	010505										559	540	540	540
NO_x	309	BIOGAS	1A2f	030105									578	559	540	540	540
NO_x	309	BIOGAS	1A4a	020105									578	559	540	540	540
NO_x	309	BIOGAS	1A4c	020304									578	559	540	540	540
NMVOC	301	NATURAL GAS	1A1a	010105	58	67	78	122	136	137	134	120	118	118	117	117	117
NMVOC	301	NATURAL GAS	1A1c	010505	58	67	78	122	136	137	134	120	118	118	117	117	117
NMVOC	301	NATURAL GAS	1A2f	030105	58	67	78	122	136	137	134	120	118	118	117	117	117
NMVOC	301	NATURAL GAS	1A4a	020105	58	67	78	122	136	137	134	120	118	118	117	117	117
NMVOC	301	NATURAL GAS	1A4b	020204	58	67	78	122	136	137	134	120	118	118	117	117	117
NMVOC	301	NATURAL GAS	1A4c	020304	58	67	78	122	136	137	134	120	118	118	117	117	117
CO	111	WOOD AND SIMIL.	1A1a	0102	400	373	347	320	293	267	240	240					
CO	111	WOOD AND SIMIL.	1A2f	0301	400	373	347	320	293	267	240	240	240	240	240	240	240
CO	111	WOOD AND SIMIL.	1A4a	0201	400	373	347	320	293	267	240	240	240	240	240	240	240
CO	111	WOOD AND SIMIL.	1A4c	0203	400	373	347	320	293	267	240	240	240	240	240	240	240
CO	114	MUNICIP. WASTES	1A1a	010102		85	70	55	40	25				10	7,4	7,4	7,4
CO	114	MUNICIP. WASTES	1A1a	010103							10	10	10	10	7,4	7,4	7,4
CO	114	MUNICIP. WASTES	1A1a	0102	100	85	70	55	40	25	10	10					
CO	114	MUNICIP. WASTES	1A4a	0201	100	85	70	55	40	25	10	10	10	10	10	10	10
CO	117	STRAW	1A1a	0102	600	554	508	463	417	371	325	325					
CO	117	STRAW	1A4b	0202	8500	8500	8500	8500	8500	7500	6500	5500	4500	4000	4000	4000	4000
CO	117	STRAW	1A4c	0203	600	554	508	463	417	371	325	325	325	325	325	325	325
CO	301	NATURAL GAS	1A1a	010105	181	202	203	217	216	212	211	174	174	174	175	175	175
CO	301	NATURAL GAS	1A1c	010505	181	202	203	217	216	212	211	174	174	174	175	175	175
CO	301	NATURAL GAS	1A2f	030105	181	202	203	217	216	212	211	174	174	174	175	175	175
CO	301	NATURAL GAS	1A4a	020105	181	202	203	217	216	212	211	174	174	174	175	175	175
CO	301	NATURAL GAS	1A4b	020204	181	202	203	217	216	212	211	174	174	174	175	175	175
CO	301	NATURAL GAS	1A4c	020304	181	202	203	217	216	212	211	174	174	174	175	175	175
CO	309	BIOGAS	1A1a	010105									265	269	273	273	273
CO	309	BIOGAS	1A1c	010505										269	273	273	273
CO	309	BIOGAS	1A2f	030105									265	269	273	273	273
CO	309	BIOGAS	1A4a	020105									265	269	273	273	273
CO	309	BIOGAS	1A4c	020304									265	269	273	273	273

Table 49 PM emission factors and references 2002.

Fuel	IPCC sector	SNAP	TSP [g/GJ]	Reference	PM_{10} [g/GJ]	Reference	$PM_{2.5}$ [g/GJ]	Reference
STRAW	1A1a	010102, 010103	3,97	3	0,133	3	0,102	3
STRAW	1A1a, 1A2f, 1A4a, 1A4c	010202, 010203, 030102, 030105, 0201, 0203, 020302	21	1	15	2	12	2
STRAW	1A4b	0202	234	4	222	5	211	5
BIOGAS	1A1a, 1A1c, 1A2f, 1A4a, 1A4c	Gas engines: 010105, 010405, 010505, 030105, 020105, 020304	2,63	3	0,451	3	0,206	3
BIOGAS	1A1a, 1A2f, 1A4a, 1A4c	010102, 010103, 010203, 0301, 030102, 0201, 020103, 0203	1,5	6	1,5	7	1,5	7
FISH & RAPE OIL	1A1a, 1A4c	010203, 020304	19	15	19	15	19	15
FISH & RAPE OIL	1A2f	030105	21	8	15	8	12	8
BROWN COAL BRI.	all	all	17	16	12	16	7	16
COKE OV.COKE	all	all	17	16	12	16	7	16
GAS OIL	all	all	5	9	5	9	5	9
KEROSENE	all	all	5	9	5	9	5	9
LPG	all	all	0,2	9	0,2	9	0,2	9
MUNICIP. WASTES	1A1a	010102, 010103, 010104, 010105	2,02	3	1,126	3	1,084	3
MUNICIP. WASTES	1A1a, 1A2f	010203, 030102	6	10	5	11	4	11
MUNICIP. WASTES	1A4a	0201, 020103	100	9	95	9	90	9
NATURAL GAS	1A1a, 1A1c, 1A2f, 1A4a, 1A4b, 1A4c	0101, 010101, 010102, 010103, 010202, 010203, 010502, 0301, 030103, 030106, 0201, 020103, 0202, 020202, 0203	0,1	9	0,1	9	0,1	9
NATURAL GAS	1A1a, 1A1b, 1A1c, 1A2f, 1A4a, 1A4c	Gas turbines: 010104, 010304, 010504, 030104, 020104, 020303	0,1	3	0,061	3	0,051	3
NATURAL GAS	1A1a, 1A1c, 1A2f, 1A4a, 1A4b, 1A4c	Gas engines: 010105, 010405, 010505, 030105, 020105, 020204, 020304	0,76	3	0,189	3	0,161	3
ORIMULSION	1A1a	010101	1,9	12	1,8	12	1,6	12
PETROLEUM COKE	1A2f	0301	10	9	7	9	3	9
PETROLEUM COKE	1A4a, 1A4b, 1A4c	0201, 0202, 0203	100	9	60	9	30	9
REFINERY GAS	all	all	5	9	5	9	5	9
RESIDUAL OIL	1A1a	0101, 010101, 010102, 010103, 010104, 010202, 010203	3	9	3	9	2,5	9
RESIDUAL OIL	1A1b	010303	50	9	40	9	35	9
RESIDUAL OIL	1A2f, 1A4a	0301, 030102, 030103, 030104, 030105, 0201	14	6	10,5	13	7	13
RESIDUAL OIL	1A4a, 1A4c	Engines: 020105, 020304	60	9	50	9	40	9
RESIDUAL OIL	1A4b, 1A4c	0202, 0203, 020302	14	6	10,5	13	7	13
COAL	1A1a	010101, 010102, 010103	3	12	2,6	12	2,1	12
COAL	1A1a	010202, 010203	6	9	6	9	5	9
COAL	1A2f, 1A4b, 1A4c	0301, 0202, 0203	17	6	12	14	7	14
WOOD AND SIMIL.	1A1a	010102, 010103, 010104	7,9	3	1,94	3	1,23	3
WOOD AND SIMIL.	1A1a, 1A2f	010105, 010202, 010202, 010203, 010205, 0301, 030102, 030103	19	1	13	2	10	2
WOOD AND SIMIL.	1A4a, 1A4c	0201, 020105, 0203	143	1	143	9	135	9
WOOD AND SIMIL.	1A4b	0202	150	9	143	9	135	9

1. Danish legislation, Miljøstyrelsen 2001. Luftvejledningen, Begrænsning af luftforurening fra virksomheder, Vejledning fra Miljøstyrelsen nr 2 2001
2. Particulate size distribution for wood combustion in power plants refers to the TNO CEPMEIP emission factor database 2001. Available on the internet at: http://www.air.sk/tno/cepmeip/
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
4. German, L., 2002. The Danish Technological Institute, Personal communication, rough estimate
5. Particulate size distribution for wood combustion in residential plants refers to the TNO CEPMEIP emission factor database 2001. Available on the internet at: http://www.air.sk/tno/cepmeip/
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. Same emission factor as for straw is assumed (NERI assumption)
9. The TNO CEPMEIP emission factor database 2001. Available on the internet at: http://www.air.sk/tno/cepmeip/
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 Forbrændingsaerosoler, 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/
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. Error. Assuming same emission factors as for straw the emission factors should have been TSP: 21g/GJ, PM_{10}: 15 g/GJ and $PM_{2.5}$: 12 g/GJ. The error is negligible.
16. Same emission factor as for coal is assumed (NERI assumption)

The same PM emission factors are applied for 2000-2002.

Table 50 HM emission factors and references 2002.

Fuel	IPCC sec-tor	SNAP	As [mg/GJ]	Refer-ence	Cd [mg/GJ]	Refer-ence	Cr [mg/GJ]	Refer-ence	Cu [mg/GJ]	Refer-ence	Hg [mg/GJ]	Refer-ence	Ni [mg/GJ]	Refer-ence	Pb [mg/GJ]	Refer-ence	Se [mg/GJ]	Refer-ence	Zn [mg/GJ]	Refer-ence
BROWN COAL BRI.	1A4b	0202	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
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
FISH & RAPE OIL	all	all			0,62	1	0,62	1	1,06	1	6,8	1	0,53	1	3,22	1			8,39	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
MUNICIP. WASTES	1A1a	010102, 010103, 010104, 010105	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 1A2f 1A4a	010203, 030102, 0201, 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
ORIMULSION	1A1a	010101	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
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
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
STRAW	1A1a	010102, 010103	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, 1A2f, 1A4a, 1A4b, 1A4c	010202, 010203, 030102, 030105, 0201, 0202, 0203, 020302			0,62	1	0,62	1	1,06	1	6,8	1	0,53	1	3,22	1			8,39	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 1A2f 1A4a 1A4b 1A4c	010105 010202 010203 010205 0301 030102 030103 0201 020105 0202 0203			6,8	1			6,8	1	6,8	1			3,4	1			136	1

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
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

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 51 HM emission factors [mg/GJ] 2002 for large point sources. 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	-	8,02	4,41	2,2	6,81	-	13	-
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 that are not the same in 1990-2002 are shown below. All other factors are constant in 1990-2002.

