DANISH EMISSION INVENTORY FOR WASTE INCINERATION AND OTHER WASTE

Inventories until year 2011

Scientific Report from DCE – Danish Centre for Environment and Energy No. 70 2013

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Data sheet

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Abstract: This report contains detailed methodological issues, activity data, emission factors, uncertainties and references for waste incineration without energy recovery and other waste source categories of the Danish emission inventories 2013. The emissions are calculated for the years 1980-2011 according to reporting requirements. Calculations include the categories; human and animal cremation, composting, accidental building and vehicle fires and production of biogas, and the pollutants; SO_2, NO_x, NMVOC, CH_4, CO, CO_2, N_2O, NH_3, As, Cd, Cr, Cu, Hg, Ni, Pb, Se, Zn, HCB, PCDD/F, PAHs and PCBs.

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Contents

List of abbreviations

CORINAIR:	CORe INventory on AIR emissions.
CRF:	The Common Reporting Format (CRF) used for reporting under the United Nations Framework Convention on Climate Change (UNFCCC) and the Kyoto protocol.
DCE:	Danish Centre for Environment and Energy (DCE) at Aarhus University.
DEMA:	Danish Emergency Management Agency.
DEPA:	Danish Environmental Protection Agency.
DKL:	Danske Kommuners Landsforening (Association of Danish crematoria).
DOC:	Degradable organic carbon.
DP:	Data Processing.
DS:	Data Storage.
EEA:	European Environment Agency.
EMEP:	European Monitoring and Evaluation Program.
FSE:	Full Scale Equivalent.
GHG:	Greenhouse gases, including CO_2, CH_4 and N_2O.
GPW:	Garden- and Park Waste.
HCB:	Hexachlorobenzene.
I-TEQ:	International Toxicity Equivalents, which is a weighted addition of congener toxicity with reference to 2,3,7,8-TCDD (Seveso-dioxin).
IPCC:	Intergovernmental Panel on Climate Change.
ISAG:	Informations System for Affald og Genanvendelse (Information System for Waste and Recycling).
LRTAP:	Long-Range Transboundary Air Pollution.
LULUCF:	Land Use, Land Use Change and Forestry.
MSW:	Municipal Solid Waste.
NA:	Not Applicable.
NECD:	National Emissions Ceiling Directive of the European Commission.
NFR:	Nomenclature For Reporting. NFR category classification is used for reporting under the convention on Long-Range Transboundary Air Pollution (LRTAP).
NMVOC:	Non-methane volatile organic compound.
NO:	Not Occurring.
ODIN:	Online Dataregistrerings- og INberetningssystem (Online Data Registration- and Reporting System).
PAH:	Polycyclic aromatic hydrocarbon.
PCBs:	Polychlorinated biphenyls; a group of more than 200 configurations of chlorinated biphenyls.
PCDD/F:	Polychlorinated dibenzodioxins (PCDD) and Polychlorinated dibenzofurans (PCDF) or simply dioxins and furans. The PCDD/F emission is given in I-TEQ.
$PM_{2.5}$:	Particulate Matter, particles smaller than 2.5 micrometres.
PM_{10}:	Particulate Matter, particles smaller than 10 micrometres.
PMs:	Points of Measurement.
SNAP:	Selected Nomenclature for Air Pollution.
TSP:	Total suspended particles.
UNECE:	United Nations Economic Commission for Europe.
UNFCCC:	United Nations Framework Convention on Climate Change.
QA:	Quality assurance.
QC:	Quality Control.

Preface

The Danish Centre for Environment and Energy (DCE) at Aarhus University prepares the Danish atmospheric emission inventories and carries out the annual reporting to the United Nations Framework Convention on Climate Change (UNFCCC) and to the United Nations Economic Commission for Europe, Convention on Long- Range Transboundary Air Pollution (UNECE CLRTAP). Furthermore, the greenhouse gas emission inventory is reported to the EU monitoring mechanism, the Kyoto Protocol and to the NEC directive (National Emission Ceilings for certain atmospheric pollutants).

This report summarises the methods and data used for quantification of the emissions from waste incineration without energy recovery and other waste. It includes the latest updates and improvements to emission inventory of waste emissions. Data provided in this report are based on the national emission inventory for the year 2011, which are provided fully described in Denmark's National Inventory Report 2013 (Nielsen et al., 2013a).

Summary

The Danish emission inventories are prepared on an annual basis and are reported to the United Nations Framework Convention on Climate Change (UNFCCC) and to the Kyoto Protocol as well as to the United Nations Economic Commission for Europe (UNECE) Convention on Long-Range Transboundary Air Pollution (LRTAP Convention). Furthermore, a greenhouse gas emission inventory is reported to the European Union (EU), due to the EU – as well as the individual member states – being Party to the Climate Convention and the Kyoto Protocol. Four pollutants are estimated for reporting to the European Commission's National Emissions Ceiling Directive (NECD). The annual Danish emission inventories are prepared by DCE - Danish Centre for Environment and Energy at Aarhus University. The inventories include the following pollutants relevant to waste incineration without energy recovery and other waste: sulphur dioxide (SO_2), nitrogen oxide (NO_x), non-methane volatile organic compounds (NMVOC), methane (CH_4), carbon monoxide (CO), carbon dioxide (CO_2), nitrous oxide (N_2O), ammonia (NH_3), particulate matter, heavy metals, hexachlorobenzene (HCB), dioxins and furans (PCDD/F), polycyclic aromatic hydrocarbons (PAHs) and polychlorinated biphenyls (PCBs). In addition to annual national emissions the report includes emissions data for a number of source categories. Every five years the reporting includes data on the geographical distribution of the emissions, a projection of emissions data and details of the activity data on which the inventories are based.

In the Danish emission database emissions are held on SNAP level (Selected Nomenclature for Air Pollution), the inventory of emissions from waste incineration is segmented into sub-categories covering human cremation (SNAP 090901) and animal cremation (SNAP 090902), and the inventory of emissions from other waste is segmented into sub-categories covering compost production (SNAP 091005), biogas production (SNAP 091006) and accidental building and vehicle fires (SNAP 091009).

The inventories for waste incineration and other waste are based on activity data from different statistical databases and reports and on a set of emission factors for various source categories. This report provides detailed background information on the methodology and references for the input data in the inventory, activity data and emission factors. Emission factors are based on either literature studies or on international guidebooks (European Environment Agency (EEA) 2007, 2009 and Intergovernmental Panel on Climate Change (IPCC) 1997, 2000, 2006). The overall method for estimating emissions is to multiply activity data by an emission factor. The data basis and the adopted methods are outlined on sub-sector level in this report. The emissions are calculated for the years 1980-2011 according to reporting requirements.

In 2011 the total Danish emission of greenhouse gasses was 53,583 Gg CO_2 equivalents including emissions and removals associated with land-use, land-use change and forestry (LULUCF). Emissions from the source categories waste incineration (without energy recovery) and other waste accounts for 147 Gg CO_2 equivalents or approximately 0.3 %. The major part of the emissions is emitted as CH_4 (57 %), and the major part of the CH_4 emission is emitted from the other waste subsector; composting (98 % of CH_4 emis-

sions). The major source of N_2O is also composting (99 % of N_2O emissions). And the major source of CO_2 emissions is accidental building fires with 12 Gg in 2011 or 67 % of the emission of non-biogenic CO_2 from waste incineration and other waste.

Besides the greenhouse gasses CO_2, CH_4 and N_2O, other relevant emissions in the inventory on emissions from waste incineration and other waste include SO_2, NO_x, particulate matter and heavy metals. Accidental building fires are the major source of SO_2 emissions with 598 Mg or 97 % of the sector in 2011 and human cremation is the major source to NO_x emissions closely followed by building fires (39 % and 38 % respectively). Building fires are also the major source of particle emissions with 173 Mg or 96 % in 2011. The most important heavy metal emissions are in this context those of Zn, Pb and Hg. All three were nearly constant from 1980-2010 but has strongly decreased from 2010 to 2011; Zn, Pb and Hg have decreased with 15 %, 14 % and 97 % respectively to the total emissions of 444 kg, 113 kg and 1 kg respectively in 2011. This decrease is caused by installation of particle filters at all Danish crematoria and by fewer vehicle fires. In 2011, 96 % of all remaining heavy metal emissions (As, Cd, Cr, Cu, Hg, Ni, Pb, Se and Zn) from the source category waste incineration and other waste were caused by accidental vehicle fires.

Sammendrag

Opgørelser over de samlede danske luftemissioner rapporteres årligt til Klimakonventionen (United Nation Framework Convention on Climate Change, UNFCCC) og Kyotoprotokollen samt til UNECE (United Nations Economic Commission for Europe) Konventionen om langtransporteret grænseoverskridende luftforurening (UNECE Convention on Long-Range Transboundary Air Pollution der forkortes LRTAP Convention). Endvidere rapporteres drivhusgasemissionen til Den Europæiske Union (EU), fordi EU – såvel som de enkelte medlemslande – har ratificeret Klimakonventionen og Kyotoprotokollen. Der udarbejdes også opgørelser til rapportering til EUs NEC (National Emission Ceilings) direktiv. De danske emissioner opgøres og rapporteres af DCE -Nationalt Center for Miljø og Energi ved Aarhus Universitet. Emissionsopgørelserne omfatter følgende stoffer af relevans for affaldsforbrænding uden energiudnyttelse (waste incineration) og andet affald (other waste): svovldioxid (SO_2), kvælstofoxider (NO_x), non-metan flygtige organiske forbindelser (NMVOC), metan (CH_4), kulilte (CO), kuldioxid (CO_2), lattergas (N_2O), ammoniak (NH_3), partikler, tungmetaller, hexachlorbenzen (HCB), dioxiner og furaner (PCDD/F), polycykliske aromatiske kulbrinter (PAHs) og polychlorerede biphenyler (PCBs). Foruden de årlige opgørelser over samlede nationale emissioner rapporteres også sektoropdelte emissioner. Hvert femte år rapporteres endvidere en geografiske fordeling af emissionerne, fremskrivning af emissionerne samt detaljer om de aktivitetsdata, som opgørelserne er baseret på.

I den danske emissionsdatabase er aktiviteterne lagret på SNAP-niveau (Selected Nomenclature for Air Pollution), og emissionerne estimeres og aggregeres efterfølgende i overensstemmelse med rapporteringsformaterne. Affalds forbrænding (uden energianvendelse) er opdelt i underkategorier, der dækker kremering af mennesker (SNAP 090901) og dyrekremering (SNAP 090902), og opgørelsen af emissioner fra andet affald er opdelt i underkategorier, der dækker kompostering (SNAP 091005), biogasproduktion (SNAP 091006) samt bygnings- og bilbrande (SNAP 091009).

Emissionsopgørelserne for affaldsforbrænding (uden energianvendelse) og andet affald er baseret på aktivitetsdata fra forskellige statistiske databaser og videnskabelige rapporter, og på et sæt af emissionsfaktorer for forskellige kildekategorier. Denne rapport giver detaljeret baggrundsinformation om den anvendte metode samt referencer for de data, der ligger til grund for opgørelsen - aktivitetsdata og emissionsfaktorer. Emissionsfaktorerne er baseret på litteraturstudier eller internationale guidebøger (EEA (European Environment Agency) 2007, 2009 og IPCC (Intergovernmental Panel on Climate Change) 1997, 2000, 2006) udarbejdet til brug for denne type emissionsopgørelser. Den generelle metode til at estimere en emission er ved at multiplicere en aktivitet med en emissionsfaktor. Datagrundlaget og de anvendte metoder er gennemgået på SNAP niveau i denne rapport. Emissionerne er beregnet for årene 1980-2011 i overensstemmelse med rapporteringskravene.

I 2011 var den samlede danske udledning af drivhusgasser 53.583 Gg CO_2-ækvivalenter. Heraf var 147 Gg CO_2-ækvivalenter, svarende til ca. 0,3 %, fra affaldsforbrænding (uden energiudnyttelse) og andet affald. Størstedelen af emissionerne udledes som CH_4 (57 %), og størstedelen af CH_4 emissionerne

udledes fra andet affald ("other waste") fra underkategorien kompostering (98 % af CH_4-emissionen). Den største kilde til N_2O er også kompostering (99 % af N_2O-emissioner), og den største kilde til CO_2-emissioner er bygningsbrande (12 Gg) med 67 % af emissionerne af fossilt CO_2 fra affaldsforbrænding og andet affald i 2011.

Udover drivhusgasserne CO_2, CH_4 og N_2O, kan der, af øvrige relevante emissioner i opgørelsen for affaldsforbrænding og andet affald, nævnes SO_2, NO_x, partikler og tungmetaller. Bygningsbrande er den største kilde til SO_2 emissioner med 598 Mg eller 97 % af sektoren i 2011 og kremering af mennesker er den største kilde til NO_x emissionerne tæt efterfulgt af bygningsbrande (39 % og 38 % henholdsvis). Bygningsbrande er også den største kilde til partikelemissioner med 173 Mg eller 96 % i 2011. De mest relevante tungmetalemissioner, i denne sammenhæng, er Zn, Pb og Hg. Alle tre er nogenlunde konstante fra 1980-2010, men har haft et kraftigt fald fra 2010 til 2011. Zn, Pb og Hg er faldet med henholdsvis 15 %, 14 % og 97 % til total emissioner på henholdsvis 444 kg, 113 kg og 1 kg i 2011. Dette fald skyldes installation af partikelfiltre med aktivt kul på alle landets krematorier samt et lavere antal bilbrande. I 2011, stammede 96 % af alle tilbageværende tungmetalemissioner (As, Cd, Cr, Cu, Hg, Ni, Pb, Se og Zn) i sektoren affaldsforbrænding og andet affald fra bilbrande.

1 Introduction

The present sector report consists of two waste CRF/NFR source categories: 6.C. Waste Incineration and 6.D. Other Waste. Table 1.1 shows the relevant SNAP codes and names.

Table 1.1 Link between SNAP codes and CRF/NFR sectors.

SNAP code	SNAP name	CRF/NFR code
090201	Incineration of domestic or municipal wastes	6C
090202	Incineration of industrial wastes (except flaring)	6C
090204	Flaring in chemical industries	6C
090205	Incineration of sludge from waste water treatment	6C
090207	Incineration of hospital wastes	6C
090208	Incineration of waste oil	6C
090901	Incineration of human corpses	6C
090902	Incineration of carcasses	6C
090700	Open burning of agricultural wastes	6C
091003	Sludge spreading	6D
091005	Compost production	6D
091006	Biogas production	6D
091008	Other production of fuel (refuse derived fuel)	6D
091009	Accidental fires	6D

For the CRF/NFR source category 6.C. Waste Incineration, the main emissions are included in the energy sector (CRF/NFR 1A) since all incineration of municipal, industrial, clinical and hazardous waste in Denmark is carried out with energy recovery, these emissions are therefore not included in this sector report. The Waste Incineration category includes emissions from the minor sources; cremation of corpses and carcasses. Emissions from the Waste Incineration category include SO_2, NO_x, NMVOC, CH_4, CO, N_2O, NH_3, particulate matter (TSP, PM_{10} and $PM_{2.5}$), As, Cd, Cr, Cu, Hg, Ni, Pb, Se, Zn, HCB, PCDD/F, PAHs and PCBs.

The source sector 6.D. Other Waste covers emissions from combustion of biogas in biogas production plants (mentioned as Gasification of biogas in the CRF tables) for the years 1994-2005 where these emissions existed. This activity is not occurring in 2006 - 2011. Other sources covered by this sector are accidental building fires, accidental vehicle fires and compost production. Emissions from the Other Waste category includes SO_2, NO_x, NMVOC, CH_4, CO, CO_2, N_2O, NH_3, particulate matter (TSP, PM_{10} and $PM_{2.5}$), As, Cd, Cr, Cu, Hg, Ni, Pb, Zn, PCDD/F and PAHs.

Table 1.2 specifies the origin and type of the methods and emission factors applied in the present inventory.

Table 1.2 Calculation methods and type of emissions factors for the subcategory waste handling in the Danish inventory. (CS=country specific, D=default, OTH=other).

Sector	Source	Method	Emission factor
Waste Incineration	Human cremation	Tier 1	OTH, D
	Animal cremation	Tier 1	OTH
Other Waste	Composting	Tier 1, CS	CS, OTH
	Accidental building fires	Tier 1, CS	CS, OTH
	Accidental vehicle fires	Tier 1, CS	CS, OTH
	Combustion of biogas	Tier 1	CS

2 National emissions

In Table 2.1, an overview of all emissions from the present waste sectors is presented. The full time series and sub categorisation is shown in Annex 1 Table A1.1 - A1.5 and in Chapter 6 Emissions.

Table 2.1 Emissions from the waste sector.

		1990	1995	2000	2005	2006	2007	2008	2009	2010	2011
Greenhouse gases	Gg CO_2 eqv.	59.7	74.1	124.6	120.4	127.9	141.9	134.2	142.0	143.2	147.1
SO_2	Mg	578.5	660.3	586.7	573.3	589.2	702.2	662.2	640.6	565.0	617.6
NO_x	Mg	73.2	81.2	80.5	81.9	86.5	92.9	95.4	94.2	90.5	88.2
NMVOC	Mg	173.2	195.2	176.9	173.8	179.4	196.5	204.1	197.7	177.7	182.4
CH_4	Mg	1405.4	1797.0	3055.1	3310.4	3502.4	3902.6	3567.6	3795.5	3908.8	4011.5
CO	Mg	789.0	907.3	1023.8	1040.4	1082.8	1166.5	1182.6	1193.0	1123.5	1139.8
CO_2, non-biogenic	Gg	18.3	20.1	18.8	18.2	18.7	19.3	21.4	21.0	18.2	18.2
N_2O	Mg	38.4	52.4	134.6	105.6	114.9	131.1	122.2	133.0	138.6	144.1
NH_3	Mg	208.0	274.5	480.4	517.0	548.6	610.3	557.6	600.4	616.9	632.9
TSP	Mg	176.4	201.7	178.8	173.0	178.1	191.5	207.3	197.0	179.6	180.9
PM_{10}	Mg	176.1	201.4	178.4	172.4	177.2	190.5	206.3	195.9	178.5	180.1
$PM_{2.5}$	Mg	176.1	201.3	178.3	172.2	177.0	190.2	206.0	195.6	178.2	179.8
As	kg	2.2	2.5	2.3	2.3	2.4	2.6	2.7	2.6	2.5	2.5
Cd	kg	1.5	1.6	1.5	1.4	1.5	1.5	1.7	1.6	1.5	1.5
Cr	kg	2.6	2.9	2.7	2.6	2.7	2.8	3.1	3.0	2.8	2.7
Cu	kg	8.3	9.0	8.6	8.3	8.5	7.8	9.7	9.7	8.5	7.9
Hg	kg	46.9	50.2	47.6	46.6	47.1	47.8	47.9	48.5	48.1	1.5
Ni	kg	1.1	1.2	1.2	1.2	1.2	1.2	1.3	1.3	1.3	1.2
Pb	kg	127.9	131.3	134.5	128.7	132.4	104.9	150.4	156.6	132.3	113.1
Se	kg	0.9	0.9	1.0	1.0	1.2	1.2	1.2	1.2	1.3	1.2
Zn	kg	502.4	515.6	528.4	505.5	519.7	411.6	590.1	614.6	519.2	443.9
HCB	g	6.6	7.1	7.3	8.0	8.9	9.3	9.5	9.6	9.8	9.1
PCDD/F	g I-TEQ	6.1	7.0	6.2	6.1	6.2	7.2	7.2	6.8	6.0	6.4
Benzo(b)fluoranthene	kg	66.4	70.5	69.0	66.5	68.4	61.5	78.0	79.0	67.8	62.1
Benzo(k)fluoranthene	kg	53.4	55.6	55.9	53.6	55.1	46.1	62.7	64.6	54.9	48.3
Benzo(a)pyrene	kg	54.8	57.7	57.2	55.0	56.5	49.4	64.4	65.7	56.1	50.6
Indeno(1.2.3-cd)pyrene	kg	80.5	84.2	84.2	80.8	83.1	70.7	94.7	97.1	82.6	73.5
PCBs	g	17.9	19.4	20.0	21.7	24.2	25.4	25.8	26.1	26.6	24.8

CO2 CH4 N2O

Figure 2.1 shows the time series (1990-2011) for greenhouse gas emissions from the waste sectors of this report.

In addition to emissions of CH_4 and N_2O, CO and NH_3 emissions are increasing quite drastically throughout the time series.

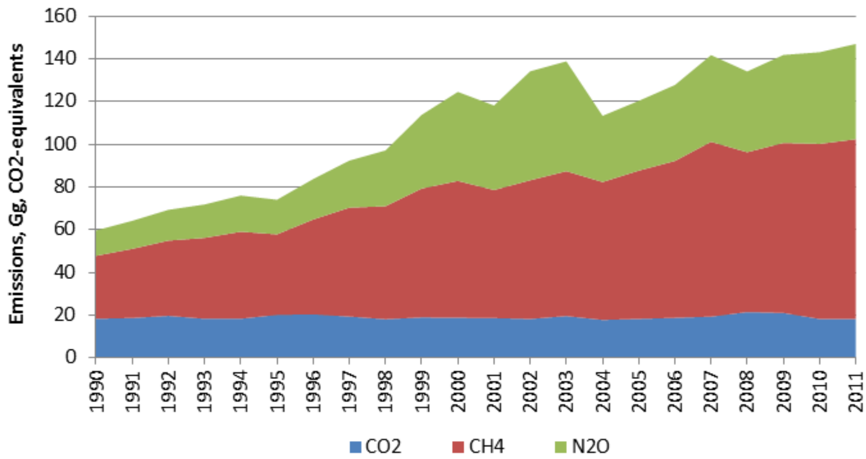

Figure 2.1 Total emissions of CO_2 equivalents in Gg for the three greenhouse gases.

The trend for the total greenhouse gas (GHG) emission 1990 - 2011 from this sector is increasing; compared to 1990 the 2010 and 2011 emissions have increased with 246 % and 240 % respectively. This increase is almost entirely caused by the increase in compost production as this activity is the largest contributor to GHG emissions and has risen with 321 % from 1990 to 2011.

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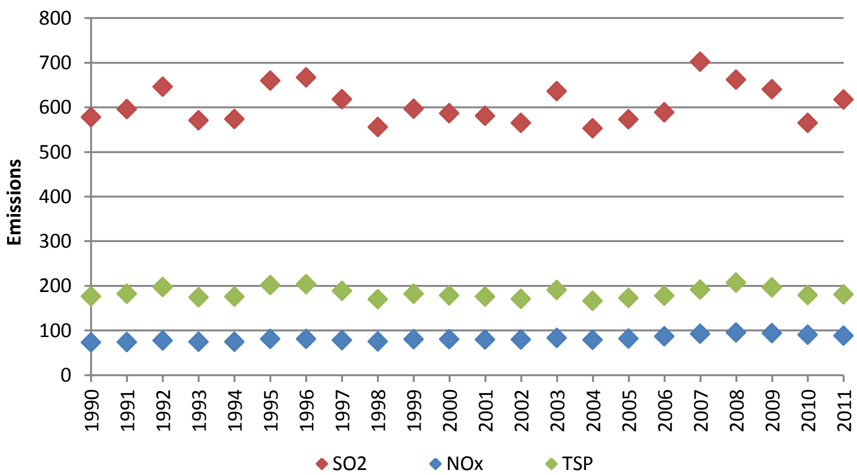

Figure 2.2 Total emissions of SO_2, NO_x and TSP.

The trend of these three pollutants show fluctuations but are otherwise constant.

3 Methodology

The CRF/NFR code system divides the source categories of this sector report in two sections; waste incineration and other waste. In Denmark, incineration of municipal, industrial, clinical and hazardous waste takes place with energy recovery, therefore the emissions are included in the sector report for energy (CRF/NFR 1A). Flaring off-shore and in refineries are included in the sector report of fugitive emissions (CRF/NFR 1B2c). No flaring in chemical industry occurs in Denmark. Waste incineration therefore only includes cremation of human corpses and animal carcasses.

The “other waste” category is a catch all for the waste sector. Emissions in this category could stem from compost production, accidental fires, biogas production, sludge spreading and other combustion without energy recovery.

3.1 Human cremation

The incineration of human corpses is a common practice that is performed on an increasing part of the deceased. All Danish crematoria use optimised and controlled cremation facilities, with temperatures reaching 800-850 °C, secondary combustion chambers, controlled combustion air flow and regulations for coffin materials.

However, the emissions of especially Hg caused by cremations can still contribute to a considerable part of the total national emissions. In addition to the most frequently discussed emissions of Hg and PCDD/Fs (dioxins and furans), are the emissions of compounds like SO_2, NO_x, NMVOC, CH_4, CO, N_2O, other heavy metals (As, Cd, Cr, Cu, Ni, Pb, Se, Zn), particulate matter, HCB, PAHs and PCBs.

Crematoria are usually located within cities, close to residential areas and normally, their stacks are relatively low. Therefore environmental and human exposure is likely to occur as a result of emissions from cremation facilities.

During the 1990es all Danish crematoria were rebuilt to meet new standards. This included installation of secondary combustion chambers and in most cases, replacement of old primary combustion chambers (Schleicher et al., 2001). All Danish crematoria are therefore performing controlled incinerations with a good burn-out of the gases, and a low emission of pollutants.

Following the development of new technology, the emission limit values for crematoria were lowered again in January 2011. These new standards were originally expected from January 2009 but were postponed two years for existing crematoria.

Table 3.1 shows a comparison of the emission limit values from February 1993 and the new standard limits.

Table 3.1 Emission limit values mg per Nm^3 at 11 % O_2 (Schleicher & Gram, 2008).