Table 52 HM emission factors time-series [mg/GJ].

Pol-lutant	Fuel	IPCC sector	SNAP	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
M01	MUNICIP. WASTES	1A1a	010102		7,207	6,594	5,981	5,369	4,756				3,53	6,74	6,74	6,74
M01	MUNICIP. WASTES	1A1a	010103							4,143	3,53	3,53	3,53	6,74	6,74	6,74
M01	MUNICIP. WASTES	1A1a	0102	7,82	7,207	6,594	5,981	5,369	4,756	4,143	3,53					
M01	MUNICIP. WASTES	1A4a	0201	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
M01	RESIDUAL OIL	1A1b	010303								14,07	17,07	17,07	14,07	14,07	14,07
M02	PETROLEUM COKE	1A2f	0301	0,2	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1
M02	MUNICIP. WASTES	1A1a	010102		28,161	25,003	21,844	18,686	15,527				9,21	4,73	4,73	4,73
M02	MUNICIP. WASTES	1A1a	010103							12,369	9,21	9,21	9,21	4,73	4,73	4,73
M02	MUNICIP. WASTES	1A1a	0102	31,32	28,161	25,003	21,844	18,686	15,527	12,369	9,21					
M02	MUNICIP. WASTES	1A4a	0201	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
M03	MUNICIP. WASTES	1A1a	010102		164,224	142,349	120,473	98,597	76,721				32,97	2,43	2,43	2,43
M03	MUNICIP. WASTES	1A1a	010103							54,846	32,97	32,97	32,97	2,43	2,43	2,43
M03	MUNICIP. WASTES	1A1a	0102	186,1	164,224	142,349	120,473	98,597	76,721	54,846	32,97					
M03	MUNICIP. WASTES	1A4a	0201	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
M04	MUNICIP. WASTES	1A1a	010102		110,391	97,293	84,194	71,096	57,997				31,8	10,03	10,03	10,03
M04	MUNICIP. WASTES	1A1a	010103							44,899	31,8	31,8	31,8	10,03	10,03	10,03
M04	MUNICIP. WASTES	1A1a	0102	123,49	110,391	97,293	84,194	71,096	57,997	44,899	31,8					
M04	MUNICIP. WASTES	1A4a	0201	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
M05	MUNICIP. WASTES	1A1a	010102		121,889	111,357	100,826	90,294	79,763				58,7	7,39	7,39	7,39
M05	MUNICIP. WASTES	1A1a	010103							69,231	58,7	58,7	58,7	7,39	7,39	7,39
M05	MUNICIP. WASTES	1A1a	0102	132,42	121,889	111,357	100,826	90,294	79,763	69,231	58,7					
M05	MUNICIP. WASTES	1A4a	0201	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
M06	MUNICIP. WASTES	1A1a	010102		172,451	152,943	133,434	113,926	94,417				55,4	4,71	4,71	4,71
M06	MUNICIP. WASTES	1A1a	010103							74,909	55,4	55,4	55,4	4,71	4,71	4,71
M06	MUNICIP. WASTES	1A1a	0102	191,96	172,451	152,943	133,434	113,926	94,417	74,909	55,4					
M06	MUNICIP. WASTES	1A4a	0201	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
M07	MUNICIP. WASTES	1A1a	010102		639,024	555,449	471,873	388,297	304,721				137,57	123	123	123
M07	MUNICIP. WASTES	1A1a	010103							221,146	137,57	137,57	137,57	123	123	123
M07	MUNICIP. WASTES	1A1a	0102	722,6	639,024	555,449	471,873	388,297	304,721	221,146	137,57					
M07	MUNICIP. WASTES	1A4a	0201	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
M09	MUNICIP. WASTES	1A1a	010102		741,254	677,629	614,003	550,377	486,751				359,5	359,5	359,5	359,5
M09	MUNICIP. WASTES	1A1a	010103							423,126	359,5	359,5	359,5	359,5	359,5	359,5
M09	MUNICIP. WASTES	1A1a	0102	804,88	741,254	677,629	614,003	550,377	486,751	423,126	359,5					
M09	MUNICIP. WASTES	1A4a	0201	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

Table 53 PAH emission factors 2002.

Fuel	IPCC id	SNAP	Benzo(a)-pyrene		Benzo(b)-fluoranthene		Benzo(k)-fluoranthene		Indeno(1,2,3-c,d)-pyrene	
			[µg/GJ]	Refer-ence	[µg/GJ]	Refer-ence	[µg/GJ]	Refer-ence	[µg/GJ]	Refer-ence
BIOGAS	all	all	1	8	1	8	0,4	8	1,1	8
BROWN COAL BRI.	1A4b	0202	59524	4 (9)	63492	4 (9)	1984	4 (9)	119048	4 (9)
COAL	1A1a	010101, 010102, 010103, 010202, 010203	0,14	4	0,29	4	0,29	4	0,28	4
COAL	1A2f	0301	23	4	929	4	929	4	698	4
COAL	1A4b, 1A4c	0202, 0203	59524	4	63492	4	1984	4	119048	4
COKE OV.COKE	1A2f	0301	23	4 (9)	929	4 (9)	929	4 (9)	698	4 (9)
COKE OV.COKE	1A4b	0202	59524	4 (9)	63492	4 (9)	1984	4 (9)	119048	4 (9)
FISH & RAPE OIL	all	all	1529	2 (3)	3452	2 (3)	1400	2 (3)	1029	2 (3)
GAS OIL	1A1a 1A1c	0101, 010101, 010102, 010103, 010104, 010105, 010202, 010203, 010205, 010505	109,6	4	475,41	4	93,21	4	177,28	4
GAS OIL	1A2f 1A4a 1A4b 1A4c	0301, 030102, 030103, 030104, 030105, 030106, 0201, 020103, 020105, 0202, 0203, 020304	80	4	42	4	66	4	160	4
MUNICIP. WASTES	1A1a	010102, 010103, 010104, 010105	0,8	8	1,7	8	0,8	8	0,9	8
MUNICIP. WASTES	1A1a, 1A2f, 1A4a	010203, 030102, 0201, 020103	67	5	571	5	1	5	1	5
NATURAL GAS	1A1a, 1A1b, 1A1c, 1A2f, 1A4a, 1A4c	Gas turbines: 010104, 010304, 010504, 030104, 020104, 020303	1	8	1	8	2	8	3	8
NATURAL GAS	1A1a, 1A1c, 1A2f, 1A4a, 1A4b, 1A4c	Gas engines: 010105, 010405, 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
ORIMULSION	1A1a	010101	109,6	4 (7)	475,41	4 (7)	93,21	4 (7)	177,28	4 (7)

PETROLEUM COKE	all	all	3184	5	9554	5				
RESIDUAL OIL	1A1a, 1A1b	0101, 010101, 010102, 010103, 010104, 010202, 010203, 010303	109,6	4	475,41	4	93,21	4	177,28	4
RESIDUAL OIL	1A2f 1A4a 1A4b 1A4c	0301, 030102, 030103, 030104, 030105, 0201, 020105, 0202, 0203, 020302, 020304	80	4	42	4	66	4	160	4
STRAW	1A1a	010102	1,6	1	1,4	1	1	1	1,6	1
STRAW	1A1a	010103	21	8	157	8	90	8	23	8
STRAW	1A1a, 1A2f	010202, 010203, 030102, 030105	1529	2	3452	2	1400	2	1029	2
STRAW	1A4a, 1A4b, 1A4c	0201, 0202, 0203, 020302	12956	2	12828	2	6912	2	4222	2
WOOD AND SIMIL.	1A1a	010102, 010103, 010104	3	8	2	8	2	8	2	8
WOOD AND SIMIL.	1A1a, 1A2f	010105, 010202, 010203, 010205, 0301, 030102, 030103	6,46	4	1292,52	4	1292,52	4	11,56	4
WOOD AND SIMIL.	1A4a, 1A4b, 1A4c	0201, 020105, 0202, 0203	168707	4	221769	4	73469	4	119728	4

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9. Same emission factor as for coal is assumed (NERI assumption)

The same PAH emission factors are applied for 1990-2002.

Appendix 6 Implied emission factors for municipal waste incineration plants and power plants combustion coal

Table 54 Implied emission factors for municipal waste incineration plants 2002.

Pollutant	Implied Emission factor	Unit
SO_2	28	g/GJ
NO_x	127	g/GJ
TSP	3,0	g/GJ
PM_{10}	2,5	g/GJ
$PM_{2.5}$	2,1	g/GJ
As	7,3	mg/GJ
Cd	4,6	mg/GJ
Cr	5,1	mg/GJ
Cu	12	mg/GJ
Hg	12	mg/GJ
Ni	10	mg/GJ
Pb	62	mg/GJ
Zn	352	mg/GJ

Table 55 Implied emission factors for power plants combusting coal, 2002.

Pollutant	Implied Emission factor	Unit
SO_2	36	g/GJ
NO_x	148	g/GJ
TSP	3,7	g/GJ
PM_{10}	3,0	g/GJ
$PM_{2.5}$	2,5	g/GJ
As	0,73	mg/GJ
Cd	0,06	mg/GJ
Cr	1,5	mg/GJ
Cu	0,96	mg/GJ
Hg	1,0	mg/GJ
Ni	4,3	mg/GJ
Pb	1,9	mg/GJ
Se	3,8	mg/GJ
Zn	7,2	mg/GJ

Appendix 7 Large point sources

Table 56 Large point sources, fuel consumption in 2002 (1A1, 1A2 and 1A4).

lps_id	lps name	part_id	SNAP_id	fuel_id	fuel	fuel consump-tion [GJ]	IPCC source
001	Amagervaerket	01	010101	102	COAL	2064946	1A1a
001	Amagervaerket	01	010101	203	RESIDUAL OIL	184904	1A1a
001	Amagervaerket	02	010101	102	COAL	3290774	1A1a
001	Amagervaerket	02	010101	203	RESIDUAL OIL	214191	1A1a
001	Amagervaerket	03	010101	102	COAL	13750850	1A1a
001	Amagervaerket	03	010101	203	RESIDUAL OIL	86228	1A1a
002	Svanemoellevaerket	05	010101	204	GAS OIL	720	1A1a
002	Svanemoellevaerket	05	010101	301	NATURAL GAS	1679600	1A1a
002	Svanemoellevaerket	07	010104	204	GAS OIL	42	1A1a
002	Svanemoellevaerket	07	010104	301	NATURAL GAS	3787960	1A1a
003	H.C.Oerstedsvaerket	03	010101	203	RESIDUAL OIL	438313	1A1a
003	H.C.Oerstedsvaerket	03	010101	301	NATURAL GAS	1928414	1A1a
003	H.C.Oerstedsvaerket	07	010101	203	RESIDUAL OIL	584175	1A1a
003	H.C.Oerstedsvaerket	07	010101	301	NATURAL GAS	2737670	1A1a
004	Kyndbyvaerket	21	010101	203	RESIDUAL OIL	198245	1A1a
004	Kyndbyvaerket	22	010101	203	RESIDUAL OIL	296933	1A1a
004	Kyndbyvaerket	26	010101	203	RESIDUAL OIL	215426	1A1a
004	Kyndbyvaerket	28	010101	203	RESIDUAL OIL	57826	1A1a
004	Kyndbyvaerket	41	010105	204	GAS OIL	1432	1A1a
004	Kyndbyvaerket	51	010104	204	GAS OIL	14126	1A1a
004	Kyndbyvaerket	52	010104	204	GAS OIL	10578	1A1a
005	Masnedoevaerket	12	010102	111	WOOD AND SIMIL.	125807	1A1a
005	Masnedoevaerket	12	010102	117	STRAW	467182	1A1a
005	Masnedoevaerket	12	010102	204	GAS OIL	991	1A1a
005	Masnedoevaerket	31	010104	204	GAS OIL	21913	1A1a
007	Stigsnaesvaerket	01	010101	102	COAL	2272643	1A1a
007	Stigsnaesvaerket	01	010101	203	RESIDUAL OIL	143140	1A1a
007	Stigsnaesvaerket	02	010101	102	COAL	6796315	1A1a
007	Stigsnaesvaerket	02	010101	203	RESIDUAL OIL	111473	1A1a
008	Asnaesvaerket	01	010101	203	RESIDUAL OIL	77287	1A1a
008	Asnaesvaerket	02	010101	102	COAL	4755522	1A1a
008	Asnaesvaerket	02	010101	203	RESIDUAL OIL	134726	1A1a
008	Asnaesvaerket	03	010101	102	COAL	379041	1A1a
008	Asnaesvaerket	03	010101	203	RESIDUAL OIL	35793	1A1a
008	Asnaesvaerket	04	010101	102	COAL	3724192	1A1a
008	Asnaesvaerket	04	010101	203	RESIDUAL OIL	38991	1A1a
008	Asnaesvaerket	05	010101	203	RESIDUAL OIL	580710	1A1a
008	Asnaesvaerket	05	010101	225	ORIMULSION	23846400	1A1a
009	Statoil Raffinaderi	01	010306	203	RESIDUAL OIL	682280	1A1b
009	Statoil Raffinaderi	01	010306	308	REFINERY GAS	6568024	1A1b
010	Avedoerevaerket	01	010101	102	COAL	16051850	1A1a
010	Avedoerevaerket	01	010101	203	RESIDUAL OIL	61806	1A1a
010	Avedoerevaerket	01	010101	204	GAS OIL	14695	1A1a
010	Avedoerevaerket	02	010104	111	WOOD AND SIMIL.	117062	1A1a
010	Avedoerevaerket	02	010104	117	STRAW	1215692	1A1a
010	Avedoerevaerket	02	010104	203	RESIDUAL OIL	6624653	1A1a
010	Avedoerevaerket	02	010104	301	NATURAL GAS	7757769	1A1a
011	Fynsvaerket	03	010101	102	COAL	963550	1A1a
011	Fynsvaerket	03	010101	114	MUNICIP. WASTES	890980	1A1a
011	Fynsvaerket	03	010101	203	RESIDUAL OIL	61930	1A1a
011	Fynsvaerket	03	010101	301	NATURAL GAS	5913280	1A1a
011	Fynsvaerket	07	010101	102	COAL	12160620	1A1a
011	Fynsvaerket	07	010101	203	RESIDUAL OIL	206020	1A1a
011	Fynsvaerket	08	010101	114	MUNICIP. WASTES	2611150	1A1a
011	Fynsvaerket	08	010101	203	RESIDUAL OIL	55000	1A1a
012	Studstrupvaerket	03	010101	102	COAL	10941110	1A1a
012	Studstrupvaerket	03	010101	203	RESIDUAL OIL	238500	1A1a
012	Studstrupvaerket	04	010101	102	COAL	16009780	1A1a
012	Studstrupvaerket	04	010101	117	STRAW	889080	1A1a
012	Studstrupvaerket	04	010101	203	RESIDUAL OIL	150990	1A1a
014	Vendsysselvaerket	03	010101	102	COAL	18869460	1A1a
014	Vendsysselvaerket	03	010101	203	RESIDUAL OIL	216600	1A1a
014	Vendsysselvaerket	03	010101	204	GAS OIL	14840	1A1a
017	Shell Raffinaderi	01	010306	203	RESIDUAL OIL	680360	1A1b
017	Shell Raffinaderi	01	010306	308	REFINERY GAS	4773776	1A1b
017	Shell Raffinaderi	05	010304	308	REFINERY GAS	2455232	1A1b
018	Skaerbaekvaerket	01	010101	203	RESIDUAL OIL	341140	1A1a
018	Skaerbaekvaerket	03	010101	204	GAS OIL	41190	1A1a
018	Skaerbaekvaerket	03	010101	301	NATURAL GAS	6987650	1A1a
019	Enstedvaerket	03	010101	102	COAL	30974580	1A1a
019	Enstedvaerket	03	010101	203	RESIDUAL OIL	150200	1A1a
019	Enstedvaerket	04	010101	111	WOOD AND SIMIL.	65930	1A1a
019	Enstedvaerket	04	010101	117	STRAW	1753980	1A1a
019	Enstedvaerket	04	010101	204	GAS OIL	20950	1A1a
020	Esbjergvaerket	03	010101	102	COAL	18603150	1A1a
020	Esbjergvaerket	03	010101	203	RESIDUAL OIL	137510	1A1a
022	Oestkraft	05	010102	203	RESIDUAL OIL	9320	1A1a
022	Oestkraft	06	010102	102	COAL	713024	1A1a
022	Oestkraft	06	010102	111	WOOD AND SIMIL.	37905	1A1a
022	Oestkraft	06	010102	203	RESIDUAL OIL	30781	1A1a
023	Danisco Ingredients	01	030102	102	COAL	542112,9	1A2f
023	Danisco Ingredients	01	030102	301	NATURAL GAS	21035,91	1A2f
024	Dansk Naturgas Behandlingsanlaeg	01	010502	301	NATURAL GAS	379362,15	1A1c
025	Horsens Kraftvarmevaerk	01	010102	111	WOOD AND SIMIL.	2969	1A1a
025	Horsens Kraftvarmevaerk	01	010102	114	MUNICIP. WASTES	859200	1A1a