Component	Report 2/1993	Standards (1/2011)
	Emission limit value mg per normal m^3 at 11 % O_2	
Total dust	80	10
CO	50	50
CO_2	500	500
Hg	No demands	0.1
Other demands:		
Stack height	3 m above rooftop	3 m above rooftop
Temperature in stack	Minimum 150 °C	Minimum 110 °C
Flue gas flow in stack	8 – 20 m/s	No demands
Temperature in after burner	850 °C	800 °C
Residence time in after burner	2 seconds	2 seconds
Odour	The crematorium must not cause noticeable odour in the surroundings	The crematory must not cause odour nuisance outside the crematory perimeter that is significant ac-cording to the supervisory authority

To meet the new standards, some crematoria have been rebuilt to larger capacity while others are closed (MILIKI, 2006). In 2011, there were 28 operating crematoria in Denmark, some with multiple furnaces (DKL, 2012).

Crematoria that are not closed are equipped with flue gas cleaning (bag filters with activated carbon). The use of air pollution control devices, and activated carbon, for the removal of Hg will also reduce the flue gas concentration of dioxins, PAHs and odour. Existing knowledge on the reduction efficiencies justifies that no emission limits are necessary (Schleicher & Gram, 2008).

Around half of the Danish crematoria are currently connected to the district heating system and in addition, a few crematoria produce heat for use in their own buildings. The bag filter cleaning system requires that the flue gas is cooled down to 125-150 °C, and the cheapest way to do so is to use the surplus heat in the district heating system (DKL, 2009). The heat contribution from crematoria is negligible compared to the total district heat production and is not part of the Danish energy statistics.

3.2 Animal cremation

The incineration of animal carcasses in animal crematoria follows much the same procedure as human cremation. Animal crematoria use similar two chambered furnaces and controlled incineration. However, animal carcasses are incinerated in special designed plastic (PE) bags rather than coffins. Emissions from animal cremation are similar to those from human cremation, with the exception of Hg which mainly stems from amalgam tooth fillings.

Animal cremations are performed in two ways, individually where the owner often pays for receiving the ashes in an urn or collectively which is most often the case with animal carcasses that are left at the veterinarian.

Open burning of animal carcasses is illegal in Denmark and is not occurring, and small-scale incinerators are not known to be used at Danish farms. Livestock that is diseased or in other ways unfit for consumption is disposed of through rendering plants. Incineration of livestock carcasses is illegal and these carcasses are therefore commonly used in the production of fat and soap at Daka Bio-industries.

The only animal carcasses that are approved for cremation in Denmark are deceased pets and animals used for experimental purposes, where the incineration must take place at a specialised animal crematorium. There are four animal crematoria in Denmark but one of these is situated at a waste incineration company in northern Jutland called AVV. The specially designed cremation furnaces are at this location connected to the flue gas cleaning equipment of the municipal waste incineration plant with energy recovery and the emission from the cremations are therefore included in the annual inventory from AVV. Consequently this crematorium is included under the energy sector and not in this report. Therefore only three animal crematoria are included in this sector report.

Animal by-products are regulated under the EU commission regulation no. 142/2011. This states that animal crematoria must be approved by the authority and comply either with the EU directive (2000/76/EC) on waste incineration or with Regulation (EC) No. 1069/2009. (EC, 2011)

The incineration of animal carcasses is, as the incineration of human corpses, performed in special incineration chambers. All Danish animal crematoria have primary combustion chambers with temperatures around 850 ºC and secondary combustion chambers with temperatures around 1100 ºC. The support fuel used at the Danish facilities is natural gas.

Emissions from animal cremations are calculated for *SO_2*, *NO_x*, NMVOC, *CH_4*, *CO*, *N_2O*, NH_3, particulate matter, heavy metals (*As*, Cd, Cr, Cu, Ni, Pb, *Se*, Zn), *HCB*, PCDD/F, *PAHs* and *PCBs*. For half of these pollutants (italic type) emissions are estimated by using the same emission factors as for human cremation.

3.3 Composting

This section covers the biological treatment of solid waste called composting. Pollutants that are emitted from this process are CH_4, CO, N_2O and NH_3.

Emissions from composting have been calculated according to a country specific Tier 1 method. However, a Tier 1 default methodological guidance is available in the 2006 IPCC Guidelines (IPCC, 2006).

In Denmark, composting of solid biological waste includes composting of:

- garden and park waste (GPW),
- organic waste from households and other sources,
- sludge,
- home composting of garden and vegetable food waste.

In 2001, 123 composting facilities treated only garden and park waste (type 2 facilities), nine facilities treated organic waste mixed with GPW or other organic waste (type 1 facilities) and 10 facilities treated GPW mixed with sludge and/or “other organic waste” (type 3 facilities). 92 % of these facilities consisted entirely of windrow composting, which is a simple technology composting method with access to only natural air. It is assumed that all facilities can be considered as using windrow composting. (Petersen & Hansen, 2003)

Composting is performed with simple technology in Denmark; this implies that temperature, moisture and aeration are not consistently controlled or regulated. Temperature is measured but not controlled, moisture is regulated by watering the windrows in respect to weather conditions and aeration is assisted by turning the windrows. (Petersen & Hansen, 2003)

During composting a large fraction of the degradable organic carbon (DOC) in the waste material is converted into CO_2 and CO. Even though the windrows are occasionally turned to support aeration, anaerobic sections are inevitable and will cause emissions of CH_4. In the same manner, aerobic biological digestion of N leads to emission of N_2O and NO_X, while the anaerobic decomposition leads to emission of NH_3.

3.4 Accidental building fires

Emissions from accidental fires are categorised under CRF/NFR category 6D Other Waste. Pollutants that are emitted from building fires include SO_2, NO_x, NMVOC, CH_4, CO, CO_2, heavy metals (As, Cd, Cr, Cu, Hg, Pb), particulate matter, PCDD/F and PAHs.

Emissions from building fires are calculated by multiplying the number of building fires with selected emission factors. Six types of buildings are distinguished with different emission factors: detached houses, undetached houses, apartment buildings, industrial buildings, additional buildings and containers.

3.5 Accidental vehicle fires

Pollutants that are emitted from accidental vehicle fires include SO_2, NO_x, NMVOC, CH_4, CO, CO_2, particulate matter, heavy metals (As, Cd, Cr, Cu, Ni, Pb, Zn), PCDD/F and PAHs.

Emissions from vehicle fires are calculated by multiplying the mass of vehicle fires with selected emission factors. Emission factors are not available for different vehicle types, whereas it is assumed that all the different vehicle types leads to similar emissions. The activity data are calculated as an annual combusted mass by multiplying the number of different full scale vehicle fires with the Danish registered average weight of the given vehicle type.

3.6 Combustion at biogas production plants

The source sector 6.D. Other Waste also covers emissions from combustion of biogas in biogas production plants (mentioned as Gasification of biogas in the CRF tables) for the years 1994-2005 where these emissions existed. This activity is not occurring in 2006 - 2011. Pollutants from this activity are SO_2, NO_x, NMVOC, CH_4, CO, N_2O, particulate matter and PCDD/F.

3.7 Biogas production

Emissions from biogas production are divided and reported in different sectors according to waste type and method.

Emissions from the combustion of biogas regardless of the origin are included in the energy sector and are allocated to the appropriate subsector in the Danish energy statistics.

In the agricultural sector the reduced emissions of CH_4 and N_2O from gasification of manure are included.

Fugitive emissions of CH_4 and N_2O from anaerobic digestion of sludge from wastewater treatment are covered by the CRF/NFR source category 6B Wastewater Handling and are not part of this sector report.

Biogas production in this sector only covers fugitive emissions from the handling of biological waste, sludge and manure. This includes activities like storage, pre- and post-treatment during which anaerobic conditions may occur, and fugitive emissions from the anaerobic digestion that is the actual production. However, emissions from these activities are not currently included in the inventory.

3.8 Sludge spreading

Sludge from wastewater treatment plants is only spread out in the open with the purpose of fertilising crop fields. Emissions that derive from this activity are covered in the agricultural sector, and are not part of this report.

3.9 Other

Other combustion sources include open burning of yard waste and bonfires.

Due to the cold and wet climatic conditions in Denmark wild fires very seldom occur. Controlled field burnings and the occasional wild fires are categorised under the sectors Agriculture and Land Use, Land Use Change and Forestry (LULUCF) respectively.

In Denmark, the open burning of private yard waste is under different restrictions according to the respective municipality. These restrictions involve what can be burned but also the quantity, and how, when and where, or in some cases a complete ban is imposed. The burning of yard waste is not allowed within urban areas (DEPA, 2011b). There is no registration of private waste burning and the activity data on this subject are very difficult to estimate. Citizens are generally encouraged to compost their yard waste or to dispose of it through one of the many waste disposal/recycling sites.

The occurrence of bonfires at midsummer night and in general are likewise not registered, therefore it has not been possible to obtain activity data and consequently, bonfires are not included in this inventory.

4 Activity data

The following sections deals with the activity data for every contributing source category in the waste incineration and other waste sectors.

4.1 Human cremation

Table 4.1 shows the time series of total number of deceased persons (Statistics Denmark, 2012), number of cremations and the fraction of cremations in relation to the total number of deceased (DKL, 2012). Annex 2, Table A2.1 presents data for the entire time series 1980-2011.

Table 4.1 Data on human cremations, DKL (2012), Statistics Denmark (2012).

Year	1990	1995	2000	2005	2006	2007	2008	2009	2010	2011
Deceased	60926	63127	57998	54962	55477	55604	54591	54872	54368	52516
Cremations	40991	43847	41651	40758	41233	41766	41788	42408	42050	41248
Cremation fraction, %	67.3	69.5	71.8	74.2	74.3	75.1	76.6	77.3	77.3	78.6

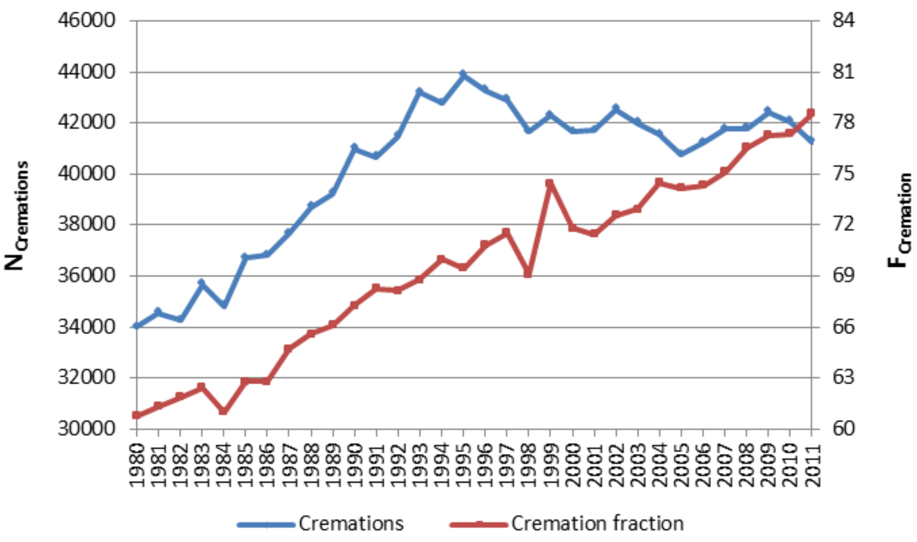

Figure 4.1 Illustration of the development in cremations (DKL 2012), where the number of cremations, $N_{cremations}$, is shown at the left Y-axis. The cremation percentage, $F_{cremations}$, shows the percentage of cremated deceased of the total number of deceased for the years 1984 to 2011. Data for 1980-1983 are estimated values, for details on the estimation, see Annex 2.

Even though the total number of annual cremations is fluctuating, the cremation percentage has been steadily increasing since 1984, and is likely to continue to increase.

The average body weight is assumed to be 65 kg. (EEA, 2009).

Figure **4.2** presents the trend of the number of deceased persons together with the activity data for human cremation. The figure shows a direct connection between the number of deceased and the activity of human cremation as the two trends are quite similar.

Figure **4.2** also shows the effect of the increasing fraction of cremations per deceased, as the number of cremations is not decreasing along with the number of deceased. The cremation fraction has increased from 67 % in 1990 to 79 % in 2011; the trend of this fraction is shown in Figure 4.1.

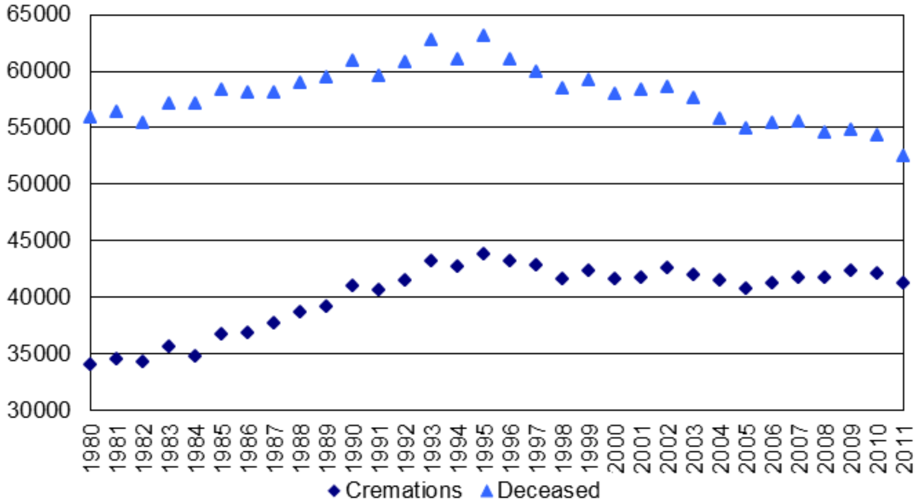

Figure 4.2 Trends of the activity data for cremation of human corpses and the number of deceased persons.

4.2 Animal cremation

Activity data for animal cremation are gathered directly from the animal crematoria. There is no national statistics available on the activity from these facilities. The precision of activity data therefore depends on the information provided by the crematoria.

Table 4.2 lists the four Danish animal crematoria, their foundation year and provides each crematorium with an id letter.

Table 4.2 Animal crematoria I Denmark.

Id	Name of crematorium	Founded in
A	Dansk Dyrekremering ApS	May 2006
B	Ada's Kæledyrskrematorium ApS	Early 1980es
C	Kæledyrskrematoriet	2006
D	Kæledyrskrematoriet v. Modtagestation Vendsyssel I/S	-

Crematoria D is situated at the AVV municipal waste incineration site and the emissions from this site are, as previously mentioned, included in the annual emission reporting from AVV and consequently included in the energy sector as waste incineration with energy recovery. Therefore, only crematoria A-C are considered in this chapter.

Table 4.3 lists the activity data for animal crematoria A-C. The entire dataset for 1980-2011 is available in Annex 2, Table A2.2.

Table 4.3 Activity data. Source: direct contact with all Danish crematoria.

	1990	1995	2000	2005	2006	2007	2008	2009	2010	2011
Total, Mg	150	200	443	762	1116	1284	1338	1339	1449	1219

Crematorium B delivered exact annual activity data for the years 1998-2011. They were not certain about the founding year but believe to have existed since the early 1980es. It is assumed that crematorium B was founded at January 1st 1980 and activity data for 1980-1997 must therefore be estimated.

Statistical data describing the national consumption for pets including food and equipment for pets were evaluated as surrogate data. These statistical data show an increase of consumption of 6 % from 1998 to 2000, in the same period the amount of cremated animal carcasses increased with 89 % and no correlation seems to be present. Since there are no other available data on the subject of pets, it is concluded that there are no surrogate data available.

It is not possible to extrapolate data linearly back to 1980 because the activity, due to the steep increase, in this case would become negative from 1993 and back in time.

The activity data for animal cremation for the period of 1980-1997 are estimated by expert judgement.

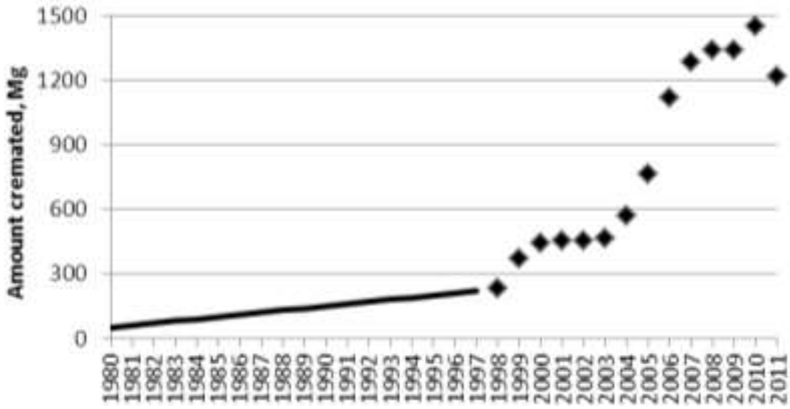

Figure 4.3 The amount of animal carcasses cremated, in Mg. Data from 1998-2011 are delivered by the crematoria and is considered to be exact; these data are marked as points. Data from 1980-1997 are estimated and are shown as the thick line in the figure.

4.3 Composting

All Danish waste treatment plants are obligated to statutory registration and reporting of all waste entering and leaving the plants. All waste streams are weighed, categorised with a waste type and a type of treatment and registered to the ISAG waste information system, which contain data for 1995-2009 (ISAG, 2010). The new waste data system that was supposed to replace ISAG in 2010 is not yet functioning; activity data for 2010-2011 has therefore been estimated by extrapolation.

Figure 4.4 illustrates the composted amount of waste divided in the four categories mentioned earlier.

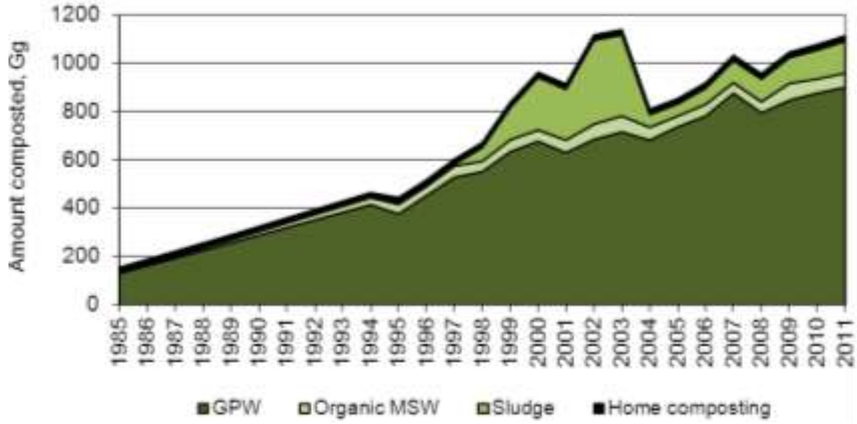

Figure 4.4 Amount of composted waste divided in garden and park waste (GPW), organic municipal solid waste (MSW), sludge and home composting of garden and food waste, these data are also shown in Table 4.4.

Activity data for the years 1995-2009 are collected from the ISAG database for the categories: "sludge", "organic waste from households and other sources" and "garden and park waste". Activities for 2010-2011 are calculated by using the trend from earlier years.

The Danish legislation on sludge (DEPA, 2006b) was implemented in the summer of 2003. This stated that composted sludge may only be used as a fertilizer on areas not intended for growing foods of any kind for at least 2-3 years. This restriction caused the amount of composted sludge to drop drastically from 2003 to 2004.

The trend in composting of sludge does not demonstrate a convincing trend that can be used for estimation of activity data for previous years. Since this activity is insignificant for 1995-1997 (1-2 %) it is assumed to be "not occurring" for 1985-1994.

The amount of organic waste from households composted in the years 1985-1994 is estimated by multiplying the number of facilities treating this type of waste with the average amount composted per facility in the years 1995-2001 (2.6-3.8 Gg per facility per year). The following Table 4.4 shows the number of composting sites divided in the three types described in Chapter 3.3 (Petersen, 2001 and Petersen & Hansen, 2003).

Table 4.4 Number of composting facilities in the years 1985-2001.

Facility type	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
Type 1	2	2	3	3	4	5	6	7	8	9
Type 2	6	10	14	18	22	38	54	70	86	102
Type 3	0	0	0	0	0	1	2	2	3	4
Total	8	12	17	21	26	44	62	79	97	115

Continued

Facility type	1995	1996	1997	1998	1999	2000	2001
Type 1	13	14	13	14	13	11	9
Type 2	113	108	99	102	111	115	123
Type 3	9	9	11	10	10	7	10
Total	136	133	126	130	139	138	149

Type 1 waste treatment sites normally includes biogas producing facilities, but these are not included in this table.

The ISAG activity data for composting of garden and park waste (GPW) include wood chipping. Compost data for GPW provided by Petersen (2001) and Petersen & Hansen (2003) show that for 1997-2001, wood chipping accounts for about 3 % of the total chosen ISAG activity data for GPW. Activity data for GPW for the years 1985-1994 and 2010-2011 are estimated by extrapolating the trend.

The last waste category involved in composting is home composting of garden waste and vegetable waste. The activity data for this category are known from Petersen & Kielland (2003) to be 21.4 Gg in 2001. It is assumed that the following estimates made by Petersen & Kielland (2003) are valid for all years 1985-2011.

- 28 % of all residential buildings with private gardens (including summer cottages) are actively contributing to home composting.
- 14 % of all multi-dwelling houses are actively contributing to home composting.
- 50 kg waste per year will on average be composted at every contributing residential building.
- 10 kg waste per year will on average be composted at every contributing multi-dwelling house.

Multi-dwelling houses include apartment buildings, it is very un-common for people in these types of buildings to compost their bio waste and the average amount of composted waste is therefore lower in spite of the higher number of residents. The total number of occupied residential buildings, summer cottages and multi-dwelling houses are found at the Statistics Denmark's website.

The calculated activity data for home composting of garden and vegetable waste are shown in Table 4.5 and Annex 2 Table A2.3.

Table 4.5 Activity data composting, Gg.

	1990	1995	2000	2005	2006	2007	2008	2009	2010	2011
Composting of garden and park waste	288	376	677	737	782	876	795	847	877	901
Composting of organic waste from households and other sources	16	40	47	45	48	44	46	70	58	59
Composting of sludge	NO	7	218	50	67	91	94	107	120	132
Home composting of garden and vegetable food waste	20	21	21	22	22	22	22	23	23	23
Total	324	444	963	854	919	1033	957	1047	1078	1114

NO = Not occurring.

A new waste database is being developed by the Danish Environmental Protection Agency and should be ready during 2013. This new database will provide activity data for composting for the year 2012 and onwards. In spite of the data inconsistency that this will cause, data for the recent years which are presently estimated, will improve. Inconsistencies between the new reporting system and the old ISAG will be handled.

4.4 Accidental building fires

In January 2005 it became mandatory for the local authorities to register every rescue assignment in the online data registration- and reporting system called ODIN, ODIN is developed and run by the Danish Emergency Management Agency (DEMA, 2007).

Activity data for accidental building fires are given by ODIN (DEMA, 2012). Fires are classified in four categories: full, large, medium and small. The emission factors comply for full scale fires and the activity data are therefore recalculated as a full scale equivalent where it is assumed that a full, large, medium and a small scale fire leads to 100 %, 75 %, 30 % and 5 % of a full scale fire respectively.

In practice, a full scale fire is defined as a fire where more than three fire hoses were needed for extinguishing the fire, a full scale fire is considered as a complete burnout. A large fire is in this context defined as a fire that involves the use of two or three fire hoses for fire extinguishing and is assumed to typically involve the majority of a house, an apartment, or at least part of an industrial complex. A medium size fire is in this context defined as a fire involving the use of only one fire hose for fire-fighting and will typically involve a part of a single room in an apartment or house. And a small size fire is in this context defined as a fire that was extinguished before the arrival of the fire service, extinguished by small tools or a chimney fire.

The total number of registered fires is known for the years 1989-2011. For the years 2007-2011 the total number of registered building fires is known with a very high degree of detail.

Table 4.6 shows the occurrence of all types of fires (registered for 1989-2011) and the occurrence of building fires (2007-2011) registered at DEMA. The 1980-1988 data for all fires are estimated to be the average of 1989-2010 data. In 2007-2010 the average per cent of building fires, in relation to all fires, was 60 %. The total numbers of building fires 1980-2006 are calculated using this percentage. The full time series is presented in Annex 2, Table A2.4.

Table 4.6 Occurrence of all fires and building fires.

	1990	1995	2000	2005	2006	2007	2008	2009	2010	2011
All fires	17025	19543	17174	16551	16965	18263	20643	18930	16728	16157
Building fires	10187	11694	10276	9903	10151	12527	12124	10652	9325	11447

The building fires that occurred in the years 2007-2011 are subcategorised into six building types; detached houses, undetached houses, apartment buildings, industrial buildings, additional buildings and container fires.

Table 4.7 states the registered activity data for building fires for the years 2007-2010, divided in both damage size and building type. The calculated averages describes the average share of building fires from 2007-2010 of a certain type and size, in relation to all building fires in the same four years period.

Table 4.7 Registered occurrence of building fires (DEMA).