025	Horsens Kraftvarmevaerk	02	010104	301	NATURAL GAS	893452	1A1a
026	Herningvaerket	01	010102	111	WOOD AND SIMIL.	243170	1A1a
026	Herningvaerket	01	010102	203	RESIDUAL OIL	15820	1A1a
026	Herningvaerket	01	010102	301	NATURAL GAS	2560550	1A1a
027	Vestforbraendingen	01	010102	114	MUNICIP. WASTES	2021880	1A1a
027	Vestforbraendingen	01	010102	204	GAS OIL	23457,67	1A1a
027	Vestforbraendingen	02	010102	114	MUNICIP. WASTES	2966608	1A1a
028	Amagerforbraendingen	01	010102	114	MUNICIP. WASTES	4142540	1A1a
029	Randersvaerket	01	010102	102	COAL	2920674	1A1a
029	Randersvaerket	01	010102	309	BIOGAS	20466	1A1a
029	Randersvaerket	02	010102	204	GAS OIL	45623	1A1a
030	Grenaavaerket	01	010102	102	COAL	1050880	1A1a
030	Grenaavaerket	01	010102	111	WOOD AND SIMIL.	39000	1A1a
030	Grenaavaerket	01	010102	114	MUNICIP. WASTES	137208	1A1a
030	Grenaavaerket	01	010102	117	STRAW	787673	1A1a
030	Grenaavaerket	01	010102	203	RESIDUAL OIL	50258	1A1a
030	Grenaavaerket	01	010102	204	GAS OIL	9378	1A1a
031	Hilleroedvaerket	01	010104	301	NATURAL GAS	3190706	1A1a
032	Helsingoervaerket	01	010104	301	NATURAL GAS	2019878	1A1a
032	Helsingoervaerket	02	010105	301	NATURAL GAS	20789	1A1a
034	Stora Dalum	01	030102	301	NATURAL GAS	1169100	1A2f
035	Assens Sukkerfabrik	01	030102	102	COAL	266710	1A2f
035	Assens Sukkerfabrik	01	030102	203	RESIDUAL OIL	120935	1A2f
035	Assens Sukkerfabrik	01	030102	309	BIOGAS	22754	1A2f
036	Kolding Kraftvarmevaerk	01	010103	114	MUNICIP. WASTES	726736,3	1A1a
036	Kolding Kraftvarmevaerk	02	010103	114	MUNICIP. WASTES	323698	1A1a
037	Maabjergvaerket	02	010102	111	WOOD AND SIMIL.	443570	1A1a
037	Maabjergvaerket	02	010102	114	MUNICIP. WASTES	1742510	1A1a
037	Maabjergvaerket	02	010102	117	STRAW	386090	1A1a
037	Maabjergvaerket	02	010102	301	NATURAL GAS	209580	1A1a
038	Soenderborg Kraftvarmevaerk	01	010102	114	MUNICIP. WASTES	481102	1A1a
038	Soenderborg Kraftvarmevaerk	02	010104	301	NATURAL GAS	1178454	1A1a
039	Kara Affaldsforbraendingsanlaeg	01	010102	114	MUNICIP. WASTES	1801188,4	1A1a
039	Kara Affaldsforbraendingsanlaeg	01	010102	301	NATURAL GAS	9771,52	1A1a
040	Viborg Kraftvarmevaerk	01	010104	301	NATURAL GAS	2334004	1A1a
042	Nordforbraendingen	01	010102	114	MUNICIP. WASTES	1015274,5	1A1a
045	Aalborg Portland	01	030311	102	COAL	4348589	1A2f
045	Aalborg Portland	01	030311	110	PETROLEUM COKE	7543476	1A2f
045	Aalborg Portland	01	030311	114	MUNICIP. WASTES	1787613	1A2f
045	Aalborg Portland	01	030311	118	SEWAGE SLUDGE	64508	1A2f
045	Aalborg Portland	01	030311	203	RESIDUAL OIL	591804	1A2f
046	Aarhus Nord	01	010102	114	MUNICIP. WASTES	1830728	1A1a
047	Reno Nord	01	010103	111	WOOD AND SIMIL.	1038717	1A1a
047	Reno Nord	01	010103	114	MUNICIP. WASTES	699226,5	1A1a
048	Silkeborg Kraftvarmevaerk	01	010104	301	NATURAL GAS	3207206	1A1a
049	Rensningsanlægget Lynetten	01	020103	114	MUNICIP. WASTES	12593,92	1A4a
049	Rensningsanlægget Lynetten	01	020103	204	GAS OIL	43889,5	1A4a
049	Rensningsanlægget Lynetten	01	020103	309	BIOGAS	74286	1A4a
050	I/S Fasan	01	010203	114	MUNICIP. WASTES	934589,7	1A1a
051	AVV Forbrændingsanlæg	01	010103	114	MUNICIP. WASTES	662682	1A1a
052	I/S REFA Kraftvarmeværk	01	010103	114	MUNICIP. WASTES	970453,6	1A1a
053	Svendborg Kraftvarmeværk	01	010102	114	MUNICIP. WASTES	548898	1A1a
053	Svendborg Kraftvarmeværk	01	010102	301	NATURAL GAS	5093,23	1A1a
054	Kommunekemi	01	010102	114	MUNICIP. WASTES	141708	1A1a
054	Kommunekemi	01	010102	203	RESIDUAL OIL	42084	1A1a
054	Kommunekemi	01	010102	204	GAS OIL	18113,34	1A1a
054	Kommunekemi	02	010102	114	MUNICIP. WASTES	655105	1A1a
054	Kommunekemi	02	010102	203	RESIDUAL OIL	37729	1A1a
054	Kommunekemi	02	010102	204	GAS OIL	5093,26	1A1a
054	Kommunekemi	03	010102	114	MUNICIP. WASTES	658875	1A1a
054	Kommunekemi	03	010102	203	RESIDUAL OIL	46927	1A1a
054	Kommunekemi	03	010102	204	GAS OIL	5164,99	1A1a
054	Kommunekemi	04	010104	301	NATURAL GAS	109,36	1A1a
055	I/S Fælles Forbrænding	01	010203	114	MUNICIP. WASTES	282819,6	1A1a
056	Vestfyns Forbrænding	01	010203	114	MUNICIP. WASTES	228332	1A1a
058	I/S Reno Syd	01	010103	114	MUNICIP. WASTES	643403	1A1a
059	I/S Kraftvarmeværk Thisted	01	010103	111	WOOD AND SIMIL.	985,8	1A1a
059	I/S Kraftvarmeværk Thisted	01	010103	114	MUNICIP. WASTES	551449,5	1A1a
059	I/S Kraftvarmeværk Thisted	01	010103	117	STRAW	2668	1A1a
060	Knudmoseværket	01	010103	114	MUNICIP. WASTES	36080	1A1a
060	Knudmoseværket	01	010103	301	NATURAL GAS	8205,37	1A1a
061	Kavo I/S Energien	01	010103	114	MUNICIP. WASTES	674320,5	1A1a
062	VEGA	01	010203	114	MUNICIP. WASTES	589029	1A1a
063	Hadsund Bys Fjernvarmeværk	01	010203	111	WOOD AND SIMIL.	30400	1A1a
063	Hadsund Bys Fjernvarmeværk	01	010203	114	MUNICIP. WASTES	201660	1A1a
064	Aars Fjernvarmeforsyning	01	010103	111	WOOD AND SIMIL.	9445	1A1a
064	Aars Fjernvarmeforsyning	01	010103	114	MUNICIP. WASTES	521349	1A1a
065	Haderslev Kraftvarmeværk	01	010103	114	MUNICIP. WASTES	666358	1A1a
065	Haderslev Kraftvarmeværk	01	010103	301	NATURAL GAS	54	1A1a
066	Frederikshavn Affaldskraftvarmeværk	01	010103	114	MUNICIP. WASTES	352602	1A1a
066	Frederikshavn Affaldskraftvarmeværk	01	010103	204	GAS OIL	1761	1A1a
067	Vejen Kraftvarmeværk	01	010103	114	MUNICIP. WASTES	408470	1A1a
068	Bofa I/S	01	010203	114	MUNICIP. WASTES	193924	1A1a
069	DTU	01	010104	301	NATURAL GAS	1194192	1A1a
070	Næstved Kraftvarmeværk	01	010104	301	NATURAL GAS	407112	1A1a
071	Maricogen	01	030104	204	GAS OIL	896,7	1A2f
071	Maricogen	01	030104	301	NATURAL GAS	2302648	1A2f
072	Hjørring KVV	01	010104	301	NATURAL GAS	1397583	1A1a

Table 57 Large point sources, plant specific emissions (IPCC 1A1, 1A2 and 1A4)[1].

lps	lps name	part id	SNAP id	IPCC id	SO_2 Mg	NO_X Mg	NMVOC Mg	CO Mg	TSP Mg	PM_{10} Mg[2]	$PM_{2,5}$ Mg[2]	As kg	Cd kg	Cr kg	Cu kg	Hg kg	Ni kg	Pb kg	Se kg	Zn kg
001	Amagervaerket	01	010101	1A1a	x	x			x	x	x	x	x	x	x	x	x	x	x	x
		02	010101	1A1a	x	x			x	x	x	x	x	x	x	x	x	x	x	x
		03	010101	1A1a	x	x			x	x	x	x		x	x	x	x	x	x	x
002	Svanemoellevaerket	05	010101	1A1a		x														
		07	010104	1A1a		x														
003	H.C.Oerstedsvaerket	03	010101	1A1a	x	x														
		07	010101	1A1a	x	x						x	x	x	x	x	x	x	x	
004	Kyndbyvaerket	21	010101	1A1a	x	x														
		22	010101	1A1a	x	x			x	x	x	x	x	x	x	x	x	x	x	
		26	010101	1A1a	x	x														
		28	010101	1A1a	x	x														
		41	010105	1A1a																
		51	010104	1A1a	x	x														
		52	010104	1A1a	x	x														
005	Masnedoevaerket	12	010102	1A1a	x	x														
		31	010104	1A1a	x	x														
007	Stigsnaesvaerket	01	010101	1A1a	x	x			x	x	x	x	x	x	x	x	x	x	x	x
		02	010101	1A1a	x	x			x	x	x	x	x	x	x	x	x	x	x	x
008	Asnaesvaerket	02	010101	1A1a	x	x			x	x	x	x	x	x	x	x	x	x	x	x
		03	010101	1A1a	x	x			x	x	x	x	x	x	x	x	x	x	x	x
		04	010101	1A1a	x	x			x	x	x	x	x	x	x	x	x	x	x	x
		05	010101	1A1a	x	x			x	x	x	x	x	x	x	x	x	x	x	x
009	Statoil Raffinaderi	01	010306	1A1b	x															
010	Avedoerevaerket	01	010101	1A1a	x	x			x	x	x	x	x	x	x	x	x	x	x	x
		02	010104	1A1a	x	x			x	x	x	x	x	x	x	x	x	x	x	
011	Fynsvaerket	03	010101	1A1a	x	x			x	x	x	x	x	x	x	x	x	x	x	
		07	010101	1A1a	x	x			x	x	x	x	x	x	x	x	x	x	x	
		08	010101	1A1a	x	x		x	x	x	x							x		
012	Studstrupvaerket	03	010101	1A1a	x	x			x	x	x	x	x	x	x	x	x	x	x	
		04	010101	1A1a	x	x			x	x	x	x	x	x	x	x	x	x	x	
014	Vendsysselvaerket	03	010101	1A1a	x	x			x	x	x	x	x	x	x	x	x	x	x	
017	Shell Raffinaderi	01	010306	1A1b	x	x														
		05	010304	1A1b	x	x														
018	Skaerbaekvaerket	01	010101	1A1a	x	x			x	x	x	x	x	x	x	x	x	x	x	
		03	010101	1A1a	x	x			x	x	x	x	x	x	x		x	x		
019	Enstedvaerket	03	010101	1A1a	x	x			x	x	x	x	x	x	x	x	x	x	x	
		04	010101	1A1a	x	x			x	x	x	x	x	x	x	x	x	x	x	
020	Esbjergvaerket	03	010101	1A1a	x	x			x	x	x	x	x	x	x	x	x	x	x	
022	Oestkraft	05	010102	1A1a	x	x														
		06	010102	1A1a	x	x														
023	Danisco Ingredients	01	030102	1A2f	x															
024	Dansk Naturgas Behandling-sanlaeg	01	010502	1A1c		x														
025	Horsens Kraftvarmevaerk	01	010102	1A1a	x	x		x	x	x	x							x		
		02	010104	1A1a		x														
026	Herningvaerket	01	010102	1A1a	x	x			x	x	x	x	x	x	x	x	x	x	x	
027	Vestforbraendingen	01	010102	1A1a	x	x		x	x	x	x					x				
		02	010102	1A1a																
028	Amagerforbraendingen	01	010102	1A1a	x	x	x	x	x	x	x		x			x		x		
029	Randersvaerket	01	010102	1A1a	x	x			x	x	x									
030	Grenaavaerket	01	010102	1A1a	x	x			x	x	x	x	x	x	x	x	x	x	x	
031	Hilleroedvaerket	01	010104	1A1a		x														
032	Helsingoervaerket	01	010104	1A1a		x														
		02	010105	1A1a																
034	Stora Dalum	01	030102	1A2f		x														
035	Assens Sukkerfabrik	01	030102	1A2f	x															
036	Kolding Kraftvarmevaerk	01	010103	1A1a	x		x	x	x	x	x	x	x	x	x	x	x	x		
		02	010103	1A1a	x		x	x	x	x	x	x	x	x	x	x	x	x		
037	Maabjergvaerket	02	010102	1A1a	x	x	x	x	x	x	x							x		
038	Soenderborg Kraftvarmevaerk	01	010102	1A1a	x	x		x	x	x	x	x	x	x	x	x	x	x		
		02	010104	1A1a		x														
039	Kara Affaldsforbraendingsan-laeg	01	010102	1A1a	x			x	x	x	x							x		
040	Viborg Kraftvarmevaerk	01	010104	1A1a		x														
042	Nordforbraendingen	01	010102	1A1a	x			x	x	x	x							x		
045	Aalborg Portland	01, 03	030311	1A2f	x	x		x	x	x	x	x	x	x	x	x	x	x	x	x
046	Aarhus Nord	01	010102	1A1a	x				x	x	x							x		
047	Reno Nord	01	010103	1A1a	x			x	x	x	x	x	x	x	x	x	x	x		
048	Silkeborg Kraftvarmevaerk	01	010104	1A1a		x														
049	Rensningsanlægget Lynetten	01	020103	1A4a	x				x	x	x	x	x	x	x	x	x	x		
050	I/S Fasan	01	010203	1A1a	x	x														
051	AVV Forbrændingsanlæg	01	010103	1A1a	x			x	x	x	x							x		
052	I/S REFA Kraftvarmeværk	01	010103	1A1a					x	x	x							x		
053	Svendborg Kraftvarmeværk	01	010102	1A1a	x	x	x	x	x	x	x							x		
054	Kommunekemi	01	010102	1A1a	x			x	x	x	x					x				
		02	010102	1A1a	x			x	x	x	x					x				
		03	010102	1A1a	x			x	x	x	x					x				

		04	010104	1A1a		x																	
056	Vestfyns Forbrænding	01	010203	1A1a	x	x		x	x	x	x												
058	I/S Reno Syd	01	010103	1A1a	x			x	x	x	x										x		
059	I/S Kraftvarmeværk Thisted	01	010103	1A1a	x			x	x	x	x		x				x				x		
060	Knudmoseværket	01	010103	1A1a	x			x	x	x	x												
061	Kavo I/S Energien	01	010103	1A1a	x		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x
062	VEGA	01	010203	1A1a	x	x		x	x	x	x										x		
063	Hadsund Bys Fjernvarmeværk	01	010203	1A1a	x			x	x	x	x										x		
065	Haderslev Kraftvarmeværk	01	010103	1A1a	x	x		x	x	x	x										x		
066	Frederiskhavn Affaldskraft-varmeværk	01	010103	1A1a	x	x		x	x	x	x										x		
067	Vejen Kraftvarmeværk	01	010103	1A1a	x	x		x	x	x	x										x		
068	Bofa I/S	01	010203	1A1a	x			x	x	x	x										x		
069	DTU	01	010104	1A1a		x																	
070	Næstved Kraftvarmeværk	01	010104	1A1a		x		x															
071	Maricogen	01	030104	1A2f		x																	
072	Hjørring KVV	01	010104	1A1a		x																	
	Total				**11471**	**45523**	**22**	**1659**	**1182**	**995**	**761**	**246**	**62**	**293**	**254**	**528**	**2910**	**1571**	**671**	**225**			

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 include plant specific data.
2) Based on particle size distribution

Appendix 8 Uncertainty estimates

Table 58 Uncertainty estimation, GHG.

IPCC Source category	Gas	Base year emission	Year t emission	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	Combined uncertainty as % of total national emissions in year t	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions
		Input data	Input data	Input data	Input data							
		Gg CO_2 eq	Gg CO_2 eq	%	%	%	%	%	%	%	%	%
Stationary Combustion, Coal	CO_2	24209	16708	1	5	5,099	2,254	-0,187	0,437	-0,935	0,617	1,120
Stationary Combustion, Petroleum coke	CO_2	410	762	3	5	5,831	0,118	0,009	0,020	0,047	0,084	0,096
Stationary Combustion, Plastic waste	CO_2	369	599	5	5	7,071	0,112	0,006	0,016	0,031	0,111	0,115
Stationary Combustion, Residual oil	CO_2	2505	1923	2	2	2,828	0,144	-0,014	0,050	-0,029	0,142	0,145
Stationary Combustion, Gas oil	CO_2	4564	2920	4	5	6,403	0,495	-0,041	0,076	-0,207	0,432	0,479
Stationary Combustion, Kerosene	CO_2	366	18	4	5	6,403	0,003	-0,009	0,000	-0,045	0,003	0,045
Stationary Combustion, Orimulsion	CO_2	0	1908	1	2	2,236	0,113	0,050	0,050	0,100	0,070	0,122
Stationary Combustion, Natural gas	CO_2	4330	11090	3	1	3,162	0,928	0,178	0,290	0,178	1,229	1,242
Stationary Combustion, LPG	CO_2	194	104	4	5	6,403	0,018	-0,002	0,003	-0,011	0,015	0,019
Stationary Combustion, Refinery gas	CO_2	806	842	3	5	5,831	0,130	0,001	0,022	0,006	0,093	0,094
Stationary combustion plants, gas engines	CH_4	2	400	2,2	40	40,060	0,424	0,010	0,010	0,416	0,033	0,417
Stationary combustion plants, other	CH_4	117	133	2,2	100	100,024	0,352	0,000	0,003	0,047	0,011	0,048
Stationary combustion plants	N_2O	397	383	2,2	1000	1000,002	10,124	0,000	0,010	-0,248	0,031	0,250
Total		38269	37789				109,062					3,335
Total uncertainties		**Overall uncertainty in the year (%):**					**10,443**		**Trend uncertainty (%):**			**1,826**

Table 59 Uncertainty estimation, CO_2.

IPCC Source category	Gas	Base year emission	Year t emission	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	Combined uncertainty as % of total national emissions in year t	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions
		Input data	Input data	Input data	Input data							
		Gg CO_2	Gg CO_2	%	%	%	%	%	%	%	%	%
Stationary Combustion, Coal	CO_2	24209	16708	1	5	5,099	2,254	-0,187	0,437	-0,935	0,617	1,120
Stationary Combustion, Petroleum coke	CO_2	410	762	3	5	5,831	0,118	0,009	0,020	0,047	0,084	0,096
Stationary Combustion, Plastic waste	CO_2	369	599	5	5	7,071	0,112	0,006	0,016	0,031	0,111	0,115
Stationary Combustion, Residual oil	CO_2	2505	1923	2	2	2,828	0,144	-0,014	0,050	-0,029	0,142	0,145
Stationary Combustion, Gas oil	CO_2	4564	2920	4	5	6,403	0,495	-0,041	0,076	-0,207	0,432	0,479
Stationary Combustion, Kerosene	CO_2	366	18	4	5	6,403	0,003	-0,009	0,000	-0,045	0,003	0,045
Stationary Combustion, Orimulsion	CO_2	0	1908	1	2	2,236	0,113	0,050	0,050	0,100	0,070	0,122
Stationary Combustion, Natural gas	CO_2	4330	11090	3	1	3,162	0,928	0,178	0,290	0,178	1,229	1,242
Stationary Combustion, LPG	CO_2	194	104	4	5	6,403	0,018	-0,002	0,003	-0,011	0,015	0,019
Stationary Combustion, Refinery gas	CO_2	806	842	3	5	5,831	0,130	0,001	0,022	0,006	0,093	0,094
Total	CO_2	37753,414	36873,43				6,581					3,115

Total uncertainties	Overall uncertainty in the year (%):	2,565	Trend uncertainty (%):	1,765

Table 60 Uncertainty estimation, CH_4.

IPCC Source category	Gas	Base year emission	Year t emission	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	Combined uncertainty as % of total national emissions in year t	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions
		Input data	Input data	Input data	Input data							
		Mg CH_4	Mg CH_4	%	%	%	%	%	%	%	%	%
Stationary combustion plants, gas engines	CH4	106	19046	2,2	40	40,060	30,058	3,283	3,368	131,303	10,477	131,720
Stationary combustion plants, other	CH4	5549	6338	2,2	100	100,024	24,975	-3,251	1,121	-325,129	3,487	325,147
Total	CH_4	5656	25384				1527,23					123071
Total uncertainties			**Overall uncertainty in the year (%):**				**39,080**			**Trend uncertainty (%):**		**350,815**

Table 61 Uncertainty estimation, N_2O.