	Size	Detached	Undetached	Apartment	Industry	Additional	Container	All building fires
	full	263	32	24	65	35	11	430
	large	446	112	107	155	358	162	1340
	medium	553	193	601	255	373	1484	3459
	small	1385	394	1260	464	277	316	4096
2010	all	2647	731	1992	939	1043	1973	9325
	full	270	47	35	81	52	8	493
	large	497	111	145	191	355	203	1502
	medium	574	193	654	299	447	2046	4213
	small	1212	393	1464	610	276	489	4444
2009	all	2553	744	2298	1181	1130	2746	10652
	full	312	71	34	82	73	18	590
	large	419	130	119	190	329	239	1426
	medium	638	294	783	312	557	2469	5053
	small	1375	419	1500	566	713	482	5055
2008	all	2744	914	2436	1150	1672	3208	12124
	full	239	77	47	100	39	43	545
	large	391	156	108	218	307	257	1437
	medium	550	379	697	445	550	2300	4921
	small	1189	700	1367	758	967	643	5624
2007	all	2369	1312	2219	1521	1863	3243	12527
	full	2.46	0.50	0.31	0.73	0.44	0.17	4.61
	large	4.01	1.14	1.09	1.69	3.08	1.92	12.93
	medium	5.24	2.33	6.15	2.92	4.30	18.46	39.40
	small	11.77	4.24	12.64	5.36	4.79	4.27	43.06
Average, %	all	23.47	8.21	20.19	10.70	12.61	24.82	100.00

It is assumed that the average percentages provided by the years 2007-2010 shown in Table 4.7 are compliable for the years 1980-2006. Hereby, similar activity data for building fires can be estimated back to 1980.

By applying the damage rates of 100 %, 75 %, 30 % and 5 % corresponding to the damage sizes full, large, medium and small, a full scale equivalent can be determined. Table 4.8 shows the calculated full scale equivalents (FSE). The full time series is shown in Annex 2, Table A2.5.

Table 4.8 Accidental building fires full scale equivalent activity data.

	1990	1995	2000	2005	2006	2007	2008	2009	2010	2011
Container fires	750	861	756	729	747	958	962	799	594	729
Detached house fires	777	892	784	755	774	757	886	876	833	818
Undetached house fires	231	265	233	224	230	343	278	208	194	206
Apartment building fires	367	421	370	357	366	405	433	413	348	362
Industry building fire	320	368	323	311	319	435	346	344	281	334
Additional building fires	437	501	440	424	435	483	523	466	429	740

4.5 Accidental vehicle fires

As with accidental building fires, data for accidental vehicle fires are available through the Danish Emergency Management Agency (DEMA). DEMA provides very detailed data for 2007-2011; the remaining years back to 1980 are estimated by using surrogate data.

Table 4.9 shows the occurrence of fires in general and vehicle fires registered at DEMA. In 2007-2010 the average per cent of vehicle fires, in relation to all fires, was 20 %. The total numbers of vehicle fires in 1980-2006 are calculated using this percentage. The full time series is presented in Annex 2, Table A2.4.

Table 4.9 Occurrence of all fires and vehicle fires.

	1990	1995	2000	2005	2006	2007	2008	2009	2010	2011
All fires	17025	19543	17174	16551	16965	18263	20643	18930	16728	16157
Vehicle fires	3354	3850	3383	3260	3342	3223	4068	3930	3459	3255

There are fourteen different vehicle categories. The activity data are categorised in passenger cars (lighter than 3500 kg), buses, light duty vehicles (vans and motor homes), heavy duty vehicles (trucks and tankers), motorcycles/mopeds, other transport, caravans, trains, boats, airplanes, bicycles, tractors, combine harvesters and machines.

In the same manner as accidental building fires, the 2007-2011 data from DEMA can be divided in four categories according to damage size. It is assumed that a full scale fire is a complete burnout of the given vehicle, and that a large, medium and small scale fire corresponds to 75 %, 30 % and 5 % of a full scale fire respectively. The total number of full scale equivalent (FSE) fires can be calculated for each of the fourteen vehicle categories for 2007-2011.

The total number of registered vehicles is known from Jensen et al. (2012) and Statistics Denmark (2012). By assuming that the share of vehicle fires in relation to the total number of registered vehicles, of every category respectively, can be counted as constant, the number of vehicle fires is estimated for the years 1980-2006. The numbers of registered vehicles from 1980 to 1984 are extrapolated based on the years 1985 to 1989, where a clear trend has been visible this trend has been extrapolated (e.g. passenger cars), otherwise the average value of 1985 to 1989 has been used (e.g. buses).

Table 4.10 states the total number of national registered vehicles and the number of full scale equivalent vehicle fires. The full time series 1980-2011 is shown in Annex 2, Table A2.6a-c.

Table 4.10 Number of nationally registered vehicles and full scale equivalent vehicle fires.

	Passenger Cars		Buses		Light Duty Vehicles		Heavy Duty Vehicles	
	Registered	FSE fires	Registered	FSE fires	Registered	FSE fires	Registered	FSE fires
1990	1645587	479	8109	12	192321	19	45664	58
1995	1733405	504	14371	21	228076	22	48077	61
2000	1916686	558	15051	22	272387	27	50227	64
2005	2012399	586	15131	22	372674	36	49311	63
2006	2064005	601	15180	22	414454	40	50691	64
2007	2151344	518	15013	16	402464	19	51758	46
2008	2187294	666	14854	24	398718	44	50606	71
2009	2201821	729	14794	23	373694	48	46585	67
2010	2247021	646	14577	23	362389	38	44812	60
2011	2282304	584	13915	13	343372	43	43639	54

Continued

	Motorcycles/Mopeds		Caravans		Train		Boat	
	Registered	FSE fires	Registered	FSE fires	Registered	FSE fires	Registered	FSE fires
1990	163133	58	86257	24	7156	9	2324	26
1995	165272	58	95831	26	6854	8	1911	21
2000	233309	82	106935	29	4907	6	1759	19
2005	273904	97	121350	33	3195	4	1792	20
2006	287366	102	126011	35	3002	4	1789	20
2007	302475	99	131708	36	2617	2	1755	20
2008	308538	122	136905	45	2588	3	1728	20
2009	307335	128	140366	34	2489	5	1742	22
2010	301562	83	142354	37	2740	2	1773	16
2011	295488	91	142764	34	2943	3	1768	21

Continued

	Airplane		Tractor		Combined Harvester		Bicycle	Other Transport	Machine
	Registered	FSE fires	Registered	FSE fires	Registered	FSE fires	FSE fires	FSE fires	FSE fires
1990	1055	1	135980	82	35118	57	NAV	NAV	NAV
1995	1058	1	134277	81	29291	47	NAV	NAV	NAV
2000	1070	1	115692	70	24128	39	NAV	NAV	NAV
2005	1073	1	107867	65	21436	35	NAV	NAV	NAV
2006	1039	1	105865	64	20976	34	NAV	NAV	NAV
2007	1058	1	106025	52	20507	19	2	85	75
2008	1077	1	106025	62	20046	34	4	97	135
2009	1122	1	106025	64	19584	43	3	93	111
2010	1152	1	106025	77	19354	32	4	58	94
2011	1132	0	106025	59	19354	21	3	50	111

The average weights of a passenger car, bus, light commercial vehicle, truck and motorcycle/moped are known for every year back to 1993 (Statistics Denmark, 2012). The corresponding weights from 1980 to 1992 and the average weight of the units from the remaining categories are estimated by an expert judgment; see Table 4.11 and Annex 2, Table A2.7.

Table 4.11 Average weight of different vehicle categories, kg.

	Cars	Buses	Vans	Trucks	Motorcycles/ Mopeds
1990	850	10000	2000	15000	80
1995	923	10807	2492	14801	107
2000	999	11195	3103	15214	107
2005	1068	11560	3793	13258	111
2006	1086	11684	4120	13179	113
2007	1105	11753	4505	13268	114
2008	1122	11700	4710	13246	116
2009	1134	11642	4682	12802	116
2010	1144	11804	4498	11883	117
2011	1154	11907	4296	11291	118

It is assumed that the average weight of a boat equals that of a bus. That tractors and vans weigh the same and that trains, airplanes and combine harvesters have the same average weight as trucks.

Bicycles, machines and other transport can only be calculated for the years 2007-2011 due to the lack of surrogate data (number of nationally registered vehicles). The average weight of a bicycle, caravan, machine and other transport is estimated as 12 kg, 90 % of a car, 50 % of a car and 40 % of a car respectively.

By multiplying the number of full scale fires with the average weight of the vehicles respectively, the total amount of combusted vehicle mass can be calculated. The result is shown in Table 4.12 and in Annex 2, Table A2.8a-d.

Table 4.12 Burnt mass of different vehicle categories, Mg.

	1990	1995	2000	2005	2006	2007	2008	2009	2010	2011
Passenger cars	407	466	557	626	652	572	748	827	739	674
Buses	116	223	242	251	255	182	283	264	266	160
Light duty vehicles	37	55	82	138	166	86	207	223	171	185
Heavy duty vehicles	869	903	969	829	847	608	936	863	715	606
Motorcycle, moped	5	6	9	11	11	11	14	15	10	11
Other transport	-	-	-	-	-	47	54	53	33	29
Caravan	18	22	26	32	34	36	45	34	38	35
Train	128	121	89	51	47	33	39	63	24	28
Boat	257	228	218	229	231	234	230	253	189	249
Airplane	12	11	12	10	10	8	13	13	7	3
Bicycle	-	-	-	-	-	0	0	0	0	0
Tractor	164	201	216	246	263	235	290	301	347	254
Combine harvester	854	702	595	460	448	255	450	552	378	242
Machine	-	-	-	-	-	33	61	50	43	51
Total	2866	2939	3015	2883	2965	2339	3371	3512	2960	2526

4.1 Combustion at biogas production plants

Activity data for this source category are collected from the energy statistics (DEA, 2012). Combustion of biogas in biogas production plants occurred for the years 1994-2005[1].

[1] Activity data for combustion of biogas is in need of an updating, this will be done as soon as the energy statistics for 2013 is available.

Table 4.13 Combusted biogas.

	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
GJ	857	4711	4503	4447	35416	43688	40990	27270	30567	35544	28744	22034

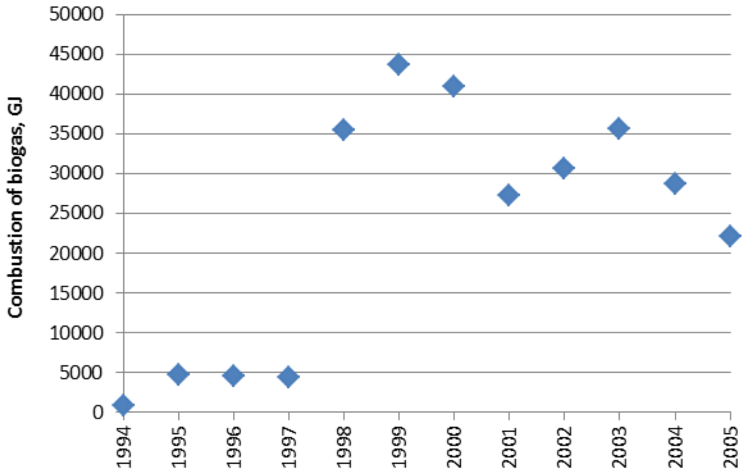

Figure 4.5 Combusted biogas at biogas production plants.

5 Emission factors

The following sections deals with the emission factors for every contributing source category in the waste incineration and other waste sectors.

5.1 Human cremation

For human cremation, emissions are calculated by multiplying the total number of human cremations by the emission factors. Since there are no continuous measurements available of the annual emission from Danish crematoria, the estimation of emissions is based on emission factors from literature.

A literature search has provided the emission factors shown in Table 5.1. Selected emission factors are valid for countries that are comparable with Denmark. By comparable is meant countries that use similar incineration processes, similar cremation techniques including support fuel and have a similar composition of sources to lifetime exposure, lifetimes and coffins.

Table 5.1 lists the emission factors for 2011 and their respective references. As mentioned earlier, 2011 is year one after installation of bag filters with activated carbon at all Danish crematoria, causing the emission factors for TSP, PM_{10}, $PM_{2.5}$, As, Cd, Cr, Cu, Hg, Ni, Pb, Se, Zn and PCDD/Fs to decrease quite drastically. See Annex 3, Table A3.1 for emission factors on human cremation prior to the installation of flue gas filters.

Table 5.1 Emission factors for human cremation with references.

Pollutant name	Unit	Emission factor	Reference
SO_2	kg/body	0.113	Santarsiero et al., 2005
NO_X	kg/body	0.825	Santarsiero et al., 2005
NMVOC	kg/body	0.013	EEA, 2007
CH_4	kg/body	0.012	Aasestad, 2008
CO	kg/body	0.010	Schleicher et al., 2001
N_2O	kg/body	0.015	Aasestad, 2008
TSP	g/body	0.39	Webfire, 2012
PM_{10}	g/body	0.35	Webfire, 2012
$PM_{2.5}$	g/body	0.35	Webfire, 2012
As	mg/body	0.27	Webfire, 2012
Cd	mg/body	0.10	Webfire, 2012
Cr	mg/body	0.27	Webfire, 2012
Cu	mg/body	0.25	Webfire, 2012
Hg	mg/body	11.2	Kriegbaum et al., 2005
Ni	mg/body	0.35	Webfire, 2012
Pb	mg/body	0.60	Webfire, 2012
Se	mg/body	0.40	Webfire, 2012
Zn	mg/body	3.20	Webfire, 2012
HCB	mg/body	0.152	Toda, 2006
PCDD/F	µg I-TEQ/body*	0.088	Schleicher et al., 2001
Benzo(b)flouranthene	µg/body	7.21	Webfire, 2012
Benzo(k)flouranthene	µg/body	6.44	Webfire, 2012
Benzo(a)pyrene	µg/body	13.20	Webfire, 2012
Indeno(1,2,3-c-d)pyrene	µg/body	6.99	Webfire, 2012
PCBs	mg/body	0.414	Toda, 2006

* I-TEQ: International Toxicity Equivalents.

The average body weight of cremated corpses is assumed to be 65 kg (EEA, 2009).

Flue gas cleaning efficiencies are based on measurements performed at Danish crematoria and expert judgements, and are 75 % for PCDD/Fs, 99 % for particulate matter and Hg and 98 % for other heavy metals. These abatement efficiencies are implemented from 2011.

There are several data sources available for each of the compounds SO_2, NO_x, NMVOC and CO; two of these are guidebooks (EEA 2007 and 2009)[2]. There is good agreement between the different sources.

SO_2 emission factors in literature vary from 0.02 kg (Aasestad et al., 2008) to 0.54 kg (EEA, 2007) per cremation, with an average of 0.15 kg per cremation. Santarsiero et al. (2005) is considered the most reliable with an emission factor for SO_2 of 0.113 kg per cremation. Santarsiero et al. (2005) provide experimental data in the unit of mass pollutant per volume air in the flue gas (Santarsiero et al., 2005, Table 4, p. 315) Emission factors are calculated from the average of the measured ranges of concentrations, the average rate of pollution emission (2000-3500 Nm^3 per h) and the cremation duration (2 h).

NO_x emission factors from literature vary from 0.04 kg (Aasestad et al., 2008) to 1.18 kg (Fontelle et al., 2012) per cremation, with an average of 0.48 kg per cremation. Santarsiero et al. (2005) is considered the most reliable with an emission factor for NO_x of 0.825 kg per cremation.

NMVOC emission factors vary from 0.01 kg (NAEI, 2009) to 0.06 kg (Aasestad, 2012) per cremation, with an average of 0.03 kg per cremation. EEA (2007) is considered the best reliable with an emission factor for NMVOC of 0.013 kg per cremation.

CO emission factors from literature vary from 0.01 kg (Schleicher et al., 2001) to 0.74 kg (Aasestad et al., 2008) per cremation, with an average of 0.20 kg per cremation. Schleicher et al. (2001) is based on Danish measurements and is therefore considered the best available with an emission factor for CO of 0.010 kg per cremation.

For CH_4 and N_2O, Aasestad et al. (2012) is the only available source.

There are also several data sources to the emission factor of particulate matter. Emission factors for TSP from literature vary from 0.03 g (EEA, 2007) to 1.55 kg (Fontelle et al., 2012) per cremation, with an average of 0.27 kg per cremation. The Webfire database (2012) is considered the most reliable source; partly because it brings consistency in relation to the chosen heavy metal emission factors. The particle fractions of PM_{10} and $PM_{2.5}$ are both calculated from TSP, as it is assumed that PM_{10} and $PM_{2.5}$ are 90 % of the total TSP.

Mercury is one of the best documented pollutants from human cremation with 19 individual datasets found through this literature study. Hg emission factors vary from 0.20 g (Reindl, 2008) to 5.00 g (EEA, 2007) per cremation,

[2] There are a few discrepancies between the two references; EEA (2007) and EEA (2009).

with an average of 2.30 g per cremation. The emission factor of 1.49 g per cremation from Webfire (2012) is chosen for consistency purposes.

With a few exceptions EEA (2007) and Webfire (2012) are the only data sources to emission factors for heavy metals (excluding mercury). Emission factors provided by Webfire (2012) are about a factor 1000 higher than those from EEA (2007). The few other emission factor sources found in the literature study verifies the emission level from Webfire (2012). Webfire (2012) is therefore chosen for all heavy metals.

For the compounds benzo(b)flouranthene, benzo(k)flouranthene and indeno(1,2,3-c,d)pyrene it has not been possible to find any additional data to validate the emission factors from Webfire (2012). EEA (2007) provides an emission factor for benzo(a)pyrene that is a factor 1000 too low; Webfire (2012) is chosen as the source for all four PAHs.

In the case of PCBs and HCB Toda (2006) is considered the best reliable source of emission factors. BiPRO (2006) and NAEI (2012) provide additional information to the two pollutants respectively, and both are in relatively good compliance with Toda (2006).

19 individual data sources were found to the emission factor for dioxins/furans and these vary from 0.01 µg (Takeda et al., 2000) to 24.7 µg (NAEI, 2012) per cremation, with an average of 4.79 µg per cremation. Since emission factors preferably should be country specific, Danish estimated data are selected whenever available. Danish measurements of dioxin emissions from three furnaces in two different crematoria in 2001 showed concentration ranges of 0.2 – 0.7 ng I-TEQ per m^3 (n.t.10 % O_2) and emission factor in the range of 180 - 930 ng I-TEQ per cremation. The calculated average emission factor is 0.35 µg I-TEQ per cremation, and the average concentration is 0.3 ng I-TEQ per m^3 (n.t.10 %O_2). The measurements are assumed representative for all Danish crematory furnaces (Schleicher et al., 2001).

It has not been possible to find data for ammonia. Ammonia might appear in lesser amounts, but will most likely be converted to NO_X at the high incineration temperatures.

There might for some emission factors be included a small part of the support fuel (natural gas) if the measurements were taken early in the incineration process. This would then be a double counting since fuel for cremation is reported under NFR code 1A4a, commercial and institutional plants and hence included in the energy sector. However, this double counting is considered negligible.

5.2 Animal cremation

Concerning the incineration of animal carcasses in animal crematoria there is not much literature to be found. The EMEP/EEA Guidebook (EEA, 2009) is the only available source to emission factors for NMVOC, NH_3, TSP, PM_{10}, $PM_{2.5}$ and PCDD/F.

Chen et al. (2004) is the only available source to emission factors for the heavy metals Cd, Cr, Cu, Ni, Pb and Zn.

There is a good agreement between the emission factors for animal and human cremation for PCDD/F and a relatively good agreement for NMVOC, TSP, PM_{10}, $PM_{2.5}$ and heavy metals.

The emission factors of the remaining pollutants SO_2, NO_x, CH_4, CO, CO_2, N_2O, As, Se, HCB, PAHs and PCBs are collected from the literature search on human cremation, and it is assumed that humans and animals are similar in composition for this purpose. Emission factors from human cremation are recalculated to match the activity data for animal cremation, emission per Mg.

No data were available for the emission of Hg in animal cremations. The emission factor accepted for human cremation is not accepted in the case of Hg, because the Hg emission from human cremations primarily stems from tooth fillings.

Table 5.2 lists the emission factors and their respective references.

Table 5.2 Emission factors for animal cremation with references, per Mg.

Pollutant	Unit	Emission factor	Source
SO_2	kg	1.73*	Santarsiero et al, 2005
NO_X	kg	12.69*	Santarsiero et al, 2005
NMVOC	kg	2 00	EEA, 2009
CH_4	g/Mg	182	Aasestad, 2008
CO	kg	0.15*	Schleicher et al., 2001
N_2O	g/Mg	226	Aasestad, 2008
NH_3	kg	1.90	EEA, 2009
TSP	kg	2.18	EEA, 2009
PM_{10}	kg	1.53	EEA, 2009
$PM_{2.5}$	kg	1.31	EEA, 2009
As	g	0.21*	Webfire, 2012
Cd	g	0.01	Chen et al., 2004
Cr	g	0.07	Chen et al., 2004
Cu	g	0.02	Chen et al., 2004
Hg	-	NAV	-
Ni	g	0.06	Chen et al., 2004
Pb	g	0.18	Chen et al., 2004
Se	g	0.30*	Webfire, 2012
Zn	g	0.19	Chen et al., 2004
HCB	mg	2.33*	Toda, 2006
PCDD/F	µg I-TEQ	10.00	EEA, 2009
Benzo(b)flouranthene	mg	0.11*	Webfire, 2012
Benzo(k)flouranthene	mg	0.10*	Webfire, 2012
Benzo(a)pyrene	mg	0.20*	Webfire, 2012
Indeno(1,2,3-c-d)pyrene	mg	0.11*	Webfire, 2012
PCB	mg	6.36*	Toda, 2006

* Emission factors from human cremations.

5.3 Composting

The emissions from composting strongly depend on both the composition of the treated waste and on process conditions such as aeration, mechanical agitation, moisture control and temperature pattern. (Amlinger et al., 2008)

The emission factors stated in Table 5.3 are considered the best available for the calculation of the Danish emissions from composting.

Table 5.3 Composting emission factors, per Mg.

	Composting of garden and park waste (GPW)	Composting of organic waste	Composting of sludge	Home composting of garden and vegetable food waste
Unit	kg	kg	kg	kg
NO_x	NAV	NAV	NAV	NAV
CH_4	4.20	0.27	0.04	5.63
CO	0.56	NAV	NAV	0.08
N_2O	0.12	0.07	0.22	0.11
NH_3	0.66	0.31	0.02	0.63
Source	Boldrin et al., 2009	Amlinger et al., 2008	Amlinger et al., 2008	Boldrin et al., 2009

Emission factors for composting of GPW and for home composting of garden and vegetable food waste are derived from Boldrin et al. (2009). No other sources were found that describe the emission from home composting.

Two other sources provide emission factors for composting of GPW; Amlinger et al. (2008) and Hellebrand (1998). All three sources provide very similar data. Boldrin et al. (2009) is the source chosen since this is a Danish report based on experiments on Danish waste and composting methods.

Emissions from Boldrin et al. (2009) are given as a percentage of total degraded carbon or nitrogen respectively. The factors shown in Table 5.3 are calculated by assuming 37.5 % DOC in dry matter, 2 % N in dry matter and 50 % moisture in the waste (Boldrin et al., 2009).

Emission factors for composting of organic municipal waste and sludge are given by Amlinger et al. (2008). Pagans et al. (2006) delivers similar emissions for NH_3 from these waste categories but does not consider any other pollutants. Amlinger et al. (2008) is chosen as the most recent and thorough source to these data.

IPCC (2006) provides default emission factors for CH_4 and N_2O for composting of a mixture of food waste, garden (yard) and park waste and sludge of 4 and 0.3 kg per Mg respectively. A calculated implied emission factor for the four Danish composted waste types in relation to the 2011 activity data are 3.5 and 0.13 for CH_4 and N_2O respectively.

The CO_2 produced and emitted during composting is short-cycled C and is therefore regarded as CO_2 neutral. (Boldrin et al., 2009).

5.4 Accidental building fires

For building fires, emissions are calculated by multiplying the number of full scale equivalent fires with the emission factors. The emission factors are produced from different measurements and assumptions from literature and expert judgements. When possible, emission factors are chosen that represent conditions that are comparable to Denmark. By comparable is meant countries that have similar building traditions, with respect to the materials used in building structure and interior.

In the process of selecting the best available emission factors for the calculation of the emissions from Danish accidental building fires, a range of different sources has been studied. Unfortunately it is difficult to do an interrelated comparison of the different sources because they all establish emission factors on different assumptions and many of these assumptions are not fully accounted for.

Table 5.4 lists the emission factors that were chosen for 2011 as the best available and their respective references.

Table 5.4 Emission factors building fires, per FSE, 2011.