IPCC Source category	Gas	Base year emission	Year t emission	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	Combined uncertainty as % of total national emissions in year t	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions
		Input data	Input data	Input data	Input data							
		Gg N_2O	Gg N_2O	%	%	%	%	%	%	%	%	%
Stationary combustion plants	N_2O	1,281	1,234	2,200	1000,000	1000,002	1000,002	0,000	0,964	0,000	2,998	2,998
Total	N_2O	1,281	1,234				1000005					8,987
Total uncertainties			**Overall uncertainty in the year (%):**				**1000,002**		**Trend uncertainty (%):**			**2,998**

Table 62 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	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	134117	10872	2	10	10,198	5,265	-0,041	0,067	-0,408	0,191	0,450
02	SO_2	11425	3623	2	20	20,100	3,458	0,013	0,022	0,264	0,064	0,272
03	SO_2	15812	6563	2	10	10,198	3,179	0,028	0,041	0,279	0,115	0,301
Total	SO_2	161355	21058				49,782					0,367

Total uncertainties	Overall uncertainty in the year (%):	**7,056**	Trend uncertainty (%):	**0,606**

Table 63 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	94994	53073	2	20	20,100	14,236	-0,073	0,4589	-1,452	1,298	1,948
02	NO_x	7871	7446	2	50	50,040	4,973	0,020	0,0644	1,014	0,182	1,030
03	NO_x	12798	14412	2	20	20,100	3,866	0,053	0,1246	1,057	0,352	1,114
Total	NO_x	115662	74931				242,349					6,097

Total uncertainties	Overall uncertainty in the year (%):	**15,568**	Trend uncertainty (%):	**2,469**

Table 64 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	1108	4299	2	50	50,040	11,570	0,211	0,3382	10,528	0,957	10,571
02	NMVOC	10991	13369	2	50	50,040	35,979	-0,211	1,0517	-10,556	2,975	10,967
03	NMVOC	614	926	2	50	50,040	2,491	0,002	0,0728	0,110	0,206	0,234
Total	NMVOC	12713	18594				1434,549					232,074

Total uncertainties	Overall uncertainty in the year (%):	**37,875**	Trend uncertainty (%):	**15,234**

Table 65 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	8982	12539	2	20	20,100	1,508	0,015	0,086	0,301	0,245	0,388
02	CO	130963	149434	2	50	50,040	44,729	-0,010	1,030	-0,517	2,914	2,959
03	CO	5100	5203	2	20	20,100	0,626	-0,005	0,036	-0,093	0,101	0,138
Total	CO	145045	167176				2003,377					8,928

Total uncertainties	Overall uncertainty in the year (%):	**44,759**	Trend uncertainty (%):	**2,988**

Table 66 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	1144	1332	2	50	50,040	11,524	0,030	0,234	1,498	0,661	1,637
02	TSP	3385	3415	2	500	500,004	295,123	-0,004	0,599	-1,901	1,695	2,547
03	TSP	1170	1038	2	50	50,040	8,980	-0,026	0,182	-1,307	0,515	1,405
Total	TSP	5699	5785				87311,041					11,142

Total uncertainties	Overall uncertainty in the year (%):	**295,484**	Trend uncertainty (%):	**3,338**

Table 67 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}	937	1074	2	50	50,040	10,656	0,026	0,215	1,278	0,608	1,415
02	PM_{10}	3199	3223	2	500	500,004	319,607	-0,001	0,645	-0,628	1,825	1,930
03	PM_{10}	859	745	2	50	50,040	7,398	-0,024	0,149	-1,215	0,422	1,286
Total	PM_{10}	4994	5043				102317,094					7,382

Total uncertainties	Overall uncertainty in the year (%):	**319,870**	Trend uncertainty (%):	**2,717**

Table 68 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	$PM_{2.5}$	801	903	2	50	50,040	10,297	0,021	0,209	1,034	0,591	1,191
02	$PM_{2.5}$	3010	3026	2	500	500,004	344,963	-0,007	0,700	-3,288	1,981	3,839
03	$PM_{2.5}$	511	458	2	50	50,040	5,219	-0,014	0,106	-0,704	0,299	0,765
Total	$PM_{2.5}$	4322	4386				119133,070					16,740

Total uncertainties	Overall uncertainty in the year (%):	**345,157**	Trend uncertainty (%):	**4,091**

Table 69 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	972	414	2	100	100,020	56,899	-0,051	0,286	-5,118	0,809	5,181
02	As	127	82	2	1000	1000,002	113,007	0,013	0,057	12,630	0,161	12,631
03	As	349	232	2	100	100,020	31,818	0,039	0,160	3,879	0,453	3,905
Total	As	1448	728				17020,547					201,641

Total uncertainties	Overall uncertainty in the year (%):	**130,463**	Trend uncertainty (%):	**14,200**

Table 70 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	621	230	2	100	100,020	37,587	-0,112	0,213	-11,248	0,602	11,264
02	Cd	145	147	2	1000	1000,002	239,993	0,060	0,136	59,926	0,384	59,927
03	Cd	314	235	2	100	100,020	38,429	0,053	0,218	5,296	0,615	5,332
Total	Cd	1080	611				60486,031					3746,537

Total uncertainties	Overall uncertainty in the year (%):	**245,939**	Trend uncertainty (%):	**61,209**

Table 71 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	4845	511	2	100	100,020	36,580	-0,090	0,082	-9,014	0,231	9,017
02	Cr	326	107	2	1000	1000,002	76,489	0,005	0,017	5,463	0,048	5,463
03	Cr	1097	780	2	100	100,020	55,789	0,085	0,124	8,522	0,352	8,529
Total	Cr	6268	1398				10301,150					183,896

Total uncertainties	Overall uncertainty in the year (%):	101,495	Trend uncertainty (%):	13,561

Table 72 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	3028	646	2	100	100,020	56,392	-0,075	0,173	-7,546	0,490	7,562
02	Cu	302	187	2	1000	1000,002	163,570	0,025	0,050	25,383	0,142	25,384
03	Cu	401	312	2	100	100,020	27,268	0,051	0,084	5,061	0,237	5,067
Total	Cu	3731	1146				30678,587					727,197

Total uncertainties	Overall uncertainty in the year (%):	175,153	Trend uncertainty (%):	26,967

Table 73 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	2634	664	2	100	100,020	56,718	-0,093	0,208	-9,323	0,587	9,341
02	Hg	330	223	2	1000	1000,002	190,449	0,032	0,070	31,957	0,197	31,958
03	Hg	234	284	2	100	100,020	24,253	0,062	0,089	6,196	0,251	6,201
Total	Hg	3198	1171				40075,948					1147,000

Total uncertainties	Overall uncertainty in the year (%):	200,190	Trend uncertainty (%):	33,867

Table 74 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	8585	4526	2	100	100,020	39,247	-0,003	0,210	-0,324	0,594	0,677
02	Ni	1852	1240	2	1000	1000,002	107,471	0,012	0,058	11,513	0,163	11,514
03	Ni	11109	5769	2	100	100,020	50,024	-0,008	0,268	-0,823	0,757	1,118
Total	Ni	21546	11535				15592,691					134,281

Total uncertainties	Overall uncertainty in the year (%):	**124,871**	Trend uncertainty (%):	**11,588**

Table 75 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	12739	2331	2	100	100,020	63,745	-0,035	0,145	-3,488	0,410	3,512
02	Pb	946	230	2	1000	1000,002	62,888	0,001	0,014	0,929	0,040	0,930
03	Pb	2401	1096	2	100	100,020	29,985	0,034	0,068	3,418	0,193	3,423
Total	Pb	16085	3657				8917,454					24,919

Total uncertainties	Overall uncertainty in the year (%):	**94,432**	Trend uncertainty (%):	**4,992**

Table 76 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	2958	731	2	100	100,020	41,460	-0,108	0,169	-10,845	0,477	10,856
02	Se	308	190	2	1000	1000,002	107,712	0,015	0,044	14,849	0,124	14,850
03	Se	1065	842	2	100	100,020	47,787	0,094	0,194	9,410	0,550	9,426
Total	Se	4331	1763				15604,372					427,2243787

Total uncertainties	Overall uncertainty in the year (%):	**124,92**	Trend uncertainty (%):	**20,669**

Table 77 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	15534	13636	2	100	100,020	74,360	-0,028	0,680	-2,836	1,923	3,426
02	Zn	2811	2643	2	1000	1000,002	144,113	0,004	0,132	3,573	0,373	3,592
03	Zn	1707	2062	2	100	100,020	11,246	0,025	0,103	2,498	0,291	2,515
Total	Zn	20052	18342				26424,344					30,967

Total uncertainties	Overall uncertainty in the year (%):	**162,56**	Trend uncertainty (%):	**5,565**

Table 78 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		34	10	2	100	100,020	0,275	-0,017	0,004	-1,686	0,012	1,686
02		2391	3652	2	1000	1000,002	971,520	0,008	1,476	7,770	4,175	8,820
03		49	97	2	100	100,020	2,574	0,009	0,039	0,902	0,111	0,909
Total		2474	3760				943857,442					81,470

Total uncertainties	Overall uncertainty in the year (%):	**971,523**	Trend uncertainty (%):	**9,026**

Table 79 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	16	2	100	100,020	1,273	-0,003	0,020	-0,308	0,057	0,313
02		749	1206	2	1000	1000,002	969,812	0,021	1,541	21,189	4,359	21,633
03		23	22	2	100	100,020	1,747	-0,018	0,028	-1,831	0,078	1,832
Total		783	1244				940540,842					471,426

Total uncertainties	Overall uncertainty in the year (%):	**969,82**	Trend uncertainty (%):	**21,712**

Table 80 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		9	10	2	100	100,020	0,361	-0,002	0,005	-0,177	0,015	0,178
02		1880	2804	2	1000	1000,002	987,223	-0,003	1,476	-3,392	4,175	5,379
03		11	26	2	100	100,020	0,917	0,005	0,014	0,520	0,039	0,521
Total		1899	2840				974610,747					29,241

Total uncertainties	Overall uncertainty in the year (%):	**987,22**	Trend uncertainty (%):	**5,407**

Table 81 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		7	11	2	100	100,020	0,539	0,001	0,007	0,130	0,020	0,132
02		1552	2037	2	1000	1000,002	990,755	0,005	1,295	4,910	3,664	6,126
03		14	8	2	100	100,020	0,386	-0,006	0,005	-0,626	0,014	0,626
Total		1572	2056				981596,836					37,940

Total uncertainties	Overall uncertainty in the year (%):	**990,76**	Trend uncertainty (%):	**6,160**

Appendix 9 Lower Calorific Value (LCV) of fuels

Table 82 Time-series for calorific values of fuels (Danish Energy Authority, DEA 2003b).