Compound	Unit /fire	Detached house	Undetached house	Apartment building	Industrial building	Additional building	Container	Source
SO_2	kg	263.9	212.5	124.5	802.9	32.1	2.4	Blomqvist et.al. 2002
NO_x	kg	19.7	15.9	9.3	24.0	1.0	3.0	NAEI, 2009
NMVOC*	kg	98.6	79.4	46.5	120.0	4.8	0.7	NAEI, 2009
CH_4	kg	42.7	34.4	20.2	52.0	2.1	0.3*	NAEI, 2009
CO	kg	276.1	222.3	130.2	336.0	13.4	42.0	NAEI, 2009
CO_2 - total	Mg	32.3	26.0	15.2	78.1	3.9	1.8	Blomqvist et al. 2002
CO_2 - biogenic	Mg	26.3	21.2	12.4	67.6	3.2	0.2	Blomqvist et al.,2002
CO_2 - non-biogenic	Mg	6.0	4.8	2.8	10.5	0.7	1.7	Blomqvist et al.,2002
TSP	kg	143.8	61.62	43.78	27.2	1.1	23.2	Aasestad, 2008**
PM_{10}	kg	143.8	61.62	43.78	27.2	1.1	23.2	Aasestad, 2008**
$PM_{2.5}$	kg	143.8	61.62	43.78	27.2	1.1	23.2	Aasestad, 2008**
As	g	1.35	0.58	0.41	0.25	0.01	0.22	Aasestad, 2008**
Cd	g	0.85	0.36	0.26	0.16	0.01	0.14	Aasestad, 2008**
Cr	g	1.29	0.55	0.39	0.24	0.01	0.21	Aasestad, 2008**
Cu	g	2.99	1.28	0.91	0.57	0.02	0.48	Aasestad, 2008**
Hg	g	0.85	0.36	0.26	0.16	0.01	0.14	Aasestad, 2008**
Pb	g	0.42	0.18	0.13	0.08	0.003	0.07	Aasestad, 2008**
PCDD/F*	mg	3.5	2.8	1.6	4.2	0.2	1.1	Hansen, 2000
Benzo[b]fluoranthene	g	12.5	10.1	5.9	15.2	0.6	1.9	NAEI, 2009
Benzo[k]fluoranthene	g	4.4	3.5	2.1	5.4	0.2	0.7	NAEI, 2009
Benzo[a]pyrene	g	7.9	6.4	3.7	9.6	0.4	1.2	NAEI, 2009
Indeno[1,2,3-cd]pyrene	g	8.5	6.9	4.0	10.4	0.4	1.3	NAEI, 2009

*Container fires have a different source than the other five categories; Blomqvist et. al. 2002, ** Personal contact with Kristin Aasestad in 2012 has provided a correction of the units which are inaccurate in Aasestad (2008).

Emission factors for detached, undetached and apartment fires depend on the annual average floor space; see Table 5.5. Industrial, additional and container fires on the other hand are assumed to have a constant size/volume throughout the time series. Emission factors for detached, undetached and apartment fires for 1980-2010 are shown in Annex 3, Table A3.2a-d, Table A3.3a-d and Table A3.4a-d.

Emission factors from Aasestad (2008) are already specified for four of the six building types; detached houses, undetached houses, apartment buildings and industrial buildings. Aasestad (2008) and all other sources considered were altered to match the six building types. This alternation was performed simply by adjusting the average floor space for each of the building types respectively, whereas factors like loss rate and mass of combustible contents per area are not altered.

The average floor space in Danish buildings is stated in Table 5.5. The data are collected from Statistics Denmark and takes into account possible multiple building floors but not attics and basements. For the full time series see Annex 3, Table A3.5. The average floor space in industrial buildings, schools etc. is estimated to 500 square meters for all years and the average floor space for additional buildings, sheds etc. is estimated to 20 square meters for all years.

Table 5.5 Average floor space in building types (Statistics Denmark, 2012).

	1990	1995	2000	2005	2006	2007	2008	2009	2010	2011
Detached houses	156	155	156	162	163	160	161	162	163	164
Undetached houses	129	129	131	131	132	132	133	133	134	132
Apartment buildings	75	75	75	76	76	76	77	77	77	78

Emission factors for container fires cannot be calculated based on an average floor space but on an average mass. The average mass of a container is set to 1 Mg and covers all types of containers, from small residential garbage containers to large shipping containers and waste/goods in storage piles.

Persson et al. (1998) gives for Swedish conditions emission factors for NO_x, CO and CO_2 expressed as kg per Mg of object burned and divided in three different objects; house, apartment and schools of average Swedish sizes. The data are based on the distribution of combustible material in the interior of the different building types, and does not take into account the combustible material in the structure itself. These emission factors are recalculated using Danish data for average building sizes, resulting in the subdivision of building types in detached, undetached, apartment, industrial and additional buildings.

Persson et al. (1998) sets a rate of weight loss at 12.4 %, but does not specify any further on different building types. It seems quite unrealistic that the same rate of weight loss applies for houses and industrial buildings, resulting in the conclusion that there is most likely an overestimation on the emission factors for industrial buildings.

In 2002 a report on the further development of this data was published in Blomqvist et al. (2002), this report added data for the amount of combustible material in the building structure. The emission factors from this source is calculated by combining the estimated amount of combustible material in the building structure itself, with the amount of combustible interior estimated in Persson et al. (1998) for the different building types. Again, Danish data for the average floor space in different building types is used to divide the emission factors into the six categories; detached houses, undetached houses, apartment buildings, industrial buildings, additional buildings and container fires.

The emission factors from both Persson et al. (1998) and Blomqvist et al. (2002) are probably overestimated due to building traditions, because wood is use to a larger extent in Sweden and Norway than in Denmark where bricks are more common.

Being that Persson et al. (1998) and Blomqvist et al. (2002) are the only sources to CO_2 emission factors, Blomqvist et al. (2002) is the best available source as this provides a more recent and more detailed method. The biogenic CO_2 emission stem from the burning of wood, this emission is calculated from the estimated wood content in an average house. Blomqvist et al. (2002) specifies that an average house of 120 square meters has a structure that consists of 9000 kg wood and an interior that consists of 2780 kg wood. With a CO_2 yield factor of 1.63 kg per kg wood and a Danish average floor area of 164 square meters, the biogenic CO_2 emission from the burning of wood in a full scale detached house fire in 2011 is 26.3 Mg per FSE fire.

The last two sources that were considered are presented in mass emission per mass burned. For the calculation of these emission factors to a unit that matches the activity data, the building masses are estimated using the same methodology as Hansen (2000) and stated in Table 5.6.

Table 5.6 Building mass per building type.

	Unit	Detached house	Undetached house	Apartment building	Industry building	Additional building	Container
Average floor area*	m^2	164	132	78	500	20	-
Building mass per floor area	kg per m^2	40	40	35	30	30	-
Total building mass	Mg per fire	6.6	5.3	2.7	15.0	0.6	1

* 2011 numbers

Emission factors for particulate matter are available from Aasestad (2008), EIIP (2001), Claire (1999) and NAEI (2009), giving four emission factors that vary from 9.6-143.8 kg PM per full scale fire of a detached house. The best reliable source in this case is believed to be Aasestad (2008) which states both the PM_{10} and the $PM_{2.5}$ to be equal to the TSP. There is however the quite questionable relationship between the different building types that is claimed by Aasestad (2008). Comparing with the Danish average floor areas shown in Table 5.5 and Table 5.6, it seems illogical that a fire in a detached house will cause more than twice the emission of a fire in an undetached house. That a full scale fire in an apartment building is expected to cause less than a third of the emission of that in a detached house, and that a large fire in an industrial building should cause less than a fifth of the emission from a detached house, even keeping in mind an expected difference in the composition of the interior. Still, Aasestad (2008) is considered the best available.

Aasestad (2008) is the only source found of emission factors for the heavy metals As, Cd, Cu, Cr, Pb and Hg, no emission factors were found for Ni, Se and Zn.

For the emission factor of dioxins and furans there are three sources. Hansen (2000) and UNEP toolkit (2005) provides data that are very similar with 50-1000 and 400 µg per Mg respectively. In addition Aasestad (2008) gives an emission factor of 1.4 mg per fire. Hansen (2000) is chosen as the best reliable source with an average of 475 µg per Mg, translating to 1.44 mg per fire for full scale detached house fires.

NAEI (2009) represents the UK National Atmospheric Emissions Inventory; this is the only source that provides emission factors for NMVOC, CH_4 and PAHs.

Being that Persson et al. (1998) and Blomqvist et al. (2002) are the only sources to a SO_2 emission factor, Blomqvist et al. (2002) is the best available source as this provides a more recent and more detailed method.

Emission factors for NO_x and CO are provided by several sources EIIP (2001), Persson et al. (1998), Blomqvist et al. (2002), Claire (1999) and NAEI (2009). In the case of both pollutants there is a good agreement between the emission factors provided by EIIP (2001), Claire (1999) and NAEI (2009). And in both cases the more recent factors of NAEI (2009) are selected.

No data were available for N_2O, HCB and PCBs. NH_3 is assumed not to be emitted.

5.5 Accidental vehicle fires

In the process of selecting the most reliable emission factors for the calculation of the emissions from Danish vehicle fires, a range of different sources have been studied. Unfortunately it is difficult to make an interrelated comparison of the different sources because they all establish emission factors on different assumptions and many of these assumptions are not fully accounted for. Table 5.7 lists the accepted emission factors and their respective references.

Table 5.7 Emission factors vehicle fires, per Mg.

	Unit	Emission factor	Source
SO_2	kg	5	Lönnermark et al., 2006
NO_x	kg	2	Lemieux et al., 2004
NMVOC	kg	8.5	Lönnermark et al., 2006
CH_4	kg	5	NAEI, 2009
CO	kg	63	Lönnermark et al., 2006
CO_2	Mg	2.4	Lönnermark et al., 2006
TSP	kg	2.05	EEA, 2009
PM_{10}	kg	2.05	EEA, 2009
$PM_{2.5}$	kg	2.05	EEA, 2009
As	g	0.01	Lönnermark et al., 2006
Cd	g	0.09	Lönnermark et al., 2006
Cr	g	0.2	Lönnermark et al., 2006
Cu	g	1.5	Lönnermark et al., 2006
Ni	g	0.15	Lönnermark et al., 2006
Pb	g	44.0	Lönnermark et al., 2006
Zn	g	173.0	Lönnermark et al., 2006
PCDD/F	mg	0.04	Hansen, 2000
Benzo(b)fluoranthene	g	32.3	Lemieux et al., 2004
Benzo(k)fluoranthene	g		Lemieux et al., 2004
Benzo(a)pyrene	g	14.7	Lemieux et al., 2004
Indeno(1,2,3-cd)pyrene	g	23.3	Lemieux et al., 2004

PCDD/F has the best documented emission factor as eight sources were found for this group of compounds. There is a very good agreement between the five sources; Hansen (2000), UNEP toolkit (2005), NAEI (2009), Blomqvist et al. (2002) and Schleicher & Jensen (2004). Hansen (2000) is chosen as the source for the calculation of the PCDD/F emission from vehicle fires.

Lönnermark et al. (2006) is the only available source of emission factors for heavy metals (As, Cd, Cr, Cu, Hg, Ni, Pb, Se, Zn). Lönnermark et al. (2006) is also found to be the best available source to SO_2 and NMVOC. Emission factors from this source were derived by both small-scale and full-scale tests. Heavy metal emission factors were scaled in relation to the chosen TSP emission factor. The NMVOC emission factor contains benzene, toluene, styrene, ethynylbenzene, phenol (incl. some bensaldehyde), benzonitrile, indene, xylene, ethylbenzene, alpha-methylstyrene, limonene, phtalic anhydride, and biphenyl.

There are three sources to particle matter emission factors; EEA (2009), Lönnermark et al. (2006) and Lemieux et al. (2004). The two latter provides data of 38 and 50 kg per Mg combusted vehicle respectively. The emission factor supplied by the Guidebook is given in kg per fire and is therefore divided by the average weight of a passenger car in 2009, to give a factor that is better comparable; the resulting emission factor is of 2.0 kg per Mg.

Persson et al. (1998) and Lemieux et al. (2004) delivers very similar emission factors for NO_x, the more recent Lemieux et al. (2004) is chosen as the most reliable. Lemieux et al. (2004) is also considered the best available in the case of PAHs.

Emission factors for CO are available from the same two sources and from Lönnermark et al. (2006); in this case Lönnermark et al. (2006) and Lemieux et al. (2004) deliver the same factor. Lönnermark et al. (2006) is chosen as the best available source since it is based on experimental data.

Persson et al. (1998) and Lönnermark et al. (2006) are the only available sources to CO_2 emission factors for vehicle fires. Since Lönnermark et al. (2006) is the more recent source and establishes its emission factors on experimental data, this is chosen as the best reliable source.

No data was available for N_2O, Hg, Se, HCB and PCBs. NH_3 is assumed not to be emitted.

5.6 Combustion at biogas production plants

Emission factors for combustion of biogas in biogas production plants are presented in Table 5.8. These are outdated emission factors for biogas boilers and will be updated in the next sector report.

Table 5.8 Emission factors for combustion of biogas, per GJ.

Pollutant	Unit	Emission factor
SO_2	g	25
NO_x	g	59
NMVOC	g	4
CH_4	g	4
CO	g	36
N_2O	g	2
TSP	g	1.5
PM_{10}	g	1.5
$PM_{2.5}$	g	1.5
PCDD/F	ng	0.025

6 Emissions

In the Danish inventory are included emissions from human cremation, animal cremation, compost production, accidental building fires, accidental vehicle fires and biogas production.

6.1 Human cremation

Table 6.1 gives an overview of the Danish emissions from human cremation from selected years. To view the entire time series 1980-2011, see Annex 1.

The CO_2 emission from cremations of human corpses is biogenic.

Emissions from human cremations have been steady over the last two decades but have decreased strongly for the pollutants TSP, PM_{10}, $PM_{2.5}$, As, Cd, Cr, Cu, Hg, Ni, Pb, Se, Zn and PCDD/Fs from 2010 to 2011 because of the installation of bag filters with activated carbon.

Table 6.1 Emissions from human cremation.

	Unit	1990	1995	2000	2005	2006	2007	2008	2009	2010	2011
SO_2	Mg	4.62	4.94	4.70	4.60	4.65	4.71	4.71	4.78	4.74	4.65
NO_X	Mg	33.82	36.17	34.36	33.63	34.02	34.46	34.48	34.99	34.69	34.03
NMVOC	Mg	0.53	0.57	0.54	0.53	0.54	0.54	0.54	0.55	0.55	0.54
CH_4	Mg	0.48	0.52	0.49	0.48	0.48	0.49	0.49	0.50	0.49	0.49
CO	Mg	0.41	0.44	0.42	0.41	0.41	0.42	0.42	0.42	0.42	0.41
N_2O	Mg	0.60	0.64	0.61	0.60	0.61	0.61	0.61	0.62	0.62	0.61
TSP	Mg	1.58	1.69	1.61	1.57	1.59	1.61	1.61	1.64	1.62	0.02
PM_{10}	Mg	1.42	1.52	1.45	1.41	1.43	1.45	1.45	1.47	1.46	0.01
$PM_{2.5}$	Mg	1.42	1.52	1.45	1.41	1.43	1.45	1.45	1.47	1.46	0.01
As	kg	0.56	0.60	0.57	0.55	0.56	0.57	0.57	0.58	0.57	0.01
Cd	kg	0.21	0.22	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.004
Cr	kg	0.56	0.59	0.56	0.55	0.56	0.57	0.57	0.58	0.57	0.01
Cu	kg	0.51	0.55	0.52	0.51	0.51	0.52	0.52	0.53	0.52	0.01
Hg	kg	45.87	49.06	46.61	45.61	46.14	46.74	46.76	47.45	47.05	0.46
Ni	kg	0.71	0.76	0.72	0.71	0.71	0.72	0.72	0.73	0.73	0.01
Pb	kg	1.23	1.32	1.25	1.22	1.24	1.25	1.25	1.27	1.26	0.02
Se	kg	0.81	0.87	0.82	0.81	0.82	0.83	0.83	0.84	0.83	0.02
Zn	kg	6.56	7.02	6.67	6.53	6.60	6.69	6.69	6.79	6.73	0.13
HCB	g	6.21	6.65	6.31	6.18	6.25	6.33	6.33	6.43	6.37	6.25
PCDD/F	mg	14.35	15.35	14.58	14.27	14.43	14.62	14.63	14.84	14.72	3.61
benzo(b)flouranthene	g	0.30	0.32	0.30	0.29	0.30	0.30	0.30	0.31	0.30	0.30
benzo(k)flouranthene	g	0.26	0.28	0.27	0.26	0.27	0.27	0.27	0.27	0.27	0.27
benzo(a)pyrene	g	0.54	0.58	0.55	0.54	0.54	0.55	0.55	0.56	0.56	0.54
indeno(1.2.3-c-d)pyrene	g	0.29	0.31	0.29	0.28	0.29	0.29	0.29	0.30	0.29	0.29
PCB	g	16.95	18.13	17.22	16.86	17.05	17.27	17.28	17.54	17.39	17.06

6.2 Animal cremation

CO_2 emissions from animal cremation are biogenic.

Emissions from animal cremation have increased over the last two decades. In 1990, animal cremation stood for 5 % of the total emission of CO_2 eqv. from cremations. In 2011 this number has increased to 31 %. Greenhouse gas (GHG) emissions from cremations are very small; 0.21 Gg in 1990 and 0.29

Gg in 2011. For the entire time series, GHG emissions are shown in Annex 1, Table A1.1 and all emissions are shown in Table A1.2-5.

Table 6.2 Emissions from animal cremation.

	unit	1990	1995	2000	2005	2006	2007	2008	2009	2010	2011
SO_2	Mg	0.26	0.35	0.77	1.32	1.94	2.23	2.32	2.32	2.51	2.11
NO_X	Mg	1.90	2.54	5.63	9.68	14.17	16.30	16.99	16.99	18.39	15.47
NMVOC	Mg	0.30	0.40	0.89	1.52	2.23	2.57	2.68	2.68	2.90	2.44
CH_4	Mg	0.03	0.04	0.08	0.14	0.20	0.23	0.24	0.24	0.26	0.22
CO	Mg	0.02	0.03	0.07	0.12	0.17	0.20	0.21	0.21	0.22	0.19
N_2O	Mg	0.03	0.05	0.10	0.17	0.25	0.29	0.30	0.30	0.33	0.28
NH_3	Mg	0.29	0.38	0.84	1.45	2.12	2.44	2.54	2.54	2.75	2.32
TSP	Mg	0.33	0.44	0.97	1.66	2.43	2.80	2.92	2.92	3.16	2.66
PM_{10}	Mg	0.23	0.31	0.68	1.17	1.71	1.96	2.05	2.05	2.22	1.86
$PM_{2.5}$	Mg	0.20	0.26	0.58	1.00	1.46	1.68	1.75	1.75	1.90	1.60
As	kg	0.03	0.04	0.09	0.16	0.23	0.27	0.28	0.28	0.30	0.25
Cd	kg	0.002	0.002	0.004	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Cr	kg	0.01	0.01	0.03	0.05	0.08	0.09	0.09	0.09	0.10	0.09
Cu	kg	0.003	0.004	0.01	0.02	0.02	0.03	0.03	0.03	0.03	0.02
Ni	kg	0.01	0.01	0.03	0.05	0.07	0.08	0.08	0.08	0.09	0.07
Pb	kg	0.03	0.04	0.08	0.14	0.20	0.23	0.24	0.24	0.26	0.22
Se	kg	0.05	0.06	0.13	0.23	0.34	0.39	0.41	0.41	0.44	0.37
Zn	kg	0.03	0.04	0.08	0.14	0.21	0.24	0.25	0.25	0.28	0.23
HCB	g	0.35	0.47	1.03	1.78	2.60	2.99	3.12	3.12	3.38	2.84
PCDD/F	mg	1.50	2.00	4.43	7.62	11.16	12.84	13.38	13.39	14.49	12.19
benzo(b)flouranthene	g	0.02	0.02	0.05	0.08	0.12	0.14	0.15	0.15	0.16	0.14
benzo(k)flouranthene	g	0.01	0.02	0.04	0.08	0.11	0.13	0.13	0.13	0.14	0.12
benzo(a)pyrene	g	0.03	0.04	0.09	0.15	0.23	0.26	0.27	0.27	0.29	0.25
indeno(1,2,3-c-d)pyrene	g	0.02	0.02	0.05	0.08	0.12	0.14	0.14	0.14	0.16	0.13
PCB	g	0.95	1.27	2.82	4.85	7.10	8.17	8.51	8.52	9.22	7.75

6.3 Composting

Table 6.3 shows the total national emissions from composting. The full time series is shown in Annex 1 Table A1.1-5.

CO_2 emissions from compost production are biogenic.

Compost production is the largest source of greenhouse gas emissions in this sector report. In 1990 composting stood for 66 % (40 Gg CO_2 equivalents) of the total greenhouse gas emission in CO_2 equivalents from the sectors of waste incineration and other waste, in 2011 this number had increased to 86 % (127 Gg CO_2 equivalents).

Table 6.3 Emissions from composting, Mg.

	1990	1995	2000	2005	2006	2007	2008	2009	2010	2011
CH_4	1326.4	1708.3	2974.4	3231.5	3421.3	3815.0	3475.4	3705.8	3828.6	3929.7
CO	163.5	213.1	382.4	416.2	441.5	494.4	448.8	478.2	495.0	508.5
N_2O	37.8	51.7	133.8	104.7	114.0	130.2	121.3	132.1	137.7	143.2
NH_3	207.7	274.1	479.6	515.5	546.5	607.8	555.1	597.8	614.2	630.6

6.4 Accidental building fires

Table 6.4 shows the total emissions from building fires. The entire time series 1980-2011 is shown in Annex 1 Table A1.1-5.

For accidental fires in buildings, there is a high content of wood both in the structure and in the interior; this leads to 82 % of the CO_2 emission from accidental building fires being biogenic. Emissions from accidental building fires are somewhat constant, with a peek in 2007 of 15 Gg CO_2 equivalents.

Table 6.4 Emissions from building fires.

	unit	1990	1995	2000	2005	2006	2007	2008	2009	2010	2011
SO_2	Mg	559.3	640.2	565.2	552.4	567.8	683.6	638.3	615.9	543.0	598.2
NO_x	Mg	31.8	36.3	32.1	31.5	32.4	37.4	37.2	35.2	31.5	33.7
NMVOC	Mg	148.0	169.3	149.7	147.2	151.4	173.5	172.2	164.6	149.1	158.0
CH_4	Mg	64.1	73.4	64.9	63.8	65.6	75.2	74.6	71.3	64.6	68.5
CO	Mg	444.5	508.4	449.5	441.2	453.9	524.1	520.8	493.0	441.3	471.6
CO_2 (fossil)	Gg	11.4	13.1	11.5	11.3	11.6	13.7	13.3	12.6	11.1	12.2
TSP	Mg	168.6	193.5	170.1	163.9	168.0	182.3	195.9	185.2	168.8	173.0
PM_{10}	Mg	168.6	193.5	170.1	163.9	168.0	182.3	195.9	185.2	168.8	173.0
$PM_{2.5}$	Mg	168.6	193.5	170.1	163.9	168.0	182.3	195.9	185.2	168.8	173.0
As	kg	1.58	1.81	1.59	1.54	1.57	1.71	1.84	1.74	1.58	1.62
Cd	kg	1.00	1.14	1.00	0.97	0.99	1.08	1.16	1.09	1.00	1.02
Cr	kg	1.51	1.73	1.52	1.47	1.50	1.63	1.75	1.66	1.51	1.55
Cu	kg	3.51	4.02	3.54	3.41	3.49	3.79	4.07	3.85	3.51	3.60
Hg	kg	1.00	1.14	1.00	0.97	0.99	1.08	1.16	1.09	1.00	1.02
Pb	kg	0.49	0.57	0.50	0.48	0.49	0.53	0.57	0.54	0.49	0.51
PCDD/F	g I-TEQ	6.0	6.9	6.1	5.9	6.1	7.1	7.1	6.6	5.9	6.3
Benzo(b)fluoranthene	kg	20.1	23.0	20.3	20.0	20.5	23.7	23.6	22.3	20.0	21.3
Benzo(k)fluoranthene	kg	7.1	8.1	7.2	7.0	7.2	8.4	8.3	7.9	7.0	7.5
Benzo(a)pyrene	kg	12.7	14.5	12.8	12.6	13.0	15.0	14.9	14.1	12.6	13.5
Indeno(1,2,3-cd)pyrene	kg	13.8	15.7	13.9	13.7	14.0	16.2	16.1	15.3	13.7	14.6

6.5 Accidental vehicle fires

Table 6.5 shows the total national emissions from accidental vehicle fires. The full time series is shown in Annex 1 Table A1.1-5.

Table 6.5 Emissions from vehicle fires.

	unit	1990	1995	2000	2005	2006	2007	2008	2009	2010	2011
SO_2	Mg	14.33	14.70	15.08	14.42	14.82	11.70	16.85	17.56	14.80	12.63
NO_X	Mg	5.73	5.88	6.03	5.77	5.93	4.68	6.74	7.02	5.92	5.05
NMVOC	Mg	24.36	24.98	25.63	24.51	25.20	19.88	28.65	29.85	25.16	21.47
CH_4	Mg	14.3	14.7	15.1	14.4	14.8	11.7	15.9	17.5	14.8	12.6
CO	Mg	180.57	185.18	189.95	181.64	186.77	147.38	212.37	221.24	186.51	159.15
CO_2 (fossil)	Gg	6.9	7.1	7.2	5.9	7.1	5.6	8.1	8.4	7.1	6.1
TSP	Mg	5.88	6.03	6.18	5.91	6.08	4.80	6.91	7.20	6.07	5.18
PM_{10}	Mg	5.88	6.03	6.18	5.91	6.08	4.80	6.91	7.20	6.07	5.18
$PM_{2.5}$	Mg	5.88	6.03	6.18	5.91	6.08	4.80	6.91	7.20	6.07	5.18
As	kg	0.04	0.04	0.04	0.04	0.04	0.03	0.05	0.05	0.04	0.04
Cd	kg	0.26	0.27	0.28	0.27	0.27	0.22	0.31	0.32	0.27	0.23
Cr	kg	0.57	0.59	0.60	0.58	0.59	0.47	0.67	0.70	0.59	0.51
Cu	kg	4.30	4.41	4.52	4.32	4.45	3.51	5.06	5.27	4.44	3.79
Ni	kg	0.43	0.44	0.45	0.43	0.44	0.35	0.51	0.53	0.44	0.38
Pb	kg	126.11	129.33	132.67	126.86	130.44	102.93	148.32	154.52	130.26	111.15
Zn	kg	495.84	508.51	521.62	498.79	512.88	404.70	583.18	607.54	512.16	437.03
PCDD/F	g I-TEQ	0.11	0.12	0.12	0.12	0.12	0.09	0.13	0.14	0.12	0.10
Benzo(b)fluoranthene	kg	46.29	47.47	48.69	46.56	47.88	37.78	54.44	56.72	47.81	40.80
Benzo(k)fluoranthene	kg	46.29	47.47	48.69	46.56	47.88	37.78	54.44	56.72	47.81	40.80
Benzo(a)pyrene	kg	42.13	43.21	44.32	42.38	43.58	34.39	49.55	51.62	43.52	37.13
Indeno(1.2.3-cd)pyrene	kg	66.78	68.49	70.25	67.18	69.08	54.51	78.54	81.83	68.98	58.86

6.6 'Combustion at biogas production plants

Table 6.6 shows the total national emissions from combustion of biogas. This activity only occurs from 1994 to 2005.

Table 6.6 Emissions from the combustion of biogas.

		1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
SO_2	Mg	0.02	0.12	0.11	0.11	0.89	1.09	1.02	0.68	0.76	0.89	0.72	0.55
NO_x	Mg	0.1	0.3	0.3	0.3	2.1	2.6	2.4	1.6	1.8	2.1	1.7	1.3
NMVOC	Mg	0.003	0.019	0.018	0.018	0.142	0.175	0.164	0.109	0.122	0.142	0.115	0.088
CH_4	Mg	0.003	0.019	0.018	0.018	0.142	0.175	0.164	0.109	0.122	0.142	0.115	0.088
CO	Mg	0.03	0.17	0.16	0.16	1.27	1.57	1.48	0.98	1.10	1.28	1.03	0.79
N_2O	Mg	0.002	0.009	0.009	0.009	0.071	0.087	0.082	0.055	0.061	0.071	0.057	0.044

7 Uncertainty and time series consistency

Two sets of uncertainty estimates are made for the Danish emission inventories, based on Tier 1 and Tier 2 methodologies, respectively. The uncertainty models follow the methodology in the IPCC Good Practise Guidance (IPCC, 2000). Tier 1 is based on the simplified uncertainty analysis and performed for all pollutants, and Tier 2 is based on Monte Carlo simulations and only performed on the greenhouse gases.

7.1.1 Input data

The uncertainty of the number of human cremations is miniscule, however for the purpose of uncertainty calculation it has been set to 1 %.

The uncertainty of the activity data from animal cremations is also minimal for the most recent years (1998-2011) but is increasing back in time (to 200 % in 1980). The uncertainty is set to 67 % in 1990 and 5 % for 2011(Authors expert judgement).

Activity data for composting are estimated for the years 1990-1994 and 2010-2011 resulting in a higher level of uncertainty these years; this is set at 40 %.

The uncertainty of the total number of accidental fires is very small, but the division into building and transportation types and also the calculation of full scale equivalents will lead to some uncertainty, partly caused by the category “other”. The uncertainty for both building and vehicle activity data is therefore set to 10 % for all years. The uncertainty is however lowest for the most recent years (2007-2011).

Activity data for combustion of biogas at biogas production facilities are available from the national energy statistics; the uncertainty for this activity is set to 5 %.

Table 7.1 and Table 7.2 lists the 95 % confidence interval uncertainties for activity data and emission factors used in this inventory respectively.

Table 7.1 Estimated uncertainty rates for activity data.

Activity data uncertainty, %	Human cremation	Animal cremation	Composting	Accidental building fires	Accidental vehicle fires	Combustion of biogas
1990	1	67*	40	10	10	5**
2011	1	5*	40	10	10	5**

*For the Tier 1 calculation, an uncertainty of 40 % is used for all years, **This category only exists from 1994-2005 and therefore not included in the uncertainty calculations included in this report (Uncertainties are calculated for 1990 and 2011).

The uncertainties for emission factors in the waste sector, and at the present level of available information, are listed in Table 7.2. The uncertainties are assumed valid for all years 1990-2011.

Table 7.2 Estimated uncertainty rates for emission factors, %. Valid for all years.

Pollutant	Human cremation	Animal cremation	Composting	Accidental building fires	Accidental vehicle fires	Combustion of biogas
SO_2	100	100		300	500	100
NO_x	150	150		500	500	100
NMVOC	100	300		500	500	100
CH_4	150	150	100	500	700	100
CO	150	150	100	500	500	100
CO_2				300*	500*	
N_2O	150	150	100			100
NH_3		300	100			
TSP	500	300		500	700	
PM_{10}	500	300		500	700	
$PM_{2.5}$	500	300		500	700	
As	700	700		500	500	
Cd	700	500		500	500	
Cr	700	500		500	500	
Cu	700	500		500	500	
Hg	150			500		
Ni	700	500			500	
Pb	600	500		500	500	
Se	700	700				
Zn	700	500			500	
HCB	500	500				
PCDD/F	300	300		100	100	
Benzo(b)flouranthene	1000	1000		500	500	
Benzo(k)flouranthene	1000	1000		500	500	
Benzo(a)pyrene	1000	1000		500	500	
Indeno(1,2,3-c,d)pyrene	1000	1000		500	500	
PCB	1000	1 000				

*With an upper truncation of twice the uncertainty rate. The truncation is relevant for the large uncertainty rates for CO_2 emission factors due to the log-normal distribution applied in the tier 2 model and the very low total emission of CO_2.

The input parameter uncertainties are at the same aggregation level as reported in Nielsen (2013a) and Nielsen (2013b).

7.1.2 Tier 1 uncertainty results

The Tier 1 uncertainty estimates for the waste incineration and other waste sectors are calculated from 95 % confidence interval uncertainties, results are shown in Table 7.3.

Table 7.3 Tier 1 uncertainty results for the waste sector.

Pollutant	National emission 2011, Mg	Total emission uncertainty, %	Trend 1990-2011, %	Trend Uncertainty, %-age points
Greenhouse gases	147226.70	±76.0	146.6	±155.3
SO_2	617.56	±290.9	6.8	±14.8
NO_x	88.23	±203.4	20.5	±47.3
NMVOC	182.43	±437.1	5.3	±19.1
CH_4	4016.59	±105.9	185.8	±164.5
CO	1139.84	±223.6	44.5	±135.2
CO_2	18213.04	±260.4	-0.4	±27.2
N_2O	144.08	±107.0	274.8	±210.9
NH_3	632.90	±107.3	204.3	±171.5
TSP	180.89	±478.8	1.2	±15.5
PM_{10}	180.09	±480.9	1.0	±15.5
$PM_{2.5}$	179.83	±481.6	0.9	±15.6
As	1.92E-03	±432.0	-13.0	±175.7
Cd	1.27E-03	±412.5	-13.4	±99.7
Cr	2.15E-03	±379.4	-18.8	±132.3
Cu	7.42E-03	±352.1	-10.8	±47.7
Hg	1.48E-03	±347.6	-96.8	±11.0
Ni	4.66E-04	±414.4	-59.4	±190.5
Pb	1.12E-01	±496.8	-12.5	±13.6
Se	3.87E-04	±672.2	-54.8	±403.2
Zn	4.37E-01	±499.7	-12.9	±15.5
HCB	6.43E-06	±377.8	38.6	±253.9
PCDD/F	6.21E-02	±98.7	5.1	±14.6
Benzo(b)flouranthene	4.83E-02	±370.6	-6.4	±28.4
Benzo(k)flouranthene	5.06E-02	±429.4	-9.5	±18.2
Benzo(a)pyrene	7.35E-02	±390.4	-7.7	±24.7
Indeno(1,2,3-c,d)pyrene	2.48E-05	±412.9	-8.8	±20.8
PCBs	9.09E-06	±755.3	38.6	±506.0

*Trend 2000-2011, %

The overall uncertainty interval for greenhouse gases (GHG) is estimated to be ±76.0 % and the trend in GHG emission is +146.6 % ±155.3 %. The source with the largest uncertainty in the GHG emission trend is compost production; in 2011 this source provides 86 % of the total GHG emissions from the sectors waste incineration and other waste, the trend uncertainty of this individual category is 221.0 % ± 136.2 % for GHG.

The calculated Tier 1 uncertainties of the waste sectors treated in this sector report are generally large because of the high uncertainties on emission factors (Table 7.2).

GHG emissions are calculated in CO_2 equivalents.

7.1.3 Tier 2 uncertainty results

The Tier 2 uncertainty estimates for waste incineration and other waste are calculated from the input data presented in Section 7.1.1; results are shown in Table 7.4. The calculations are performed for the three greenhouse gases and are based on a Monte Carlo approach as described in Nielsen et al. (2013a), Chapter 1.7.

Table 7.4 National Tier 2 uncertainty estimates for the waste sector.

	1990 National emission Uncertainty interval	2011 National emission Uncertainty interval	2011 Trend Uncertainty
GHG	73.9 Gg (-43 %, +85 %)	166.9 Gg (-41 %, +87 %)	92.3 Gg (-47 %, +107 %)
CO_2	23.9 Gg (-64 %, +210 %)	24.1 Gg (-64 %, +187 %)	0.1 Gg (-97 %, +400 %)
CH_4	1.6 Gg (-55 %, +141 %)	4.2 Gg (-58 %, +156 %)	2.6 Gg (-62 %, +168 %)
N_2O	0.04 Gg (-56 %, +154 %)	0.2 Gg (-51 %, +128 %)	0.1 Gg (-51 %, +123%)

Greenhouse gas (GHG) emissions are calculated in CO_2 equivalents.

The medians for the national emissions from waste calculated with the Tier 2 method are similar to those calculated with the Tier 1 method. This is an example of how different calculation methods can cause variation in the results.

The following Figure 7.1, Figure 7.2 and Figure 7.3 show the graphical comparison of Tier 1 and Tier 2. Figure 7.1 and Figure 7.2 show the uncertainties of the national emissions for waste incineration and other waste from 1990 and 2011 respectively and Figure 7.3 shows the uncertainties of the trend.

The Tier 1 uncertainties are the same for 1990 and 2011 because the uncertainty input data in this model are the same for both years, the only input data that vary in the Tier 1 model are the activity data. For Tier 2, uncertainty input for activity data can vary between 1990 and 2011 for certain categories, see Table 7.1, furthermore results will vary slightly due to the calculation method.

The largest uncertainties lie with the accidental fires, and since the entire emission of non-biogenic CO_2 stems from accidental fires, this is the compound with the highest uncertainty; cf. Figure 7.1, Figure 7.2, Table 7.3 and Table 7.4.

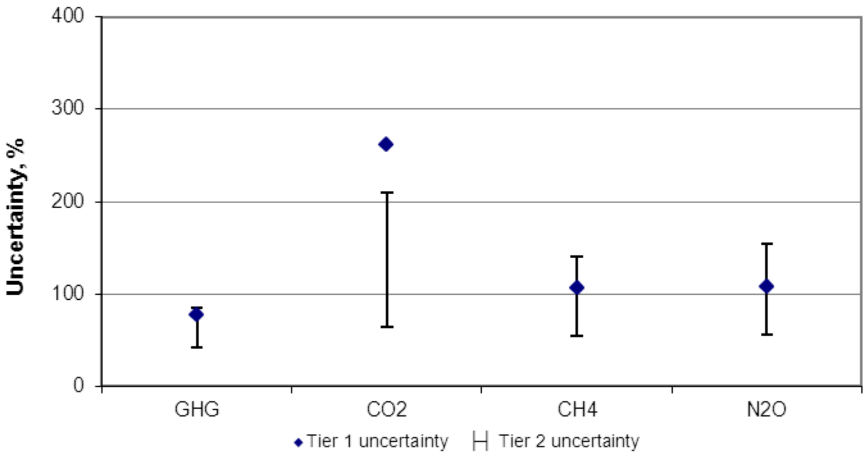

Figure 7.1 A graphical comparison of Tier 1 and Tier 2 uncertainties for 1990.

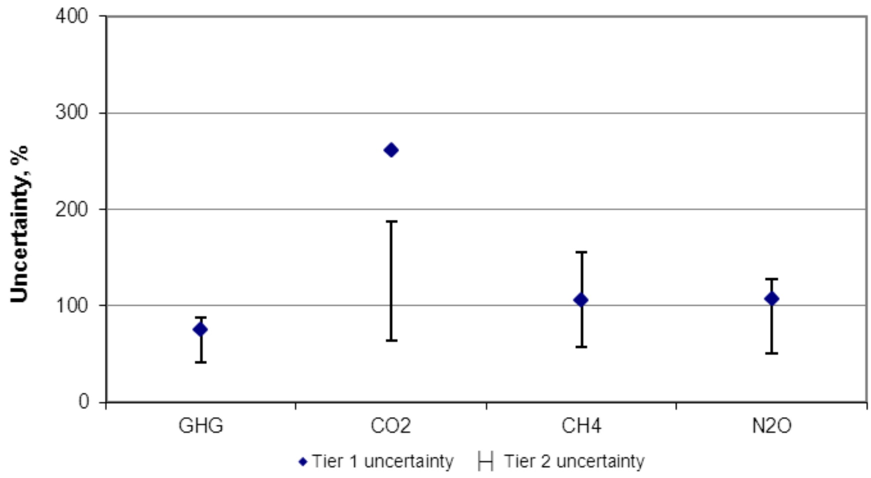

Figure 7.2 A graphical comparison of Tier 1 and Tier 2 uncertainties for 2011.

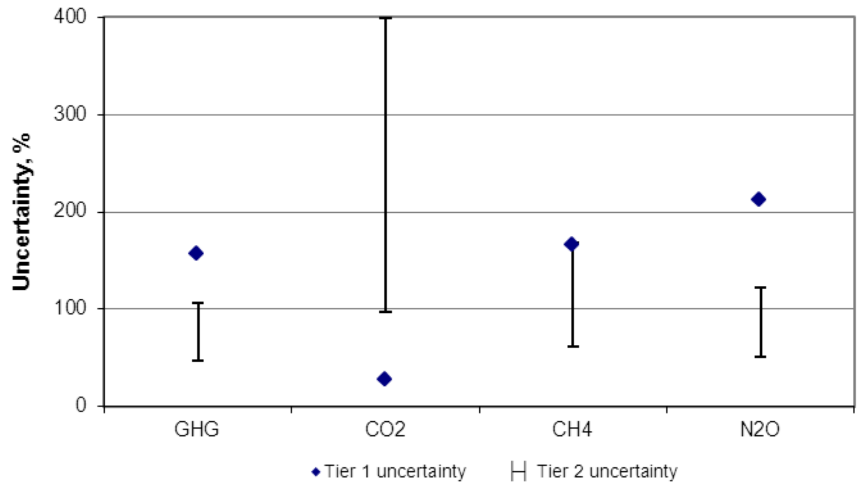

Figure 7.3 A graphical comparison of Tier 1 and Tier 2 trend uncertainties for 1990-2011.

7.1.4 Time series consistency and completeness

Human cremation

Activity data for human cremation are consistent as these data have been collected by DKL throughout the time series.

Emission factors and calculation method are consistent throughout the time series.

The category of human cremation is considered to be complete.

Animal cremation

Activity data for animal cremation are not fully consistent. Data for 1998-2011 are gathered directly from the crematoria and data for 1980-1997 are estimated by the author's expert judgement, no surrogate data or data regression is possible.

Emission factors and calculation method are consistent throughout the time series.

The category of animal cremation is complete since open burning of carcasses is illegal and therefore considered to not be occurring in Denmark, and small-scale incinerators are not known to be used at Danish farms.

Composting

For compost production, activity data are not consistent as data are only available for 1995-2009. Data for 1980-1994, 2010 and 2011 are estimated through linear regression.

Emission factors and calculation method are consistent throughout the time series.

Emissions from compost production are believed to be complete; calculations include composting at all nationally registered sites and best available estimated data for home composting.

Accidental fires

For accidental fires, DEMA provides detailed data for 2007-2011 and the total number of nationally registered fires for 1989-2011. Activity data for accidental fires are therefore not believed to be consistent.

Both emission factors and calculation method are consistent throughout the time series.

Emissions from accidental fires are believed to be complete. Field burning of agricultural residue and wild fires are not part of the waste incineration or other waste categories (Agriculture and Land Use, Land Use Change and Forestry (LULUCF) respectively).

Combustion of biogas

Combustion of biogas at biogas production plants is not complete in relation to pollutants. Because of outdated emission factors, heavy metals have not yet been included in this category.

Emissions in this source category are only calculated for the years 1994-2005. Activity data is available from the energy statistics (DEA, 2012) which is complete, but changes in the report structure of the energy statistics have reallocated the activity of combustion of biogas which is therefore not included in the waste incineration and other waste sector report for the years 1980-1993 and 2006-2011.

Other

It has not been possible to obtain the relevant data for estimating emissions from other combustion sources like open burning of yard waste and bonfires or from anaerobic digestion at biogas facilities, this category is therefore incomplete.

8 Quality Assurance, Quality Control (QA/QC) and verification

A list of QA/QC tasks are performed directly in relation to the emissions from the waste incineration and other waste. The following procedures are carried out to ensure the data quality:

- Checking of time series in the NFR and SNAP source categories. Substantial changes are controlled and explained.
- Comparison with the inventory of the previous year. Any major changes are verified.
- A manual log table is applied to collect information about recalculations.
- Some automated checks have been prepared for the emission databases:
- Check of units for activity data and emission factors.
- Additional checks on database consistency.

The QC work will continue in future years.

In general terms, for this part of the inventory, the Data Storage (DS) Level 1, 2 and 4 and the Data Processing (DP) Level 1 can be described as follows.

8.1.1 Data Storage Level 1

The external data level refers to the placement of the original input data used for estimating annual activity and emission factors in the waste sector. Data references in terms of reports and databases used for deriving input for the emission calculations. Reports and a list of links to external data sources are stored in a common data storage system.

Table 8.1 lists the external data deliveries used for the waste incineration and other waste emission inventory. Further, the table holds information on the contacts at the data delivery companies.

Table 8.1 Overview of annually stored external data sources at DS level 1.

Category	Data description	Activity data, emission factors or emissions	Reference	Contact(s)	Data agreement/ Comment	http, file or folder name
Human cremation	Annual number of cremated persons	Activity data	Association of Danish Crematoria	Hanne Ring	Public access	http://www.dkl.dk
Human cremation	Population statistics	Activity data	Statistics Denmark		Public access	http://www.statistikbanken.dk/BEF5
Animal cremation	Annual amount of cremated carcasses	Activity data	Dansk Dyrekremering ApS	Knud Ribergaard	Personal contact	
Animal cremation	Annual amount of cremated carcasses	Activity data	Ada's Kæledyrs-krematorium ApS	Anders Oxholm	Personal contact	

Table 8.1 *Continued*

Category	Data description	Activity data, emission factors or emissions	Reference	Contact(s)	Data agreement/ Comment	http, file or folder name
Animal cremation	Annual amount of cremated carcasses	Activity data	Kæledyrs-krematoriet	Annette Laursen	Personal contact	
Accidental building fires	Average floor space in buildings	Activity data	Statistics Denmark		Public access	http://www.statistikbanken.dk/BOL511
Accidental fires	Categorised fires	Activity data	The Danish Emergency Management Agency	Steen Hjere Nonnemann	Public access	https://statistikbank.brs.dk
Accidental building fires	Building type statistics	Activity data	Statistics Denmark		Public access	http://www.statistikbanken.dk BOL11, BOL3, BOL33 and BYGB11
Accidental vehicle fires	Weight categorisa-tion of vehicles	Activity data	Statistics Denmark		Public access	http://www.statistikbanken.dk BIL10, BIL12, BIL15 and BIL18
Compost-ing	Waste categories for composting	Activity data	Danish Environ-mental Protection Agency (DEPA), Waste statistics		Public access	http://www2.mst.dk/udgiv/publikationer/2010/978-87-92668-21-9/pdf/978-87-92668-22-6.pdf

8.1.2 Data Processing Level 1

Data Processing Level 1 comprises a stage where the external data are treated internally. This is the level where the activity data and emission factors are recalculated to match each other by using national average data like the average floor space in houses etc.

8.1.3 Data Storage Level 2

Data Storage Level 2 is the placement of selected output data from the calculation of emissions as inventory data on SNAP levels in the Access (CollectER) database.

8.1.4 Data Storage Level 4

Data Storage Level 4 is the placement of the calculated output data from the calculation of emissions as data on SNAP levels in the CRF/NFR.

8.1.5 Points of measurement

The present stage of QA/QC for the Danish emission inventories for the waste sector is described below for Data Storage (DS) level 1, 2 and 4 and Data Processing (DP) level 1 by Points of Measurement (PMs). This is to be seen in connection with the general QA/QC description in Nielsen et al. (2013a), Chapter 1.7.

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

The sources of data described in the methodology sections and in DS.1.2.1 and DS.1.3.1 are used in this inventory. It is the accuracy of these data that define the uncertainty of the inventory calculations.

For Waste Incineration and Other Waste the level of uncertainty is generally low for activity data but higher for emission factors, cf. Table 7.1 and Table 7.2. Expert judgments are used whenever default uncertainties are not available.

Data Storage level 1	2.Comparability	DS.1.2.1	Comparability of the emission factors/calculation parameters with data from international guidelines, and evaluation of major discrepancies.

Comparison of Danish data values from external data sources with corresponding data from other countries has been carried out in order to evaluate discrepancies.

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

The following external data sources are used for the inventory on waste (refer also to the Table 8.1):

Waste Incineration

- Tables from Association of Danish Crematoria available online
- Direct contact with the Danish animal crematoria
- Emission factors from literature

Data from the Association of Danish Crematoria is based on annual reporting from all Danish crematoria. Specific reported data are available for the complete time series.

Other Waste

- Waste Statistics (DEPA, 1996, 1998, 1999, 2001a, 2001b, 2002, 2004a, 2004b, 2005, 2006a, 2007, 2008, 2010, 2011a)
- The Danish Emergency Management Agency (DEMA) database
- Emission factors from literature

The waste statistics are based on data from the ISAG database which is the only Danish registration of waste amounts. Also the DEMA database is the only provider of data on accidental fires.

Data Storage level 1	4.Consistency	DS.1.4.1	The original external data has to be archived with proper reference.

Data are predominantly extracted from the internet (ISAG, Statistics Denmark, DEMA database, human cremation, etc.). The origin of external activity data has been preserved as much as possible by saving them as original copies in their original form. Files are saved for each year of reporting, in this way changes to previously received data and calculations is reflected and explanations are given. Specific information from reports, industries and experts are saved as e-mails and pdf files.

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

As stated in DS.1.4.1 most data are obtained from the internet. It is a statutory requirement that amounts of waste are reported annually to DEPA, no later than January 31 for the previous year. No explicit agreements have been made with external institutions.

Data Storage level 1	7.Transparency	DS.1.7.1	Listing of all archived datasets and external contacts.

Contact persons related to the delivery of specific data are provided in Table 8.1.

For a listing of all archived external datasets, see DS 1.3.1.

Data Processing level 1	1. Accuracy	DP.1.1.1	Uncertainty assessment for every data source not part of DS.1.1.1 as input to Data Storage level 2 in relation to type and scale of variability.

No data are used in addition to those included in DS.1.1.1. Uncertainties are reported in Section 7.

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

The methodological approaches applied in this sector report follow the methodology as outlined in the Emission Inventory Guidebook. Exemptions have been documented whenever occurring. The inventory calculations for Waste Incineration and Other Waste are a simple multiplication of activity data and emission factors. See also DS.1.3.1.

Data Processing level 1	3.Completeness	DP.1.3.1	Identification of data gaps with regard to data sources that could improve quantitative knowledge.

Emission factors for cremation and accidental fires are gathered from literature studies. There is no Danish literature or measurements available on emissions from these categories.

Activity data for accidental fires for the years 1980-2006 are not subcategorised into vehicles, buildings or sizes. Also, activity data for animal cremation and composting are at the present estimated by the author's expert judgement and linear regression for the years 1980-1997 and 1980-1994, 2010, 2011 respectively.

It has not been possible to obtain the relevant data for estimating emissions from other combustion sources like open burning of yard waste and bonfires, this category is therefore incomplete.

Data Processing level 1	4.Consistency	DP.1.4.1	Documentation and reasoning of methodological changes during the time series and the qualitative assessment of the impact on time series consistency.

There are no changes in the calculation procedure during the time series. And the activity data are, as far as possible, kept consistent for the calculation of the time series. Any changes in calculation procedures are noted for each year's inventory, cf. Section 8.6.4.

Data Processing level 1	5.Correctness	DP.1.5.1	Verification of calculation results using time series

The time series of activities and emissions, in the SNAP source categories and in the CRF/NFR format have been prepared. The time series are examined and significant changes are checked and explained. Comparison is made with the previous year's estimate and any major changes are verified.

Data Processing level 1	5.Correctness	DP.1.5.2	Verification of calculation results using other measures

The correct interpretation in the calculations described in the methodology sections, has been checked as far as possible.

Data Processing level 1	7.Transparency	DP.1.7.1	The calculation principle, the equations used and the assumptions made must be described.

The calculation principles are described in Section 3 Methodology.

Data Processing level 1	7.Transparency	DP.1.7.2	Clear reference to dataset at Data Storage level 1

Refer to the start of this Section 8.1.5 Points of measurement, Table 8.1 and DS.1.1.1 – DS.1.3.1.

Data Processing level 1	7.Transparency	DP.1.7.3	A manual log to collect information about recalculations.

Recalculation and changes in the emission inventories are described in the sector report whenever occurring. The logging of the changes takes place in the annual model file.

Data Storage level 2	5.Correctness	DS.2.5.1	Check if a correct data import to level 2 has been made

The transfer of emission data from level 1, storage and processing, to data storage level 2 is manually checked. This check is performed, comparing model output and report files made by the CollectER database system.