		1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
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	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	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	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	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	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	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	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	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	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	43,80	43,80	43,80
Other Kerosene	GJ / ton	43,50	43,50	43,50	43,50	43,50	43,50	43,50	43,50	43,50	43,50	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	43,50	43,50	43,50
Gas/Diesel Oil	GJ / ton	42,70	42,70	42,70	42,70	42,70	42,70	42,70	42,70	42,70	42,70	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	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	27,62	27,64	27,71
Petroleum Coke	GJ / ton	31,40	31,40	31,40	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	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	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	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	41,90	41,90	41,90
Natural Gas	GJ / 1000 m_n^3	39,00	39,00	39,00	39,30	39,30	39,30	39,30	39,60	39,90	40,00	40,15	39,99	40,06
Town Gas	GJ / 1000 m_n^3							17,00	17,00	17,00	17,00	17,01	16,88	17,39
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	24,80	24,90	25,15
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	26,50	26,50	26,50
Gas Plant Coal	GJ / ton													
Coke	GJ / ton	31,80	29,30	29,30	29,30	29,30	29,30	29,30	29,30	29,30	29,30	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	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	14,50	14,50	14,50
Wood Chips	GJ/cubic metre	2,80	2,80	2,80	2,80	2,80	2,80	2,80	2,80	2,80	2,80	2,80	2,80	2,80
Firewood, Hardwood	GJ / m^3	10,40	10,40	10,40	10,40	10,40	10,40	10,40	10,40	10,40	10,40	10,40	10,40	10,40
Firewood, Conifer	GJ / m^3	7,60	7,60	7,60	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	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	14,70	14,70	14,70
Wood Waste	GJ/ m^3	3,20	3,20	3,20	3,20	3,20	3,20	3,20	3,20	3,20	3,20	3,20	3,20	3,20
Biogas	GJ / 1000 m_n^3								23,00	23,00	23,00	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	10,50	10,50	10,50
Fish Oil	GJ / ton	37,20	37,20	37,20	37,20	37,20	37,20	37,20	37,20	37,20	37,20	37,20	37,20	37,20

Table 83 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 10 Adjustment of CO_2 emission

Table 84 Basis of adjustment calculation of CO_2 emission (ref. Danish Energy Authority).

Degree Days		1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Actual Degree Days	Degree days	2 093	2 515	3 022	3 434	3 148	3 297	3 837	3 236	3 217	3 056	2 902	3279	3011
Normal Degree Days	Degree days	2 691	2 691	3 370	3 370	3 370	3 370	3 370	3 370	3 370	3 370	3 370	3 370	3370
Actual emission	1000 tonnes	52724		56713		62728		73075		59400	56464	52468	54025	53024
Adjusted emission	1000 tonnes	60903		60823		59652		58468		56151	55488	54468	53907	52427

Appendix 11 Reference approach

TABLE 1.A(b) SECTORAL BACKGROUND DATA FOR ENERGY
CO_2 from Fuel Combustion Activities - Reference Approach (IPCC Worksheet 1-1)
(Sheet 1 of 1)

FUEL TYPES			Unit	Production	Imports	Exports	International bunkers	Stock change	Apparent consumption
Liquid Fossil	Primary Fuels	Crude Oil	TJ	780.813,92	140.204,04	########		-2.898,93	333.677,81
		Orimulsion	TJ	0,00	19.583,49	0,00		-4.199,15	23.782,63
		Natural Gas Liquids	TJ	0,00	0,00	0,00		0,00	0,00
	Secondary Fuels	Gasoline	TJ		44.006,18	49.306,91	25,34	137,61	-5.463,68
		Jet Kerosene	TJ		24.820,65	15.996,45	29.090,37	664,51	-20.930,67
		Other Kerosene	TJ		0,00	0,00	0,00	0,00	0,00
		Shale Oil	TJ		0,00	0,00		0,00	0,00
		Gas / Diesel Oil	TJ		73.362,94	41.739,16	21.579,48	-3.966,14	14.010,44
		Residual Fuel Oil	TJ		26.955,06	47.901,72	17.546,65	-1.244,05	-37.249,26
		LPG	TJ		149,27	4.558,78		-23,92	-4.385,59
		Ethane	TJ		0,00	0,00		0,00	0,00
		Naphtha	TJ		938,25	57,38		-6,99	887,86
		Bitumen	TJ		7.473,56	41,51		83,38	7.348,67
		Lubricants	TJ		2.582,63	346,85	110,41	42,57	2.082,81
		Petroleum Coke	TJ		8.664,83	543,79		-93,76	8.214,81
		Refinery Feedstocks	TJ		7.283,68	0,00		424,35	6.859,33
		Other Oil	TJ		0,00	0,00		0,00	0,00
Liquid Fossil Totals									
Solid Fossil	Primary Fuels	Anthracite [2]	TJ	0,00	0,00	0,00		0,00	0,00
		Coking Coal	TJ	0,00	0,00	0,00		0,00	0,00
		Other Bit. Coal	TJ	0,00	158.044,91	4.235,26	0,00	-19.912,86	173.722,51
		Sub-bit. Coal	TJ	0,00	0,00	0,00	0,00	0,00	0,00
		Lignite	TJ	0,00	0,00	0,00		0,00	0,00
		Oil Shale	TJ	0,00	0,00	0,00		0,00	0,00
		Peat	TJ	0,00	0,00	0,00		0,00	0,00
	Secondary Fuels	BKB & Patent Fuel	TJ		17,40	0,00		-1,52	18,92
		Coke Oven/Gas Coke	TJ		1.124,50	0,00		57,66	1.066,84
Solid Fuel Totals									
Gaseous Fossil		Natural Gas (Dry)	TJ	318.323,54	3.657,13	########		-367,42	193.737,53
Total									
Biomass total									
		Solid Biomass	TJ	77.945,91	4.208,61	0,00		0,00	82.154,51
		Liquid Biomass	TJ	0,00	0,00	0,00		0,00	0,00
		Gas Biomass	TJ	3.361,79	0,00	0,00		0,00	3.361,79

Conversion factor [1] (TJ/Unit)	[1]	Apparent consumption (TJ)	Carbon emission factor (t C/TJ)	Carbon content (Gg C)	Carbon stored (Gg C)	Net carbon emissions (Gg C)	Fraction of carbon oxidized	Actual CO_2 emissions (Gg CO_2)
1,00	NCV	333.677,81	20,00	6.673,56		6.673,56	1,00	24.469,71
1,00	NCV	23.782,63	22,00	523,22		523,22	1,00	1.918,47
1,00	NCV	0,00	17,20	0,00		0,00	1,00	0,00
1,00	NCV	-5.463,68	18,90	-103,26		-103,26	1,00	-378,63
1,00	NCV	-20.930,67	19,50	-408,15		-408,15	1,00	-1.496,54
1,00	NCV	0,00	19,60	0,00		0,00	1,00	0,00
1,00	NCV	0,00	20,00	0,00		0,00	1,00	0,00
1,00	NCV	14.010,44	20,20	283,01	0,00	283,01	1,00	1.037,71
1,00	NCV	-37.249,26	21,10	-785,96		-785,96	1,00	-2.881,85
1,00	NCV	-4.385,59	17,20	-75,43	0,00	-75,43	1,00	-276,58
1,00	NCV	0,00	16,80	0,00	0,00	0,00	1,00	0,00
1,00	NCV	887,86	20,00	17,76	13,21	4,54	1,00	16,66
1,00	NCV	7.348,67	22,00	161,67	171,60	-9,93	1,00	-36,41
1,00	NCV	2.082,81	20,00	41,66	21,89	19,76	1,00	72,47
1,00	NCV	8.214,81	27,50	225,91		225,91	1,00	828,33
1,00	NCV	6.859,33	20,00	137,19		137,19	1,00	503,02
1,00	NCV	0,00	20,00	0,00		0,00	1,00	0,00
		328.835,15		6.691,16	206,71	6.484,45		23.776,33
1,00	NCV	0,00	26,80	0,00		0,00	1,00	0,00
1,00	NCV	0,00	25,80	0,00	0,00	0,00	1,00	0,00
1,00	NCV	173.722,51	25,80	4.482,04		4.482,04	1,00	16.434,15
1,00	NCV	0,00	26,20	0,00		0,00	1,00	0,00
1,00	NCV	0,00	27,60	0,00		0,00	1,00	0,00
1,00	NCV	0,00	29,10	0,00		0,00	1,00	0,00
1,00	NCV	0,00	28,90	0,00		0,00	1,00	0,00
1,00	NCV	18,92	25,80	0,49		0,49	1,00	1,79
1,00	NCV	1.066,84	29,50	31,47		31,47	1,00	115,40
		174.808,28		4.514,00	0,00	4.514,00		16.551,34
1,00	NCV	193.737,53	15,30	2.964,18	0,00	2.964,18	1,00	10.868,68
		697.380,95		**14.169,34**	**206,71**	**13.962,64**		**51.196,34**
		85.516,30		2.533,07	0,00	2.533,07		9.287,92
1,00	NCV	82.154,51	29,90	2.456,42		2.456,42	1,00	9.006,87
1,00	NCV	0,00	20,00	0,00		0,00	1,00	0,00
1,00	NCV	3.361,79	22,80	76,65		76,65	1,00	281,05

TABLE 1.A(c) COMPARISON OF CO_2 EMISSIONS FROM FUEL COMBUSTION
(Sheet 1 of 1)

Denmark
2002
2004, Mar 15

FUEL TYPES	Reference approach		National approach [1]		Difference [2]	
	Energy consumption (PJ)	CO_2 emissions (Gg)	Energy consumption (PJ)	CO_2 emissions (Gg)	Energy consumption (%)	CO_2 emissions (%)
Liquid Fuels (excluding international bunkers)	328,84	23.776,33	316,54	23.451,78	3,88	1,38
Solid Fuels (excluding international bunkers)	174,81	16.551,34	175,73	16.707,92	-0,52	-0,94
Gaseous Fuels	193,74	10.868,68	193,61	11.089,99	0,07	-2,00
Other [3]	-10,87	599,05	1,00	672,21	-1.184,61	-10,88
Total [3]	**686,51**	**51.795,39**	**686,88**	**51.921,90**	**-0,05**	**-0,24**

[1] "National approach" is used to indicate the approach (if different from the Reference approach) followed by the Party to estimate its CO_2 emissions from fuel combustion reported in the national GHG inventory.
[2] Difference of the Reference approach over the National approach (i.e. difference = 100% x ((RA-NA)/NA), where NA = National approach and RA = Reference approach).
[3] Emissions from biomass are not included.