Data Storage level 4	4. Consistency	DS.4.4.3	The IEFs from the CRF are checked both regarding level and trend. The level is compared to relevant emission factors to ensure correctness. Large dips/jumps in the time series are explained.

See DP.1.5.1 and DP.1.5.2.

9 Conclusion

The annual Danish emission inventories are prepared and reported by DCE - Danish Centre for Environment and Energy at Aarhus University. The inventories are based on different online databases and on emission factors from literature.

Emissions from cremation of human corpses and animal carcasses have increased with 21 % and 2337 % from 1980 to 2011 respectively. Since animal cremation is the smaller of these two activities, the joint increase of emissions from cremation is 73 % since 1980 and 39% since 1990.

The activities of composting and building fires have increased with 625 % and 2 % respectively from 1980 to 2011 (1985-2011 for composting) while vehicle fires have decreased with 15 % during the same period. Together, these three activities have increased with 573 % since 1985 and 234 % since 1990 (calculated in mass activity).

In 2011 the total Danish emission of greenhouse gasses was 53,583 Gg carbon dioxide equivalents (CO_2 eqv.). Emissions from the source categories waste incineration and other waste accounts for 147 Gg CO_2 eqv. or approximately 0.3 %. The major part of the emissions is emitted as methane (CH_4) (57 %), and the major part of the CH_4 emission is emitted from the other waste subsector composting (98 % of CH_4 emissions). The major source of nitrous oxide (N_2O) is also composting (99 % of N_2O emissions). And the major source of CO_2 emissions is accidental building fires with 12 Gg in 2011 or 67 % of the emission of non-biogenic CO_2 from waste incineration and other waste.

Besides the greenhouse gasses CO_2, CH_4 and N_2O, of interesting emissions in the inventory on emissions from waste incineration and other waste can be mentioned SO_2, NO_x, particulate matter and heavy metals. Accidental building fires are the major source of SO_2 emissions with 598 Mg or 97 % of the sector in 2011 and human cremation is the major source to NO_x emissions closely followed by building fires (39 % and 38 % respectively). Building fires are also the major source of particle emissions with 173 Mg or 96 % in 2011. The most important heavy metal emissions are in this context those of Zn, Pb and Hg. All three were somewhat constant from 1980-2010 but has strongly decreased from 2010 to 2011; Zn, Pb and Hg have decreased with 15 %, 14 % and 97 % respectively to the total emissions of 444 kg, 113 kg and 1 kg respectively in 2011. This decrease is caused by installation of particle filters at all Danish crematoria and by fewer vehicle fires. In 2011, 96 % of all remaining heavy metal emissions (As, Cd, Cr, Cu, Hg, Ni, Pb, Se and Zn) from the source category waste incineration and other waste were caused by accidental vehicle fires.

There are two planned improvements to this report; the first is implementation of new and updated emission factors for combustion of biogas. And the second is implementation of activity data for composting provided from the new waste database that should be ready during 2013.

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Annex

Annex 1 Emissions

Table A1.1 presents the greenhouse gas emissions from the waste sector (CRF/NFR categories 6C and 6D); all emissions in this table are shown in CO_2-equivalents.

Table A1.1 GHG emissions for the waste sector, Gg CO_2 equivalents.

		1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
6 C. Waste incineration	CH_4	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
6 C. Waste incineration	N_2O	0.16	0.16	0.16	0.17	0.16	0.17	0.18	0.18	0.19	0.19
6 D Other	CO_2	19	19	19	19	19	19	19	19	19	19
6 D Other	CH_4	2	2	2	2	2	15	18	21	24	27
6 D Other	N_2O	NAV	NAV	NAV	NAV	NAV	6	7	8	9	10
6. Total GHG		21	21	21	21	21	40	44	48	52	57
Continued		1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
6 C. Waste incineration	CH_4	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
6 C. Waste incineration	N_2O	0.20	0.20	0.20	0.21	0.21	0.21	0.21	0.21	0.21	0.22
6 D Other	CO_2	18	19	20	18	18	20	20	19	18	19
6 D Other	CH_4	30	32	35	38	41	38	44	51	53	60
6 D Other	N_2O	12	13	14	15	17	16	19	22	26	34
6. Total GHG		60	64	69	72	76	74	84	92	97	114
Continued		2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
6 C. Waste incineration	CH_4	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02
6 C. Waste incineration	N_2O	0.22	0.22	0.23	0.22	0.23	0.24	0.27	0.28	0.28	0.29
6 D Other	CO_2	19	19	18	20	18	18	19	19	21	21
6 D Other	CH_4	64	60	65	68	65	70	74	82	75	80
6 D Other	N_2O	41	39	51	51	31	32	35	40	38	41
6. Total GHG		125	118	135	139	113	120	128	142	134	142
Continued		2010	2011								
6 C. Waste incineration	CH_4	0.02	0.01								
6 C. Waste incineration	N_2O	0.29	0.27								
6 D Other	CO_2	18	18								
6 D Other	CH_4	82	84								
6 D Other	N_2O	43	44								
6. Total GHG		143	147								

NAV = Not available

Table A1.2, A1.3, A1.4 and A1.5 presents emissions from the waste sector for the years 1980-1989, 1990-1999, 2000-2009 and 2010-2011 respectively.Table A1.2 Emissions for the waste sector, 1980-1989.

		1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
SO_2	Mg	599.1	599.2	599.1	599.3	599.2	600.1	601.2	602.1	602.8	636.4
- Human cremation	Mg	3.8	3.9	3.9	4.0	3.9	4.1	4.1	4.2	4.4	4.4
- Animal cremation	Mg	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.2
- Building fires	Mg	580.4	580.5	580.6	580.7	580.7	581.3	582.3	583.2	583.7	617.6
- Vehicle fires	Mg	14.8	14.7	14.6	14.5	14.4	14.4	14.6	14.5	14.5	14.2
NO_x	Mg	67.5	68.1	67.9	69.2	68.6	70.3	70.6	71.5	72.5	74.9
- Human cremation	Mg	28.0	28.5	28.3	29.4	28.7	30.3	30.4	31.1	31.9	32.4
- Animal cremation	Mg	0.6	0.8	0.9	1.0	1.1	1.3	1.4	1.5	1.6	1.8
- Building fires	Mg	32.9	32.9	32.9	32.9	32.9	33.0	33.0	33.1	33.1	35.1
- Vehicle fires	Mg	5.9	5.9	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.7
NMVOC	Mg	179.0	179.0	178.8	178.7	178.6	178.9	179.5	179.7	180.0	188.5
- Human cremation	Mg	0.4	0.4	0.4	0.5	0.5	0.5	0.5	0.5	0.5	0.5
- Animal cremation	Mg	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.3	0.3
- Building fires	Mg	153.3	153.4	153.4	153.4	153.4	153.7	154.1	154.4	154.6	163.5
- Vehicle fires	Mg	25.1	25.0	24.8	24.7	24.6	24.6	24.8	24.6	24.7	24.2
CH_4	Mg	81.6	81.6	81.5	81.4	81.4	735.7	866.7	1001.7	1142.4	1276.7
- Human cremation	Mg	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.5	0.5
- Animal cremation	Mg	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.02	0.03
- Composting	Mg	NAV	NAV	NAV	NAV	NAV	654.2	785.0	919.9	1060.4	1191.2
- Building fires	Mg	66.4	66.5	66.5	66.5	66.5	66.6	66.8	66.9	67.0	70.9
- Vehicle fires	Mg	14.8	14.7	14.6	14.5	14.4	14.4	14.6	14.5	14.5	14.2
CO	Mg	647.2	646.6	645.2	644.3	643.3	718.5	738.7	756.6	775.5	816.0
- Human cremation	Mg	0.3	0.3	0.3	0.4	0.3	0.4	0.4	0.4	0.4	0.4
- Animal cremation	Mg	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.02
- Composting	Mg	NAV	NAV	NAV	NAV	NAV	74.6	92.0	110.0	128.1	145.5
- Building fires	Mg	460.7	460.7	460.8	460.9	461.0	461.6	462.7	463.6	464.1	491.0
- Vehicle fires	Mg	186.2	185.5	184.0	183.0	182.0	182.0	183.7	182.6	182.9	179.1
CO_2 – non-biogenic	Gg	18.9	18.9	18.8	18.8	18.8	18.8	18.9	18.9	18.9	19.4
- Building fires	Gg	11.8	11.8	11.8	11.8	11.8	11.9	11.9	11.9	11.9	12.6
- Vehicle fires	Gg	7.1	7.1	7.0	7.0	6.9	6.9	7.0	7.0	7.0	6.8
N_2O	Mg	0.5	0.5	0.5	0.5	0.5	18.5	22.4	26.4	30.5	34.4
- Human cremation	Mg	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.6	0.6	0.6
- Animal cremation	Mg	0.01	0.01	0.02	0.02	0.02	0.02	0.02	0.03	0.03	0.03
- Composting	Mg	NAV	NAV	NAV	NAV	NAV	18.0	21.8	25.8	29.9	33.7
NH_3	Mg	0.1	0.1	0.1	0.2	0.2	99.5	120.6	142.4	164.8	185.9
- Animal cremation	Mg	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.3
- Composting	Mg	NAV	NAV	NAV	NAV	NAV	99.3	120.4	142.2	164.6	185.6
TSP	Mg	183.2	183.3	183.2	183.3	183.2	183.3	183.4	183.4	183.5	193.6
- Human cremation	Mg	1.3	1.3	1.3	1.4	1.3	1.4	1.4	1.5	1.5	1.5
- Animal cremation	Mg	0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.3	0.3	0.3
- Building fires	Mg	175.8	175.8	175.8	175.8	175.8	175.8	175.8	175.8	175.8	186.0
- Vehicle fires	Mg	6.1	6.0	6.0	6.0	5.9	5.9	6.0	5.9	6.0	5.8
PM_{10}	Mg	183.1	183.1	183.1	183.1	183.0	183.1	183.2	183.2	183.3	193.4
- Human cremation	Mg	1.2	1.2	1.2	1.2	1.2	1.3	1.3	1.3	1.3	1.4
- Animal cremation	Mg	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.2
- Building fires	Mg	175.8	175.8	175.8	175.8	175.8	175.8	175.8	175.8	175.8	186.0
- Vehicle fires	Mg	6.1	6.0	6.0	6.0	5.9	5.9	6.0	5.9	6.0	5.8
$PM_{2.5}$	Mg	183.1	183.1	183.0	183.1	183.0	183.1	183.2	183.2	183.2	193.4
- Human cremation	Mg	1.2	1.2	1.2	1.2	1.2	1.3	1.3	1.3	1.3	1.4
- Animal cremation	Mg	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.2
- Building fires	Mg	175.8	175.8	175.8	175.8	175.8	175.8	175.8	175.8	175.8	186.0
- Vehicle fires	Mg	6.1	6.0	6.0	6.0	5.9	5.9	6.0	5.9	6.0	5.8

NAV = Not available

Table A1.2 Emissions for the waste sector, 1980-1989 – Continued.

			1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
As		kg	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.3
	- Human cremation	kg	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
	- Animal cremation	kg	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.03	0.03	0.03
	- Building fires	kg	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.7
	- Vehicle fires	kg	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04
Cd		kg	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.6
	- Human cremation	kg	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
	- Animal cremation	kg	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
	- Building fires	kg	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.1
	- Vehicle fires	kg	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Cr		kg	2.6	2.6	2.6	2.6	2.6	2.7	2.7	2.7	2.7	2.8
	- Human cremation	kg	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
	- Animal cremation	kg	0.004	0.004	0.005	0.006	0.006	0.007	0.008	0.008	0.009	0.010
	- Building fires	kg	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.7
	- Vehicle fires	kg	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Cu		kg	8.5	8.5	8.5	8.5	8.4	8.4	8.5	8.5	8.5	8.6
	- Human cremation	kg	0.4	0.4	0.4	0.4	0.4	0.5	0.5	0.5	0.5	0.5
	- Animal cremation	kg	0.001	0.001	0.001	0.002	0.002	0.002	0.002	0.002	0.003	0.003
	- Building fires	kg	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.9
	- Vehicle fires	kg	4.4	4.4	4.4	4.4	4.3	4.3	4.4	4.3	4.4	4.3
Hg		kg	39.1	39.7	39.4	41.0	40.0	42.1	42.2	43.2	44.4	45.0
	- Human cremation	kg	38.0	38.7	38.3	39.9	39.0	41.1	41.2	42.1	43.3	43.9
	- Building fires	kg	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.1
Ni		kg	1.0	1.0	1.0	1.1	1.0	1.1	1.1	1.1	1.1	1.1
	- Human cremation	kg	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.7	0.7	0.7
	- Animal cremation	kg	0.003	0.004	0.004	0.005	0.005	0.006	0.007	0.007	0.008	0.008
	- Vehicle fires	kg	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
Pb		kg	131.6	131.1	130.1	129.4	128.7	128.7	129.9	129.2	129.5	126.8
	- Human cremation	kg	1.0	1.0	1.0	1.1	1.0	1.1	1.1	1.1	1.2	1.2
	- Animal cremation	kg	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.02	0.03
	- Building fires	kg	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
	- Vehicle fires	kg	130.0	129.6	128.5	127.8	127.1	127.1	128.3	127.5	127.8	125.1
Se		kg	0.7	0.7	0.7	0.7	0.7	0.8	0.8	0.8	0.8	0.8
	- Human cremation	kg	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.8	0.8
	- Animal cremation	kg	0.02	0.02	0.02	0.02	0.03	0.03	0.03	0.04	0.04	0.04
Zn		kg	516.7	515.0	510.8	508.2	505.3	505.6	510.3	507.5	508.6	498.0
	- Human cremation	kg	5.4	5.5	5.5	5.7	5.6	5.9	5.9	6.0	6.2	6.3
	- Animal cremation	kg	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.02	0.02	0.03
	- Vehicle fires	kg	511.2	509.5	505.3	502.5	499.7	499.7	504.3	501.5	502.4	491.7

Table A1.2 Emissions for the waste sector, 1980-1989 – Continued.

		1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
HCB	g	5.3	5.4	5.4	5.6	5.5	5.8	5.8	6.0	6.2	6.3
- Human cremation	g	5.2	5.2	5.2	5.4	5.3	5.6	5.6	5.7	5.9	5.9
- Animal cremation	g	0.1	0.1	0.2	0.2	0.2	0.2	0.3	0.3	0.3	0.3
PCDD/F	g I-TEQ	6.3	6.3	6.3	6.3	6.3	6.3	6.4	6.4	6.4	6.7
- Human cremation	g I-TEQ	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
- Animal cremation	g I-TEQ	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
- Building fires	g I-TEQ	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.3	6.6
- Vehicle fires	g I-TEQ	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Benzo(b)fluoranthene	kg	68.57	68.40	68.02	67.76	67.50	67.53	68.01	67.78	67.89	68.12
- Human cremation	kg	3E-04	3E-04	3E-04	3E-04	3E-04	3E-04	3E-04	3E-04	3E-04	3E-04
- Animal cremation	kg	6E-06	7E-06	8E-06	9E-06	1E-05	1E-05	1E-05	1E-05	1E-05	2E-05
- Building fires	kg	20.84	20.84	20.85	20.85	20.85	20.88	20.93	20.97	20.99	22.21
- Vehicle fires	kg	47.73	47.56	47.17	46.91	46.65	46.65	47.08	46.81	46.90	45.90
Benzo(k)fluoranthene	kg	55.08	54.91	54.52	54.26	54.00	54.01	54.46	54.21	54.30	53.74
- Human cremation	kg	2E-04	2E-04	2E-04	2E-04	2E-04	2E-04	2E-04	3E-04	3E-04	3E-04
- Animal cremation	kg	5E-06	6E-06	7E-06	8E-06	9E-06	1E-05	1E-05	1E-05	1E-05	1E-05
- Building fires	kg	7.35	7.35	7.35	7.35	7.35	7.36	7.38	7.39	7.40	7.83
- Vehicle fires	kg	47.73	47.56	47.17	46.91	46.65	46.65	47.08	46.81	46.90	45.90
Benzo(a)pyrene	kg	56.60	56.45	56.10	55.87	55.63	55.65	56.07	55.86	55.95	55.81
- Human cremation	kg	5E-04	5E-04	5E-04	5E-04	5E-04	5E-04	5E-04	5E-04	5E-04	5E-04
- Animal cremation	kg	1E-05	1E-05	1E-05	2E-05	2E-05	2E-05	2E-05	2E-05	3E-05	3E-05
- Building fires	kg	13.16	13.16	13.17	13.17	13.17	13.19	13.22	13.24	13.26	14.03
- Vehicle fires	kg	43.44	43.29	42.94	42.70	42.46	42.46	42.85	42.61	42.69	41.78
Indeno(1.2.3-cd)pyrene	kg	83.11	82.88	82.32	81.95	81.57	81.59	82.25	81.89	82.03	81.42
- Human cremation	kg	2E-04	2E-04	2E-04	3E-04	3E-04	3E-04	3E-04	3E-04	3E-04	3E-04
- Animal cremation	kg	5E-06	6E-06	7E-06	9E-06	1E-05	1E-05	1E-05	1E-05	1E-05	1E-05
- Building fires	kg	14.26	14.26	14.26	14.27	14.27	14.29	14.32	14.35	14.36	15.20
- Vehicle fires	kg	68.86	68.61	68.05	67.68	67.30	67.30	67.93	67.54	67.66	66.23
PCB	g	14.4	14.7	14.6	15.3	15.0	15.8	15.9	16.3	16.8	17.1
- Human cremation	g	14.1	14.3	14.2	14.8	14.4	15.2	15.2	15.6	16.0	16.2
- Animal cremation	g	0.3	0.4	0.4	0.5	0.6	0.6	0.7	0.8	0.8	0.9

Table A1.3 Emissions for the waste sector, 1990-1999.

			1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
SO_2		Mg	578.5	596.3	646.2	571.0	574.2	660.3	667.3	618.1	555.9	596.7
	- Human cremation	Mg	4.6	4.6	4.7	4.9	4.8	4.9	4.9	4.8	4.7	4.8
	- Animal cremation	Mg	0.3	0.3	0.3	0.3	0.3	0.3	0.4	0.4	0.4	0.6
	- Building fires	Mg	559.3	577.1	626.9	551.2	554.5	640.2	647.0	598.0	535.0	575.3
	- Vehicle fires	Mg	14.3	14.3	14.3	14.6	14.5	14.7	14.9	14.8	15.0	15.0
	- Combustion of biogas	Mg	NO	NO	NO	NO	0.02	0.12	0.11	0.11	0.89	1.09
NO_x		Mg	73.2	74.1	77.6	75.0	75.0	81.2	81.3	78.3	75.8	80.8
	- Human cremation	Mg	33.8	33.5	34.2	35.6	35.3	36.2	35.7	35.4	34.4	34.9
	- Animal cremation	Mg	1.9	2.0	2.2	2.3	2.4	2.5	2.7	2.8	3.0	4.7
	- Building fires	Mg	31.8	32.8	35.6	31.3	31.5	36.3	36.7	33.9	30.4	32.6
	- Vehicle fires	Mg	5.7	5.7	5.7	5.8	5.8	5.9	6.0	5.9	6.0	6.0
	- Combustion of biogas	Mg	NO	NO	NO	NO	0.1	0.3	0.3	0.3	2.1	2.6
NMVOC		Mg	173.2	177.9	191.0	171.6	172.3	195.2	197.4	184.3	168.1	179.1
	- Human cremation	Mg	0.5	0.5	0.5	0.6	0.6	0.6	0.6	0.6	0.5	0.5
	- Animal cremation	Mg	0.3	0.3	0.3	0.4	0.4	0.4	0.4	0.4	0.5	0.7
	- Building fires	Mg	148.0	152.7	165.8	145.8	146.7	169.3	171.0	158.2	141.5	152.2
	- Vehicle fires	Mg	24.4	24.4	24.3	24.8	24.7	25.0	25.4	25.2	25.4	25.4
	- Combustion of biogas	Mg	NO	NO	NO	NO	0.003	0.019	0.018	0.018	0.142	0.175
CH_4		Mg	1405.4	1542.6	1679.5	1806.4	1943.3	1797.0	2116.6	2432.5	2521.1	2876.0
	- Human cremation	Mg	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
	- Animal cremation	Mg	0.03	0.03	0.03	0.03	0.03	0.04	0.04	0.04	0.04	0.07
	- Composting	Mg	1326.4	1461.6	1592.9	1728.1	1864.7	1708.3	2027.0	2348.6	2444.1	2794.3
	- Building fires	Mg	64.1	66.2	71.8	63.2	63.6	73.4	74.1	68.5	61.3	65.9
	- Vehicle fires	Mg	14.3	14.3	14.3	14.6	14.5	14.7	14.9	14.8	15.0	15.0
	- Combustion of biogas	Mg	NO	NO	NO	NO	0.003	0.019	0.018	0.018	0.142	0.175
CO		Mg	789.0	821.1	877.5	839.5	858.6	907.3	958.5	960.7	926.6	1005.7
	- Human cremation	Mg	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
	- Animal cremation	Mg	0.02	0.02	0.03	0.03	0.03	0.03	0.03	0.03	0.04	0.06
	- Composting	Mg	163.5	181.5	198.9	216.9	234.5	213.1	255.8	298.6	311.5	358.2
	- Building fires	Mg	444.5	458.6	497.9	438.0	440.5	508.4	513.7	475.1	424.9	457.1
	- Vehicle fires	Mg	180.6	180.6	180.2	184.1	183.2	185.2	188.3	186.4	188.5	188.4
	- Combustion of biogas	Mg	NO	NO	NO	NO	0.03	0.17	0.16	0.16	1.27	1.57
CO_2 – non-biogenic		Gg	18.3	18.6	19.6	18.3	18.3	20.1	20.4	19.3	18.1	18.9
	- Building fires	Gg	11.4	11.8	12.8	11.2	11.3	13.1	13.2	12.2	10.9	11.7
	- Vehicle fires	Gg	6.9	6.9	6.9	7.0	7.0	7.1	7.2	7.1	7.2	7.2
N_2O		Mg	38.4	42.5	46.5	50.6	54.6	52.4	61.1	71.1	84.4	111.5
	- Human cremation	Mg	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
	- Animal cremation	Mg	0.03	0.04	0.04	0.04	0.04	0.05	0.05	0.05	0.05	0.08
	- Composting	Mg	37.8	41.9	45.9	49.9	54.0	51.7	60.5	70.4	83.7	110.7
	- Combustion of biogas	Mg	NO	NO	NO	NO	0.002	0.009	0.009	0.009	0.071	0.087
NH_3		Mg	208.0	230.1	251.8	273.9	295.9	274.5	324.0	377.0	392.1	450.7
	- Animal cremation	Mg	0.3	0.3	0.3	0.3	0.4	0.4	0.4	0.4	0.4	0.7
	- Composting	Mg	207.7	229.8	251.5	273.5	295.6	274.1	323.6	376.6	391.6	450.0
TSP		Mg	176.4	182.0	197.2	174.4	175.5	201.7	203.9	188.8	169.9	182.2
	- Human cremation	Mg	1.6	1.6	1.6	1.7	1.6	1.7	1.7	1.7	1.6	1.6
	- Animal cremation	Mg	0.3	0.3	0.4	0.4	0.4	0.4	0.5	0.5	0.5	0.8
	- Building fires	Mg	168.6	174.2	189.4	166.4	167.5	193.5	195.6	180.6	161.6	173.7
	- Vehicle fires	Mg	5.9	5.9	5.9	6.0	6.0	6.0	6.1	6.1	6.1	6.1

NO = Not occurring

Table A1.3 Emissions for the waste sector, 1990-1999 – Continued.

			1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
PM_{10}		Mg	176.1	181.7	196.9	174.1	175.3	201.4	203.6	188.5	169.5	181.8
	- Human cremation	Mg	1.4	1.4	1.4	1.5	1.5	1.5	1.5	1.5	1.4	1.5
	- Animal cremation	Mg	0.2	0.2	0.3	0.3	0.3	0.3	0.3	0.3	0.4	0.6
	- Building fires	Mg	168.6	174.2	189.4	166.4	167.5	193.5	195.6	180.6	161.6	173.7
	- Vehicle fires	Mg	5.9	5.9	5.9	6.0	6.0	6.0	6.1	6.1	6.1	6.1
$PM_{2.5}$		Mg	176.1	181.7	196.9	174.1	175.2	201.3	203.5	188.4	169.5	181.7
	- Human cremation	Mg	1.4	1.4	1.4	1.5	1.5	1.5	1.5	1.5	1.4	1.5
	- Animal cremation	Mg	0.2	0.2	0.2	0.2	0.2	0.3	0.3	0.3	0.3	0.5
	- Building fires	Mg	168.6	174.2	189.4	166.4	167.5	193.5	195.6	180.6	161.6	173.7
	- Vehicle fires	Mg	5.9	5.9	5.9	6.0	6.0	6.0	6.1	6.1	6.1	6.1
As		kg	2.2	2.3	2.4	2.2	2.2	2.5	2.5	2.4	2.2	2.3
	- Human cremation	kg	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
	- Animal cremation	kg	0.03	0.03	0.04	0.04	0.04	0.04	0.04	0.05	0.05	0.08
	- Building fires	kg	1.6	1.6	1.8	1.6	1.6	1.8	1.8	1.7	1.5	1.6
	- Vehicle fires	kg	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04
Cd		kg	1.5	1.5	1.6	1.5	1.5	1.6	1.6	1.6	1.4	1.5
	- Human cremation	kg	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
	- Animal cremation	kg	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.004
	- Building fires	kg	1.0	1.0	1.1	1.0	1.0	1.1	1.2	1.1	1.0	1.0
	- Vehicle fires	kg	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Cr		kg	2.6	2.7	2.8	2.7	2.7	2.9	3.0	2.8	2.6	2.8
	- Human cremation	kg	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
	- Animal cremation	kg	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.03
	- Building fires	kg	1.5	1.6	1.7	1.5	1.5	1.7	1.8	1.6	1.4	1.6
	- Vehicle fires	kg	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Cu		kg	8.3	8.4	8.7	8.4	8.4	9.0	9.1	8.7	8.4	8.6
	- Human cremation	kg	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
	- Animal cremation	kg	0.003	0.003	0.003	0.004	0.004	0.004	0.004	0.004	0.005	0.007
	- Building fires	kg	3.5	3.6	3.9	3.5	3.5	4.0	4.1	3.8	3.4	3.6
	- Vehicle fires	kg	4.3	4.3	4.3	4.4	4.4	4.4	4.5	4.4	4.5	4.5
Hg		kg	46.9	46.5	47.5	49.3	48.8	50.2	49.6	49.1	47.6	48.4
	- Human cremation	kg	45.9	45.5	46.4	48.3	47.9	49.1	48.4	48.0	46.6	47.3
	- Building fires	kg	1.0	1.0	1.1	1.0	1.0	1.1	1.2	1.1	1.0	1.0
Ni		kg	1.1	1.1	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2
	- Human cremation	kg	0.7	0.7	0.7	0.7	0.7	0.8	0.7	0.7	0.7	0.7
	- Animal cremation	kg	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02
	- Vehicle fires	kg	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
Pb		kg	127.9	127.9	127.7	130.4	129.8	131.3	133.5	132.1	133.4	133.4
	- Human cremation	kg	1.2	1.2	1.2	1.3	1.3	1.3	1.3	1.3	1.3	1.3
	- Animal cremation	kg	0.03	0.03	0.03	0.03	0.03	0.04	0.04	0.04	0.04	0.07
	- Building fires	kg	0.5	0.5	0.6	0.5	0.5	0.6	0.6	0.5	0.5	0.5
	- Vehicle fires	kg	126.1	126.1	125.8	128.6	128.0	129.3	131.5	130.2	131.6	131.6
Se		kg	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9
	- Human cremation	kg	0.8	0.8	0.8	0.9	0.8	0.9	0.9	0.8	0.8	0.8
	- Animal cremation	kg	0.05	0.05	0.05	0.05	0.06	0.06	0.06	0.07	0.07	0.11
Zn		kg	502.4	502.4	501.5	512.5	510.0	515.6	524.2	518.8	524.3	524.2
	- Human cremation	kg	6.6	6.5	6.6	6.9	6.8	7.0	6.9	6.9	6.7	6.8
	- Animal cremation	kg	0.03	0.03	0.03	0.03	0.04	0.04	0.04	0.04	0.04	0.07
	- Vehicle fires	kg	495.8	495.9	494.8	505.5	503.2	508.5	517.2	511.9	517.6	517.4

Table A1.3 Emissions for the waste sector, 1990-1999 – Continued.

		1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
HCB	g	6.6	6.5	6.7	7.0	6.9	7.1	7.0	7.0	6.9	7.3
- Human cremation	g	6.2	6.2	6.3	6.5	6.5	6.6	6.6	6.5	6.3	6.4
- Animal cremation	g	0.3	0.4	0.4	0.4	0.4	0.5	0.5	0.5	0.5	0.9
PCDD/F	g I-TEQ	6.1	6.3	6.8	6.0	6.1	7.0	7.1	6.5	5.9	6.3
- Human cremation	g I-TEQ	0.01	0.01	0.01	0.02	0.01	0.02	0.02	0.02	0.01	0.01
- Animal cremation	g I-TEQ	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.004
- Building fires	g I-TEQ	6.0	6.2	6.7	5.9	5.9	6.9	6.9	6.4	5.7	6.2
- Vehicle fires	g I-TEQ	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Benzo(b)fluoranthene	kg	66.40	67.04	68.72	67.00	66.90	70.47	71.52	69.28	67.54	68.97
- Human cremation	kg	3E-04	3E-04	3E-04	3E-04	3E-04	3E-04	3E-04	3E-04	3E-04	3E-04
- Animal cremation	kg	2E-05	2E-05	2E-05	2E-05	2E-05	2E-05	2E-05	2E-05	3E-05	4E-05
- Building fires	kg	20.11	20.75	22.53	19.81	19.93	23.00	23.24	21.49	19.22	20.68
- Vehicle fires	kg	46.29	46.29	46.19	47.19	46.97	47.47	48.28	47.79	48.32	48.30
Benzo(k)fluoranthene	kg	53.38	53.61	54.13	54.18	54.00	55.58	56.48	55.37	55.10	55.59
- Human cremation	kg	3E-04	3E-04	3E-04	3E-04	3E-04	3E-04	3E-04	3E-04	3E-04	3E-04
- Animal cremation	kg	1E-05	2E-05	2E-05	2E-05	2E-05	2E-05	2E-05	2E-05	2E-05	4E-05
- Building fires	kg	7.09	7.32	7.94	6.99	7.03	8.11	8.20	7.58	6.78	7.29
- Vehicle fires	kg	46.29	46.29	46.19	47.19	46.97	47.47	48.28	47.79	48.32	48.30
Benzo(a)pyrene	kg	54.83	55.24	56.27	55.47	55.34	57.74	58.63	57.07	56.12	57.02
- Human cremation	kg	6E-04	6E-04	6E-04	6E-04	6E-04	6E-04	6E-04	6E-04	6E-04	6E-04
- Animal cremation	kg	3E-05	3E-05	3E-05	4E-05	4E-05	4E-05	4E-05	4E-05	5E-05	7E-05
- Building fires	kg	12.70	13.10	14.23	12.51	12.59	14.53	14.68	13.57	12.14	13.06
- Vehicle fires	kg	42.13	42.13	42.04	42.95	42.75	43.21	43.95	43.50	43.98	43.96
Indeno(1.2.3-cd)pyrene	kg	80.54	80.98	82.05	81.64	81.40	84.23	85.56	83.65	82.86	83.83
- Human cremation	kg	3E-04	3E-04	3E-04	3E-04	3E-04	3E-04	3E-04	3E-04	3E-04	3E-04
- Animal cremation	kg	2E-05	2E-05	2E-05	2E-05	2E-05	2E-05	2E-05	2E-05	3E-05	4E-05
- Building fires	kg	13.76	14.19	15.41	13.56	13.63	15.74	15.90	14.70	13.15	14.15
- Vehicle fires	kg	66.78	66.78	66.64	68.08	67.77	68.49	69.66	68.94	69.71	69.68
PCB	g	17.9	17.8	18.2	19.0	18.9	19.4	19.2	19.1	18.7	19.8
- Human cremation	g	17.0	16.8	17.1	17.9	17.7	18.1	17.9	17.7	17.2	17.5
- Animal cremation	g	1.0	1.0	1.1	1.1	1.2	1.3	1.3	1.4	1.5	2.3

Table A1.4 Emissions for the waste sector, 2000-2009.

			2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
SO_2		Mg	586.7	581.4	565.5	636.2	552.8	573.3	589.2	702.2	662.2	640.6
	- Human cremation	Mg	4.7	4.7	4.8	4.7	4.7	4.6	4.6	4.7	4.7	4.8
	- Animal cremation	Mg	0.8	0.8	0.8	0.8	1.0	1.3	1.9	2.2	2.3	2.3
	- Building fires	Mg	565.2	560.2	544.4	615.2	532.1	552.4	567.8	683.6	638.3	615.9
	- Vehicle fires	Mg	15.1	15.0	14.8	14.5	14.3	14.4	14.8	11.7	16.9	17.6
	- Combustion of biogas	Mg	1.02	0.68	0.76	0.89	0.72	0.55	NO	NO	NO	NO
NO_x		Mg	80.5	79.6	79.6	83.5	79.3	81.9	86.5	92.9	95.4	94.2
	- Human cremation	Mg	34.4	34.4	35.1	34.6	34.3	33.6	34.0	34.5	34.5	35.0
	- Animal cremation	Mg	5.6	5.7	5.7	5.9	7.2	9.7	14.2	16.3	17.0	17.0
	- Building fires	Mg	32.1	31.9	31.0	35.1	30.4	31.5	32.4	37.4	37.2	35.2
	- Vehicle fires	Mg	6.0	6.0	5.9	5.8	5.7	5.8	5.9	4.7	6.7	7.0
	- Combustion of biogas	Mg	2.4	1.6	1.8	2.1	1.7	1.3	NO	NO	NO	NO
NMVOC		Mg	176.9	175.8	171.5	190.1	167.9	173.8	179.4	196.5	204.1	197.7
	- Human cremation	Mg	0.5	0.5	0.6	0.5	0.5	0.5	0.5	0.5	0.5	0.6
	- Animal cremation	Mg	0.9	0.9	0.9	0.9	1.1	1.5	2.2	2.6	2.7	2.7
	- Building fires	Mg	149.7	148.9	144.8	163.8	141.8	147.2	151.4	173.5	172.2	164.6
	- Vehicle fires	Mg	25.6	25.4	25.1	24.6	24.3	24.5	25.2	19.9	28.7	29.9
	- Combustion of biogas	Mg	0.164	0.109	0.122	0.142	0.115	0.088	NO	NO	NO	NO
CH_4		Mg	3055.1	2858.5	3096.1	3235.1	3079.1	3310.4	3502.4	3902.6	3567.6	3795.5
	- Human cremation	Mg	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
	- Animal cremation	Mg	0.08	0.08	0.08	0.08	0.10	0.14	0.20	0.23	0.24	0.24
	- Composting	Mg	2974.4	2778.3	3017.9	3148.9	3002.6	3231.5	3421.3	3815.0	3475.4	3705.8
	- Building fires	Mg	64.9	64.5	62.8	71.0	61.5	63.8	65.6	75.2	74.6	71.3
	- Vehicle fires	Mg	15.1	15.0	14.8	14.5	14.3	14.4	14.8	11.7	16.9	17.6
	- Combustion of biogas	Mg	0.164	0.109	0.122	0.142	0.115	0.088	NO	NO	NO	NO
CO		Mg	1023.8	992.4	1008.9	1080.1	991.9	1040.4	1082.8	1166.5	1182.6	1193.0
	- Human cremation	Mg	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
	- Animal cremation	Mg	0.07	0.07	0.07	0.07	0.09	0.12	0.17	0.20	0.21	0.21
	- Composting	Mg	382.4	356.0	387.0	404.4	385.3	416.2	441.5	494.4	448.8	478.2
	- Building fires	Mg	449.5	446.6	434.4	491.3	425.2	441.2	453.9	524.1	520.8	493.0
	- Vehicle fires	Mg	190.0	188.4	185.9	182.6	179.9	181.6	186.8	147.4	212.4	221.2
	- Combustion of biogas	Mg	1.48	0.98	1.10	1.28	1.03	0.79	NO	NO	NO	NO
CO_2 – non-biogenic		Gg	18.8	18.6	18.2	19.5	17.7	18.2	18.7	19.3	21.4	21.0
	- Building fires	Gg	11.5	11.4	11.1	12.6	10.9	11.3	11.6	13.7	13.3	12.6
	- Vehicle fires	Gg	7.2	7.2	7.1	7.0	6.9	6.9	7.1	5.6	8.1	8.4
N_2O		Mg	134.6	127.8	164.8	166.1	100.2	105.6	114.9	131.1	122.2	133.0
	- Human cremation	Mg	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
	- Animal cremation	Mg	0.10	0.10	0.10	0.10	0.13	0.17	0.25	0.29	0.30	0.30
	- Composting	Mg	133.8	127.0	164.0	165.4	99.4	104.7	114.0	130.2	121.3	132.1
	- Combustion of biogas	Mg	0.082	0.055	0.061	0.071	0.057	0.044	NO	NO	NO	NO
NH_3		Mg	480.4	450.9	494.3	515.4	482.9	517.0	548.6	610.3	557.6	600.4
	- Animal cremation	Mg	0.8	0.9	0.9	0.9	1.1	1.4	2.1	2.4	2.5	2.5
	- Composting	Mg	479.6	450.0	493.4	514.5	481.8	515.5	546.5	607.8	555.1	597.8
TSP		Mg	178.8	176.0	170.7	191.2	166.4	173.0	178.1	191.5	207.3	197.0
	- Human cremation	Mg	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6
	- Animal cremation	Mg	1.0	1.0	1.0	1.0	1.2	1.7	2.4	2.8	2.9	2.9
	- Building fires	Mg	170.1	167.3	162.0	182.6	157.7	163.9	168.0	182.3	195.9	185.2
	- Vehicle fires	Mg	6.2	6.1	6.0	5.9	5.9	5.9	6.1	4.8	6.9	7.2

NO = Not occurring

Table A1.4 Emissions for the waste sector, 2000-2009 – Continued.

			2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
PM_{10}		Mg	178.4	175.6	170.2	190.7	165.9	172.4	177.2	190.5	206.3	195.9
	- Human cremation	Mg	1.4	1.4	1.5	1.5	1.4	1.4	1.4	1.4	1.5	1.5
	- Animal cremation	Mg	0.7	0.7	0.7	0.7	0.9	1.2	1.7	2.0	2.0	2.0
	- Building fires	Mg	170.1	167.3	162.0	182.6	157.7	163.9	168.0	182.3	195.9	185.2
	- Vehicle fires	Mg	6.2	6.1	6.0	5.9	5.9	5.9	6.1	4.8	6.9	7.2
$PM_{2.5}$		Mg	178.3	175.5	170.1	190.6	165.8	172.2	177.0	190.2	206.0	195.6
	- Human cremation	Mg	1.4	1.4	1.5	1.5	1.4	1.4	1.4	1.4	1.5	1.5
	- Animal cremation	Mg	0.6	0.6	0.6	0.6	0.7	1.0	1.5	1.7	1.8	1.8
	- Building fires	Mg	170.1	167.3	162.0	182.6	157.7	163.9	168.0	182.3	195.9	185.2
	- Vehicle fires	Mg	6.2	6.1	6.0	5.9	5.9	5.9	6.1	4.8	6.9	7.2
As		kg	2.3	2.3	2.2	2.4	2.2	2.3	2.4	2.6	2.7	2.6
	- Human cremation	kg	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
	- Animal cremation	kg	0.09	0.09	0.09	0.10	0.12	0.16	0.23	0.27	0.28	0.28
	- Building fires	kg	1.6	1.6	1.5	1.7	1.5	1.5	1.6	1.7	1.8	1.7
	- Vehicle fires	kg	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.03	0.05	0.05
Cd		kg	1.5	1.5	1.4	1.6	1.4	1.4	1.5	1.5	1.7	1.6
	- Human cremation	kg	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
	- Animal cremation	kg	0.004	0.005	0.005	0.005	0.006	0.008	0.011	0.013	0.013	0.013
	- Building fires	kg	1.0	1.0	1.0	1.1	0.9	1.0	1.0	1.1	1.2	1.1
	- Vehicle fires	kg	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.2	0.3	0.3
Cr		kg	2.7	2.7	2.6	2.8	2.6	2.6	2.7	2.8	3.1	3.0
	- Human cremation	kg	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
	- Animal cremation	kg	0.031	0.032	0.032	0.032	0.040	0.053	0.078	0.090	0.094	0.094
	- Building fires	kg	1.5	1.5	1.5	1.6	1.4	1.5	1.5	1.6	1.8	1.7
	- Vehicle fires	kg	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.5	0.7	0.7
Cu		kg	8.6	8.5	8.3	8.7	8.1	8.3	8.5	7.8	9.7	9.7
	- Human cremation	kg	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
	- Animal cremation	kg	0.009	0.009	0.009	0.009	0.011	0.015	0.022	0.026	0.027	0.027
	- Building fires	kg	3.5	3.5	3.4	3.8	3.3	3.4	3.5	3.8	4.1	3.9
	- Vehicle fires	kg	4.5	4.5	4.4	4.3	4.3	4.3	4.4	3.5	5.1	5.3
Hg		kg	47.6	47.7	48.6	48.1	47.4	46.6	47.1	47.8	47.9	48.5
	- Human cremation	kg	46.6	46.7	47.6	47.0	46.5	45.6	46.1	46.7	46.8	47.5
	- Building fires	kg	1.0	1.0	1.0	1.1	0.9	1.0	1.0	1.1	1.2	1.1
Ni		kg	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.3	1.3
	- Human cremation	kg	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
	- Animal cremation	kg	0.027	0.027	0.027	0.028	0.034	0.046	0.067	0.077	0.080	0.080
	- Vehicle fires	kg	0.5	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.5	0.5
Pb		kg	134.5	133.4	131.7	129.4	127.4	128.7	132.4	104.9	150.4	156.6
	- Human cremation	kg	1.3	1.3	1.3	1.3	1.2	1.2	1.2	1.3	1.3	1.3
	- Animal cremation	kg	0.08	0.08	0.08	0.08	0.10	0.14	0.20	0.23	0.24	0.24
	- Building fires	kg	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.6	0.5
	- Vehicle fires	kg	132.7	131.6	129.8	127.5	125.6	126.9	130.4	102.9	148.3	154.5
Se		kg	1.0	1.0	1.0	1.0	1.0	1.0	1.2	1.2	1.2	1.2
	- Human cremation	kg	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
	- Animal cremation	kg	0.13	0.14	0.14	0.14	0.17	0.23	0.34	0.39	0.41	0.41
Zn		kg	528.4	524.0	517.4	508.3	500.7	505.5	519.7	411.6	590.1	614.6
	- Human cremation	kg	6.7	6.7	6.8	6.7	6.7	6.5	6.6	6.7	6.7	6.8
	- Animal cremation	kg	0.08	0.09	0.09	0.09	0.11	0.14	0.21	0.24	0.25	0.25
	- Vehicle fires	kg	521.6	517.3	510.5	501.4	493.9	498.8	512.9	404.7	583.2	607.5

Table A1.4 Emissions for the waste sector, 2000-2009 – Continued.

		2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
HCB	g	7.3	7.4	7.5	7.4	7.6	8.0	8.9	9.3	9.5	9.6
- Human cremation	g	6.3	6.3	6.4	6.4	6.3	6.2	6.2	6.3	6.3	6.4
- Animal cremation	g	1.0	1.1	1.1	1.1	1.3	1.8	2.6	3.0	3.1	3.1
PCDD/F	g I-TEQ	6.2	6.1	6.0	6.7	5.9	6.1	6.2	7.2	7.2	6.8
- Human cremation	g I-TEQ	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
- Animal cremation	g I-TEQ	0.004	0.005	0.005	0.005	0.006	0.008	0.011	0.013	0.013	0.013
- Building fires	g I-TEQ	6.1	6.0	5.8	6.6	5.7	5.9	6.1	7.1	7.1	6.6
- Vehicle fires	g I-TEQ	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Benzo(b)fluoranthene	kg	69.03	68.50	67.31	69.04	65.35	66.52	68.41	61.49	78.00	79.02
- Human cremation	kg	3E-04	4E-04	4E-04	4E-04	4E-04	4E-04	4E-04	4E-04	4E-04	5E-04
- Animal cremation	kg	5E-05	5E-05	5E-05	5E-05	6E-05	8E-05	1E-04	1E-04	1E-04	1E-04
- Building fires	kg	20.33	20.21	19.65	22.23	19.24	19.96	20.53	23.71	23.56	22.30
- Vehicle fires	kg	48.69	48.29	47.65	46.81	46.11	46.56	47.88	37.78	54.44	56.72
Benzo(k)fluoranthene	kg	55.86	55.41	54.59	54.65	52.89	53.60	55.12	46.14	62.75	64.58
- Human cremation	kg	3E-04	3E-04	3E-04	3E-04	3E-04	3E-04	4E-04	4E-04	4E-04	4E-04
- Animal cremation	kg	4E-05	4E-05	4E-05	5E-05	6E-05	8E-05	1E-04	1E-04	1E-04	1E-04
- Building fires	kg	7.17	7.13	6.93	7.84	6.78	7.04	7.24	8.36	8.31	7.86
- Vehicle fires	kg	48.69	48.29	47.65	46.81	46.11	46.56	47.88	37.78	54.44	56.72
Benzo(a)pyrene	kg	57.17	56.72	55.79	56.65	54.12	54.99	56.55	49.36	64.43	65.71
- Human cremation	kg	6E-04	6E-04	7E-04	6E-04	7E-04	7E-04	8E-04	8E-04	8E-04	8E-04
- Animal cremation	kg	9E-05	9E-05	9E-05	9E-05	1E-04	2E-04	2E-04	3E-04	3E-04	3E-04
- Building fires	kg	12.84	12.76	12.41	14.04	12.15	12.61	12.97	14.97	14.88	14.08
- Vehicle fires	kg	44.32	43.95	43.38	42.61	41.97	42.38	43.58	34.39	49.55	51.62
Indeno(1.2.3-cd)pyrene	kg	84.17	83.49	82.20	82.74	79.69	80.83	83.13	70.73	94.66	97.08
- Human cremation	kg	3E-04	3E-04	3E-04	3E-04	4E-04	4E-04	4E-04	4E-04	4E-04	4E-04
- Animal cremation	kg	5E-05	5E-05	5E-05	5E-05	6E-05	8E-05	1E-04	1E-04	1E-04	1E-04
- Building fires	kg	13.91	13.82	13.45	15.21	13.16	13.66	14.05	16.22	16.12	15.26
- Vehicle fires	kg	70.25	69.67	68.75	67.54	66.52	67.18	69.08	54.51	78.54	81.83
PCB	g	20.0	20.1	20.5	20.3	20.8	21.7	24.2	25.4	25.8	26.1
- Human cremation	g	17.2	17.2	17.6	17.4	17.2	16.9	17.1	17.3	17.3	17.5
- Animal cremation	g	2.8	2.9	2.9	2.9	3.6	4.9	7.1	8.2	8.5	8.5

Table A1.5 Emissions for the waste sector, 2010-2011.

		2010	2011
SO_2	Mg	565.0	617.6
- Human cremation	Mg	4.7	4.7
- Animal cremation	Mg	2.5	2.1
- Building fires	Mg	543.0	598.2
- Vehicle fires	Mg	14.8	12.6
NO_x	Mg	90.5	88.2
- Human cremation	Mg	34.7	34.0
- Animal cremation	Mg	18.4	15.5
- Building fires	Mg	31.5	33.7
- Vehicle fires	Mg	5.9	5.1
NMVOC	Mg	177.7	182.4
- Human cremation	Mg	0.5	0.5
- Animal cremation	Mg	2.9	2.4
- Building fires	Mg	149.1	158.0
- Vehicle fires	Mg	25.2	21.5
CH_4	Mg	3908.8	4011.5
- Human cremation	Mg	0.5	0.5
- Animal cremation	Mg	0.26	0.22
- Composting	Mg	3828.6	3929.7
- Building fires	Mg	64.6	68.5
- Vehicle fires	Mg	14.8	12.6
CO	Mg	1123.5	1139.8
- Human cremation	Mg	0.4	0.4
- Animal cremation	Mg	0.22	0.19
- Composting	Mg	495.0	508.5
- Building fires	Mg	441.3	471.6
- Vehicle fires	Mg	186.5	159.1
CO_2 – non-biogenic	Gg	18.2	18.2
- Building fires	Gg	11.1	12.2
- Vehicle fires	Gg	7.1	6.1
N_2O	Mg	138.6	144.1
- Human cremation	Mg	0.6	0.6
- Animal cremation	Mg	0.33	0.28
- Composting	Mg	137.7	143.2
NH_3	Mg	616.9	632.9
- Animal cremation	Mg	2.8	2.3
- Composting	Mg	614.2	630.6
TSP	Mg	179.6	180.9
- Human cremation	Mg	1.6	0.0
- Animal cremation	Mg	3.2	2.7
- Building fires	Mg	168.8	173.0
- Vehicle fires	Mg	6.1	5.2
PM_{10}	Mg	178.5	180.1
- Human cremation	Mg	1.5	0.0
- Animal cremation	Mg	2.2	1.9
- Building fires	Mg	168.8	173.0
- Vehicle fires	Mg	6.1	5.2
$PM_{2.5}$	Mg	178.2	179.8
- Human cremation	Mg	1.5	0.0
- Animal cremation	Mg	1.9	1.6
- Building fires	Mg	168.8	173.0
- Vehicle fires	Mg	6.1	5.2

Table A1.5 Emissions for the waste sector, 2010-2011 – Continued.

			2010	2011
As		kg	2.5	2.5
	- Human cremation	kg	0.6	0.6
	- Animal cremation	kg	0.30	0.25
	- Building fires	kg	1.6	1.6
	- Vehicle fires	kg	0.04	0.04
Cd		kg	1.5	1.5
	- Human cremation	kg	0.2	0.2
	- Animal cremation	kg	0.014	0.012
	- Building fires	kg	1.0	1.0
	- Vehicle fires	kg	0.3	0.2
Cr		kg	2.8	2.7
	- Human cremation	kg	0.6	0.6
	- Animal cremation	kg	0.101	0.085
	- Building fires	kg	1.5	1.5
	- Vehicle fires	kg	0.6	0.5
Cu		kg	8.5	7.9
	- Human cremation	kg	0.5	0.5
	- Animal cremation	kg	0.029	0.024
	- Building fires	kg	3.5	3.6
	- Vehicle fires	kg	4.4	3.8
Hg		kg	48.1	1.5
	- Human cremation	kg	47.1	0.5
	- Building fires	kg	1.0	1.0
Ni		kg	1.3	1.2
	- Human cremation	kg	0.7	0.7
	- Animal cremation	kg	0.087	0.073
	- Vehicle fires	kg	0.4	0.4
Pb		kg	132.3	113.1
	- Human cremation	kg	1.3	1.2
	- Animal cremation	kg	0.26	0.22
	- Building fires	kg	0.5	0.5
	- Vehicle fires	kg	130.3	111.2
Se		kg	1.3	1.2
	- Human cremation	kg	0.8	0.8
	- Animal cremation	kg	0.44	0.37
Zn		kg	519.2	443.9
	- Human cremation	kg	6.7	6.6
	- Animal cremation	kg	0.28	0.23
	- Vehicle fires	kg	512.2	437.0

Table A1.5 Emissions for the waste sector, 2010-2011 – Continued.