Note: In addition to estimating CO_2 emissions from fuel combustion by sector, Parties should also estimate these emissions using the IPCC Reference approach, as found in the IPCC Guidelines, Worksheet 1-1(Volume 2. Workbook). The Reference approach is to assist in verifying the sectoral data. Parties should also complete the above tables to compare the alternative estimates, and if the emission estimates lie more than 2 percent apart, should explain the source of this difference in the documentation box provided.

Documentation Box:
Non-energy use of fuels is not included in the Danish National Approach. Fuel consumption for non-energy is subtracted in Reference Approach to make results comparable. Inclusion of these fuels in future inventories will be considered.
CO2 emission from plastic part of municipal wastes is included in the Danish National Approach.
CO2 emission from the plastic part of municipal wastes is added in Reference Approach. (Other fuels of sources 1A1, 1A2 and 1A4)

Table 85 Fuel category correspondence list for the reference approach.

Reference approach		Danish energy statistics
Biomass	Gas Biomass	Biogas, other
Biomass	Gas Biomass	Biogas, landfill
Biomass	Gas Biomass	Biogas, sewage sludge
Biomass	Solid Biomass	Fish oil
Biomass	Solid Biomass	Waste combustion, plastic
Biomass	Solid Biomass	Waste combustion, other
Biomass	Solid Biomass	Firewood
Biomass	Solid Biomass	Straw
Biomass	Solid Biomass	Wood Chips
Biomass	Solid Biomass	Firewood
Biomass	Solid Biomass	Wood Pellets
Liquid fossil	Bitumen	Bitumen
Liquid fossil	Crude oil	Crude Oil
Liquid fossil	Ethane	-
Liquid fossil	Gas/diesel oil	Gas/Diesel Oil
Liquid fossil	Gasoline	Aviation Gasoline
Liquid fossil	Gasoline	Motor Gasoline
Liquid fossil	Jet Kerosene	JP1
Liquid fossil	Jet Kerosene	JP4
Liquid fossil	LPG	LPG
Liquid fossil	Lubricants	Lubricants
Liquid fossil	Naphtha	White Spirit
Liquid fossil	Naphtha	Naphtha (LVN)
Liquid fossil	Natural gas	Natural Gas
Liquid fossil	Natural gas liquids	-
Liquid fossil	Orimulsion	Orimulsion
Liquid fossil	Other kerosene	Other Kerosene
Liquid fossil	Other oil	Waste oil
Liquid fossil	Petroleum coke	Petroleum Coke
Liquid fossil	Refinery feedstocks	Refinery Feedstocks
Liquid fossil	Residual fuel oil	Fuel Oil
Liquid fossil	Shale oil	-
Solid fossil	anthracite	-
Solid fossil	BKB & Patent fuel	Brown Coal Briquettes
Solid fossil	Coke oven/gas coke	Coke
Solid fossil	Coking Coal	-
Solid fossil	Oil Shale	-
Solid fossil	Other Bit. Coal	Other Hard Coal
Solid fossil	Other Bit. Coal	Electricity Plant Coal
Solid fossil	Peat	-
Solid fossil	Sub-bit. coal	-

Appendix 12 Emission inventory 2002 based on SNAP sectors

Table 86 Emission inventory 2002 based on SNAP sectors.

SNAP 2)	SO2 [Mg]	NOX [Mg]	NMVOC [Mg]	CH4 [Mg]	CO [Mg]	CO2 1) [Gg]	N2O [Mg]	TSP [Mg]	PM10 [Mg]	$PM_{2.5}$ [Mg]	As [kg]	Cd [kg]	Cr [kg]	Cu [kg]	Hg [kg]	Ni [kg]	Pb [kg]	Se [kg]	Zn [kg]	Flouran-the [kg]	Benzo(b) [kg]	Benzo(k) [kg]	Benzo(a) [kg]	Benzo ($g_{,,}$) [kg]	Indeno [kg]
Total 01	**10872**	**53073**	**4299**	**16184**	**12539**	**31567**	**852**	**1332**	**1074**	**903**	**414**	**230**	**511**	**646**	**664**	**4526**	**2331**	**731**	**13636**	**274**	**40**	**16**	**10**	**24**	**11**
0101	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-	-	-	-	-
010101	7231	29079	373	448	2532	19430	570	755	615	511	145	29	243	192	195	1562	350	635	2518	54	14	3	3	8	5
010102	920	4034	46	39	591	3027	43	96	78	64	142	77	82	209	107	193	1122	62	7020	2	0	0	0	0	0
010103	524	1344	16	18	216	1163	13	56	42	34	80	38	28	95	153	87	541	1	2539	4	0	0	0	0	0
010104	258	3051	64	66	391	2383	81	72	71	59	11	3	11	11	1	1302	14	5	1	14	3	1	1	2	1
010105	44	5694	3307	15127	5386	1755	37	26	6	5	0	0	0	0	0	0	0	0	1	4	1	1	0	0	0
0102	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
010201	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
010202	60	82	15	12	92	68	2	7	5	4	2	3	4	3	3	78	4	2	34	4	1	0	0	0	0
010203	900	1680	419	296	2320	1271	46	175	126	101	16	61	98	118	200	428	267	9	1520	190	20	11	6	13	4
010204	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
010205	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
0103	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
010301	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
010302	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
010303	0	100	4	2	15	57	2	5	5	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
010304	5	397	-	-	37	140	5	12	12	12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
010305	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
010306	922	1057	-	-	211	752	25	125	111	104	19	18	45	18	6	875	32	17	4	2	1	0	0	0	0
0104	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
010401	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
010402	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
010403	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
010404	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
010405	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
010406	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
010407	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
0105	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
010501	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
010502	8	6501	52	157	734	1502	26	3	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
010503	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
010504	0	31	0	0	2	14	1	0	0	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
010505	1	24	2	19	13	4	0	0	0	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
010506	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total 02	**3623**	**7446**	**13369**	**7565**	**149434**	**7735**	**212**	**3415**	**3223**	**3026**	**82**	**147**	**107**	**187**	**223**	**1240**	**230**	**190**	**2643**	**13440**	**3652**	**1206**	**2804**	**3784**	**2037**
0201	247	615	612	244	578	860	21	167	165	156	10	12	15	16	13	226	21	23	180	777	216	72	164	223	117
020101	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
020102	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
020103	296	8	1	1	6	14	0	35	30	24	10	2	5	4	30	7	25	0	5	0	0	-	-	0	0
020104	0	5	0	0	0	2	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
020105	10	448	136	729	326	104	2	2	1	0	-	-	-	-	-	-	-	-	0	1	0	0	0	0	0
020106	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
0202	1786	4674	10801	3755	146801	5699	161	3095	2936	2770	38	111	35	141	156	118	134	138	2377	12171	3319	1106	2534	3431	1789
020201	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
020202	0	1	0	0	1	2	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
020203	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
020204	0	234	163	724	244	80	2	1	0	0	-	-	-	-	-	-	-	-	-	0	0	0	-	0	0
020205	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
0203	1276	822	1294	461	886	777	22	111	91	74	25	21	51	26	24	885	50	29	81	490	117	28	105	130	131
020301	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
020302	2	1	3	1	2	1	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0
020303	0	8	0	0	0	4	0	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

020304	6	629	360	1649	591	193	4	3	1	1	0	0	0	0	0	2	0	0	0	1	0	0	0	0	0
020305	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total 03	**6631**	**14829**	**927**	**1635**	**5211**	**6025**	**170**	**1038**	**745**	**458**	**232**	**235**	**780**	**312**	**284**	**5769**	**1096**	**842**	**2062**	**3430**	**97**	**22**	**26**	**9**	**8**
0301	4884	4038	500	508	3030	3710	93	322	234	168	119	152	259	161	92	4791	228	106	1105	196	15	13	2	5	4
030101	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
030102	708	513	120	101	582	428	14	56	39	29	13	25	26	27	19	477	29	9	303	20	4	4	0	1	1
030103	33	64	21	14	104	49	2	9	6	5	1	4	2	4	3	41	3	1	58	2	1	1	0	0	0
030104	2	623	9	10	42	385	15	1	0	0	-	-	-	-	-	-	-	-	0	0	-	0	-	0	0
030105	1	270	181	809	276	90	2	1	0	0	-	-	-	-	-	0	-	-	-	0	0	0	0	0	0
030106	0	2	0	0	1	2	0	0	0	0	0	-	0	0	0	-	0	0	0	0	-	-	-	-	-
0302	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
030203	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
030204	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
030205	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
0303	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
030301	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
030302	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
030303	-	-	-	-	-	-	-	175	52	8	26	12	96	-	-	113	629	437	437	-	-	-	-	-	-
030304	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
030305	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
030306	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
030307	-	-	-	-	-	-	-	2	1	1	-	0	-	1	-	-	9	-	-	-	-	-	-	-	-
030308	-	-	-	-	-	-	-	1	0	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
030309	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
030310	-	-	-	-	-	-	-	31	27	12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
030311	935	8903	95	191	1169	1361	44	185	166	74	54	19	27	27	162	54	27	19	135	3212	77	4	24	3	3
030312	-	-	-	-	-	-	-	37	18	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
030313	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
030314	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
030315	67	417	1	-	8	-	-	25	23	20	18	23	370	92	8	293	172	271	25	-	-	-	-	-	-
030316	-	-	-	-	-	-	-	114	103	80	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
030317	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
030318	-	-	-	-	-	-	-	81	73	57	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
030319	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
030320	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
030321	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
030322	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
030323	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
030324	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
030325	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
030326	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
030327	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

1) Including CO_2 emission from biomass
2) SNAP sector codes are shown in appendix 3

National Environmental Research Institute

The National Environmental Research Institute, NERI, is a research institute of the Ministry of the Environment.
In Danish, NERI is called Danmarks Miljøundersøgelser (DMU).
NERI's tasks are primarily to conduct research, collect data, and give advice on problems related to the environment and nature.

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Publications:
NERI publishes professional reports, technical instructions, and an annual report in Danish.
A R&D projects' catalogue is available in an electronic version on the World Wide Web.
Included in the annual report is a list of the publications from the current year.