		2010	2011
HCB	g	9.8	9.1
- Human cremation	g	6.4	6.3
- Animal cremation	g	3.4	2.8
PCDD/F	g I-TEQ	6.0	6.4
- Human cremation	g I-TEQ	0.01	0.00
- Animal cremation	g I-TEQ	0.014	0.012
- Building fires	g I-TEQ	5.9	6.3
- Vehicle fires	g I-TEQ	0.1	0.1
Benzo(b)fluoranthene	kg	67.77	62.13
- Human cremation	kg	5E-04	4E-04
- Animal cremation	kg	2E-04	1E-04
- Building fires	kg	19.96	21.33
- Vehicle fires	kg	47.81	40.80
Benzo(k)fluoranthene	kg	54.85	48.32
- Human cremation	kg	4E-04	4E-04
- Animal cremation	kg	1E-04	1E-04
- Building fires	kg	7.04	7.52
- Vehicle fires	kg	47.81	40.80
Benzo(a)pyrene	kg	56.13	50.61
- Human cremation	kg	8E-04	8E-04
- Animal cremation	kg	3E-04	2E-04
- Building fires	kg	12.61	13.47
- Vehicle fires	kg	43.52	37.13
Indeno(1.2.3-cd)pyrene	kg	82.64	73.46
- Human cremation	kg	4E-04	4E-04
- Animal cremation	kg	2E-04	1E-04
- Building fires	kg	13.66	14.60
- Vehicle fires	kg	68.98	58.86
PCB	g	26.6	24.8
- Human cremation	g	17.4	17.1
- Animal cremation	g	9.2	7.8

Annex 2 Activity data

Table A2.1 presents the activity data for human cremation. By assuming that the development of the cremation fraction is constant back to the year 1980, the fraction from 1980-1983 can be calculated from the trend of the development of 1984-2009. An estimation of the number of annual cremations from 1980-1983 is then found by multiplying the calculated cremation fraction with the number of nationally deceased persons.

Table A2.1 Activity data on human cremations.

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
Nationally deceased	55939	56359	55368	57156	57109	58378	58100	58136	58984	59397
Cremations	33986	34556	34256	35681	34811	36705	36805	37652	38711	39231
Cremation fraction, %	60.8	61.3	61.9	62.4	61.0	62.8	62.8	64.7	65.6	66.1
Continued	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Nationally deceased	60926	59581	60821	62809	61099	63127	61043	59898	58453	59179
Cremations	40991	40666	41455	43194	42762	43847	43262	42891	41660	42299
Cremation fraction, %	67.3	68.3	68.2	68.8	70.0	69.5	70.8	71.6	69.1	74.4
Continued	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Nationally deceased	57998	58355	58610	57574	55806	54962	55477	55604	54591	54872
Cremations	41651	41707	42539	41997	41555	40758	41233	41766	41788	42408
Cremation fraction, %	71.8	71.5	72.6	72.9	74.5	74.2	74.3	75.1	76.6	77.3
Continued	2010	2011								
Nationally deceased	54368	52516								
Cremations	42050	41248								
Cremation fraction, %	77.3	78.6								

Table A2.2 shows the activity data of the three animal crematoria that are reported in this sector.

Table A2.2 Activity data on animal cremations.

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
Total, Mg	50	60	70	80	90	100	110	120	130	140
Continued	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Total, Mg	150	160	170	180	190	200	210	220	235	368
Continued	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Total, Mg	443	452	451	462	571	762	1116	1284	1338	1339
Continued	2010	2011								
Total, Mg	1449	1219								

Table A2.2 shows the activity data for composting.

Table 2A.3 Activity data composting, Gg.

	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
Composting of garden and park waste	130	161	193	225	256	288	320	351	383	414
Composting of organic waste from households and other sources	5	7	9	11	13	16	19	23	26	29
Composting of sludge	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Home composting of garden and vegetable food waste	19	19	19	20	20	20	20	20	20	21
Total	154	187	221	256	289	324	359	394	429	464

Continued	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Composting of garden and park waste	376	452	528	551	634	677	630	685	716	682
Composting of organic waste from households and other sources	40	38	47	43	49	47	52	63	66	53
Composting of sludge	7	6	7	57	134	218	211	348	336	53
Home composting of garden and vegetable food waste	21	21	21	21	21	21	21	22	22	22
Total	444	517	603	672	838	963	914	1118	1140	810

Continued	2005	2006	2007	2008	2009	2010	2011
Composting of garden and park waste	737	782	876	795	847	877	901
Composting of organic waste from households and other sources	45	48	44	46	70	58	59
Composting of sludge	50	67	91	94	107	120	132
Home composting of garden and vegetable food waste	22	22	22	22	23	23	23
Total	854	919	1033	957	1047	1078	1115

NO = Not occurring.

Table A2.4 presents the occurrence of all fires, building and vehicle fires. The 1980-1988 data for all fires are estimated to be the average of 1989-2010 data.

Building and vehicle fires do not make up for all the national accidental fires. The total number of registered fires also include a portion of fires that does not fit into either building or vehicle fires, these are here called "Other fires" and will include e.g. a chair burning at a marked but mainly consist of "unknown/other" objects at "unknown/other open" locations.

Table A2.4 Occurrence of all fires and building and vehicle fires.

Year	All fires	Building fires	Vehicle fires	Other fires
1980	17 751	10 621	3497	3633
1981	17 751	10 621	3497	3633
1982	17 751	10 621	3497	3633
1983	17 751	10 621	3497	3633
1984	17 751	10 621	3497	3633
1985	17 751	10 621	3497	3633
1986	17 751	10 621	3497	3633
1987	17 751	10 621	3497	3633
1988	17 751	10 621	3497	3633
1989	18 784	11 239	3700	3845
1990	17 025	10 187	3354	3485
1991	17 589	10 524	3465	3600
1992	19 124	11 443	3767	3914
1993	16 803	10 054	3310	3439
1994	16 918	10 123	3333	3463
1995	19 543	11 694	3850	4000
1996	19 756	11 821	3892	4043
1997	18 236	10 911	3592	3732
1998	16 320	9 765	3215	3340
1999	17 538	10 494	3455	3589
2000	17 174	10 276	3383	3515
2001	16 894	10 108	3328	3458
2002	16 362	9 790	3223	3349
2003	18 443	11 035	3633	3775
2004	15 927	9 530	3137	3260
2005	16 551	9 903	3260	3387
2006	16 965	10 151	3342	3472
2007	18 263	12 527	3223	2513
2008	20 643	12 124	4068	4451
2009	18 930	10 652	3930	4348
2010	16 728	9 325	3459	3944
2011	16 157	11 447	3255	1455

Table A2.5 presents the full scale equivalent activity data for accidental building fires.

Table A2.5 Accidental building fires full scale equivalent activity data, 1980-2011.

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
Container fires	782	782	782	782	782	782	782	782	782	827
Detached house fires	810	810	810	810	810	810	810	810	810	857
Undetached house fires	240	240	240	240	240	240	240	240	240	254
Apartment building fires	383	383	383	383	383	383	383	383	383	405
Industry building fire	334	334	334	334	334	334	334	334	334	353
Additional building fires	455	455	455	455	455	455	455	455	455	482
Continued	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Container fires	750	775	842	740	745	861	870	803	719	772
Detached house fires	777	802	873	767	772	892	901	832	745	800
Undetached house fires	231	238	259	228	229	265	268	247	221	237
Apartment building fires	367	379	412	362	365	421	426	393	352	378
Industry building fire	320	331	360	316	318	368	372	343	307	330
Additional building fires	437	451	490	431	434	501	507	468	418	450
Continued	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Container fires	756	744	721	812	701	729	747	958	962	799
Detached house fires	784	771	747	841	727	755	774	757	886	876
Undetached house fires	233	229	222	250	216	224	230	343	278	208
Apartment building fires	370	364	353	398	343	357	366	405	433	413
Industry building fire	323	318	308	347	300	311	319	435	346	344
Additional building fires	440	433	420	473	408	424	435	483	523	466
Continued	2010	2011								
Container fires	594	729								
Detached house fires	833	818								
Undetached house fires	194	206								
Apartment building fires	348	362								
Industry building fire	281	334								
Additional building fires	429	740								

Table A2.6a-c shows the number of registered vehicles and the number of full scale equivalent vehicle fires of the different vehicle types.

Table A2.6a Number of nationally registered vehicles and full scale equivalent vehicle fires.

	Passenger Cars		Buses		Light Duty Vehicles		Heavy Duty Vehicles	
	Registered	FSE fires	Registered	FSE fires	Registered	FSE fires	Registered	FSE fires
1980	1475109	429	8070	12	99168	10	47428	60
1981	1496849	436	8070	12	109874	11	47428	60
1982	1518590	442	8070	12	120579	12	47428	60
1983	1540331	448	8070	12	131285	13	47428	60
1984	1562072	455	8070	12	141991	14	47428	60
1985	1564449	455	8010	12	147877	14	46962	60
1986	1617832	471	8105	12	165547	16	48431	61
1987	1645057	479	8110	12	179328	17	48382	61
1988	1654128	481	8093	12	187221	18	46980	60
1989	1655005	482	8031	12	190569	19	46386	59
1990	1645587	479	8109	12	192321	19	45664	58
1991	1649301	480	9989	14	197439	19	45494	58
1992	1659929	483	11259	16	202806	20	45510	58
1993	1679055	489	13513	19	211759	21	46228	59
1994	1672177	487	14261	20	219642	21	47329	60
1995	1733405	504	14371	21	228076	22	48077	61
1996	1793158	522	14594	21	234406	23	48319	61
1997	1841075	536	14690	21	240763	23	48785	62
1998	1878032	546	14894	21	249463	24	49697	63
1999	1906153	555	14953	21	259215	25	50443	64
2000	1916686	558	15051	22	272387	27	50227	64
2001	1932741	562	15005	22	283031	28	49885	63
2002	1946353	566	14971	21	295581	29	49208	62
2003	1948967	567	14989	22	309614	30	48653	62
2004	1967643	573	14997	22	336038	33	48318	61
2005	2012399	586	15131	22	372674	36	49311	63
2006	2064005	601	15180	22	414454	40	50691	64
2007	2151344	518	15013	16	402464	19	51758	46
2008	2187294	666	14854	24	398718	44	50606	71
2009	2201821	729	14794	23	373694	48	46585	67
2010	2247021	646	14577	23	362389	38	44812	60
2011	2282304	584	13915	13	343372	43	43639	54

Table A2.6b Number of nationally registered vehicles and full scale equivalent vehicle fires.

	Motorcycles/Mopeds		Caravans		Train		Ship	
	Registered	FSE fires	Registered	FSE fires	Registered	FSE fires	Registered	FSE fires
1980	220273	78	NAV	NAV	7284	9	2222	25
1981	214104	76	NAV	NAV	7284	9	2222	25
1982	207934	73	NAV	NAV	7284	9	2222	25
1983	201764	71	NAV	NAV	7284	9	2222	25
1984	195594	69	NAV	NAV	7284	9	2222	25
1985	191478	68	NAV	NAV	7284	9	2222	25
1986	179940	64	NAV	NAV	7284	9	2222	25
1987	174515	62	NAV	NAV	7284	9	2222	25
1988	168509	60	NAV	NAV	7284	9	2222	25
1989	166296	59	NAV	NAV	7284	9	2222	25
1990	163133	58	86257	24	7156	9	2324	26
1991	162357	57	88278	24	7212	9	2312	26
1992	157912	56	90299	25	7438	9	2307	26
1993	155325	55	93150	26	7496	9	2140	24
1994	153365	54	94551	26	7117	8	2027	22
1995	165272	58	95831	26	6854	8	1911	21
1996	178188	63	97592	27	6631	8	1841	20
1997	191772	68	99931	27	6428	8	1761	19
1998	205129	72	102302	28	5861	7	1696	19
1999	219577	78	104852	29	5525	7	1695	19
2000	233309	82	106935	29	4907	6	1759	19
2001	243020	86	108924	30	4561	5	1797	20
2002	253375	90	110995	30	4169	5	1878	21
2003	256438	91	113338	31	4048	5	1838	20
2004	263472	93	116930	32	3273	4	1783	20
2005	273904	97	121350	33	3195	4	1792	20
2006	287366	102	126011	35	3002	4	1789	20
2007	302475	99	131708	36	2617	2	1755	20
2008	308538	122	136905	45	2588	3	1728	20
2009	307335	128	140366	34	2489	5	1742	22
2010	301562	83	142354	37	2740	2	1773	16
2011	295488	91	142764	34	2943	3	1768	21

Table A2.6c Number of nationally registered vehicles and full scale equivalent vehicle fires.

	Airplane		Tractor		Combined Harvester		Bicycle	Other Transport	Machine
	Registered	FSE fires	Registered	FSE fires	Registered	FSE fires	FSE fires	FSE fires	FSE fires
1980	1060	1	143927	87	40557	66	NAV	NAV	NAV
1981	1060	1	137756	83	40138	65	NAV	NAV	NAV
1982	1060	1	135632	82	38953	63	NAV	NAV	NAV
1983	1060	1	133733	80	38084	62	NAV	NAV	NAV
1984	1060	1	131835	79	37215	60	NAV	NAV	NAV
1985	1060	1	133027	80	37484	61	NAV	NAV	NAV
1986	1060	1	136669	82	36532	59	NAV	NAV	NAV
1987	1060	1	133075	80	35681	58	NAV	NAV	NAV
1988	1060	1	137764	83	36625	59	NAV	NAV	NAV
1989	1060	1	137678	83	34562	56	NAV	NAV	NAV
1990	1055	1	135980	82	35118	57	NAV	NAV	NAV
1991	1059	1	135887	82	34066	55	NAV	NAV	NAV
1992	1066	1	132136	80	32923	53	NAV	NAV	NAV
1993	1059	1	133891	81	32777	53	NAV	NAV	NAV
1994	1063	1	127764	77	31022	50	NAV	NAV	NAV
1995	1058	1	134277	81	29291	47	NAV	NAV	NAV
1996	1088	1	124708	75	29736	48	NAV	NAV	NAV
1997	1094	1	128391	77	26576	43	NAV	NAV	NAV
1998	1091	1	119719	72	26484	43	NAV	NAV	NAV
1999	1087	1	120314	72	23853	39	NAV	NAV	NAV
2000	1070	1	115692	70	24128	39	NAV	NAV	NAV
2001	1089	1	114369	69	23589	38	NAV	NAV	NAV
2002	1149	1	112742	68	23065	37	NAV	NAV	NAV
2003	1083	1	111023	67	22537	37	NAV	NAV	NAV
2004	1055	1	109610	66	22076	36	NAV	NAV	NAV
2005	1073	1	107867	65	21436	35	NAV	NAV	NAV
2006	1039	1	105865	64	20976	34	NAV	NAV	NAV
2007	1058	1	106025	52	20507	19	2	85	75
2008	1077	1	106025	62	20046	34	4	97	135
2009	1122	1	106025	64	19584	43	3	93	111
2010	1152	1	106025	77	19354	32	4	58	94
2011	1132	0	106025	59	19354	21	3	50	111

Table A2.7 shows the average weight of vehicles in the different categories.

Table A2.7 Average weight of different vehicle categories, kg.

	Cars	Buses	Vans	Trucks	Motorcycles/ Mopeds
1980	850	10000	2000	15000	80
1981	850	10000	2000	15000	80
1982	850	10000	2000	15000	80
1983	850	10000	2000	15000	80
1984	850	10000	2000	15000	80
1985	850	10000	2000	15000	80
1986	850	10000	2000	15000	80
1987	850	10000	2000	15000	80
1988	850	10000	2000	15000	80
1989	850	10000	2000	15000	80
1990	850	10000	2000	15000	80
1991	850	10000	2000	15000	80
1992	850	10000	2000	15000	80
1993	901	10068	2297	14732	106
1994	908	10512	2382	14674	107
1995	923	10807	2492	14801	107
1996	935	10899	2638	14928	107
1997	948	10950	2746	14987	107
1998	964	10960	2848	15111	107
1999	982	11140	2964	15223	107
2000	999	11195	3103	15214	107
2001	1012	11312	3238	14888	108
2002	1024	11387	3333	14486	108
2003	1039	11479	3442	14026	109
2004	1052	11572	3561	13599	110
2005	1068	11560	3793	13258	111
2006	1086	11684	4120	13179	113
2007	1105	11753	4505	13268	114
2008	1122	11700	4710	13246	116
2009	1134	11642	4682	12802	116
2010	1144	11804	4498	11883	117
2011	1154	11907	4296	11291	118

Table A2.8a-d presents the activity data for accidental vehicle fires.

Table A2.8a Burnt mass of different vehicle categories, Mg, 1980-1989.

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
Passenger cars	365	370	376	381	386	387	400	407	409	409
Buses	116	116	116	116	116	115	116	116	116	115
Light duty vehicles	19	21	23	26	28	29	32	35	36	37
Heavy duty vehicles	902	902	902	902	902	893	921	920	894	882
Motorcycle, moped	6	6	6	6	6	5	5	5	5	5
Other transport	-	-	-	-	-	-	-	-	-	-
Caravan	-	-	-	-	-	-	-	-	-	-
Train	130	130	130	130	130	130	130	130	130	130
Ship	246	246	246	246	246	246	246	246	246	246
Airplane	12	12	12	12	12	12	12	12	12	12
Bicycle	-	-	-	-	-	-	-	-	-	-
Tractor	173	166	163	161	159	160	165	160	166	166
Combine harvester	986	976	947	926	905	911	888	867	890	840
Machine	-	-	-	-	-	-	-	-	-	-
Total	2955	2945	2921	2905	2889	2888	2915	2899	2904	2842

Table A2.8b Burnt mass of different vehicle categories, Mg, 1990-1999.

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Passenger cars	407	408	411	440	442	466	488	508	527	545
Buses	116	143	162	195	215	223	228	231	234	239
Light duty vehicles	37	38	40	47	51	55	60	64	69	75
Heavy duty vehicles	869	866	866	864	881	903	915	927	952	974
Motorcycle, moped	5	5	4	6	6	6	7	7	8	8
Other transport	-	-	-	-	-	-	-	-	-	-
Caravan	18	19	19	21	21	22	23	23	24	25
Train	128	129	133	132	125	121	118	115	106	100
Ship	257	256	255	238	236	228	222	213	205	209
Airplane	12	12	12	11	11	11	12	12	12	12
Bicycle	-	-	-	-	-	-	-	-	-	-
Tractor	164	164	159	185	183	201	198	212	205	215
Combine harvester	854	828	800	782	738	702	719	645	648	588
Machine	-	-	-	-	-	-	-	-	-	-
Total	2866	2866	2860	2922	2908	2939	2990	2959	2992	2991

Table A2.8c Burnt mass of different vehicle categories, Mg, 2000-2009.

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Passenger cars	557	569	580	589	602	626	652	572	748	827
Buses	242	244	245	247	249	251	255	182	283	264
Light duty vehicles	82	89	96	104	117	138	166	86	207	223
Heavy duty vehicles	969	942	904	865	833	829	847	608	936	863
Motorcycle, moped	9	9	10	10	10	11	11	11	14	15
Other transport	-	-	-	-	-	-	-	47	54	53
Caravan	26	27	28	29	30	32	34	36	45	34
Train	89	81	72	68	53	51	47	33	39	63
Ship	218	225	236	233	228	229	231	234	230	253
Airplane	12	12	12	11	10	10	10	8	13	13
Bicycle	-	-	-	-	-	-	-	0	0	0
Tractor	216	223	226	230	235	246	263	235	290	301
Combine harvester	595	569	541	512	486	460	448	255	450	552
Machine	-	-	-	-	-	-	-	33	61	50
Total	3015	2990	2951	2899	2855	2883	2965	2339	3371	3512

Table A2.8d Burnt mass of different vehicle categories, Mg, 2010-2011.

	2010	2011
Passenger cars	739	674
Buses	266	160
Light duty vehicles	171	185
Heavy duty vehicles	715	606
Motorcycle, moped	10	11
Other transport	33	29
Caravan	38	35
Train	24	28
Ship	189	249
Airplane	7	3
Bicycle	0	0
Tractor	347	254
Combine harvester	378	242
Machine	43	51
Total	2960	2526

Annex 3 Emission factors

Table A3.1 presents the human cremation emission factors for crematoria without

Table A3.1 Emission factors for human cremation with references, 1980-2010.

Pollutant name	Unit	Emission factor*	Reference
SO_2	kg/body	0.113	Santarsiero et al., 2005
NO_X	kg/body	0.825	Santarsiero et al., 2005
NMVOC	kg/body	0.013	EEA, 1996
CH_4	kg/body	0.012	Aasestad, 2008
CO	kg/body	0.010	Schleicher et al., 2001
CO_2, biogenic	kg/body	50.1	Fontelle et al., 2008
N_2O	kg/body	0.015	Aasestad, 2008
NH_3		NA	
TSP	kg/body	0.039	Webfire, 2012
PM_{10}	kg/body	0.035	Webfire, 2012
$PM_{2.5}$	kg/body	0.035	Webfire, 2012
As	g/body	0.014	Webfire, 2012
Cd	g/body	0.005	Webfire, 2012
Cr	g/body	0.014	Webfire, 2012
Cu	g/body	0.012	Webfire, 2012
Hg	g/body	1.12	Kriegbaum et al., 2005
Ni	g/body	0.017	Webfire, 2012
Pb	g/body	0.030	Webfire, 2012
Se	g/body	0.020	Webfire, 2012
Zn	g/body	0.160	Webfire, 2012
HCB	mg/body	0.152	Toda, 2006
PCDD/F	µg I-TEQ/body**	0.350	Schleicher et al., 2001
Benzo(b)flouranthene	µg/body	7.21	Webfire, 2012
Benzo(k)flouranthene	µg/body	6.44	Webfire, 2012
Benzo(a)pyrene	µg/body	13.20	Webfire, 2012
Indeno(1,2,3-c-d)pyrene	µg/body	6.99	Webfire, 2012
PCBs	mg/body	0.414	Toda, 2006

*NA = not applicable. ** I-TEQ: International Toxicity Equivalents.

Table A3.2a-d shows the emission factors for accidental detached house fires, 1980-2010.

Table A3.2a Emission factors for accidental detached building fires, 1980-1989.

Detached houses		1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
SO_2	kg	247.1	247.1	247.2	247.3	247.3	247.9	249.1	250.2	250.9	251.0
NO_X	kg	18.5	18.5	18.5	18.5	18.5	18.5	18.6	18.7	18.8	18.8
NMVOC	kg	92.3	92.3	92.4	92.4	92.4	92.6	93.1	93.5	93.8	93.8
CH_4	kg	40.0	40.0	40.0	40.0	40.0	40.1	40.3	40.5	40.6	40.6
CO	kg	258.5	258.5	258.6	258.7	258.7	259.4	260.6	261.8	262.5	262.6
CO_2 - total	Mg	30.2	30.2	30.2	30.2	30.2	30.3	30.5	30.6	30.7	30.7
CO_2 - biomasse	Mg	24.6	24.6	24.6	24.6	24.6	24.7	24.8	24.9	25.0	25.0
CO_2 - non-bio	Mg	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.7	5.7	5.7
TSP	kg	143.8	143.8	143.8	143.8	143.8	143.8	143.8	143.8	143.8	143.8
PM_{10}	kg	143.8	143.8	143.8	143.8	143.8	143.8	143.8	143.8	143.8	143.8
$PM_{2.5}$	kg	143.8	143.8	143.8	143.8	143.8	143.8	143.8	143.8	143.8	143.8
As	g	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4
Cd	g	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9
Cr	g	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3
Cu	g	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Hg	g	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9
Pb	g	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
PCDD/F	mg	3.2	3.2	3.2	3.2	3.2	3.2	3.3	3.3	3.3	3.3
Benzo[b]fluoranthene	g	11.7	11.7	11.7	11.7	11.7	11.7	11.8	11.8	11.9	11.9
Benzo[k]fluoranthene	g	4.1	4.1	4.1	4.1	4.1	4.1	4.2	4.2	4.2	4.2
Benzo[a]pyrene	g	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.5	7.5	7.5
Indeno[1,2,3-cd]pyrene	g	8.0	8.0	8.0	8.0	8.0	8.0	8.1	8.1	8.1	8.1

Table A3.2b Emission factors for accidental detached building fires, 1990-1999.

Detached houses		1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
SO_2	kg	250.5	249.8	249.1	249.7	249.0	248.5	248.1	248.9	248.4	248.7
NO_X	kg	18.7	18.7	18.6	18.7	18.6	18.6	18.5	18.6	18.6	18.6
NMVOC	kg	93.6	93.3	93.1	93.3	93.0	92.9	92.7	93.0	92.8	92.9
CH_4	kg	40.6	40.4	40.3	40.4	40.3	40.2	40.2	40.3	40.2	40.3
CO	kg	262.0	261.3	260.6	261.2	260.5	260.0	259.6	260.4	259.8	260.1
CO_2 - total	Mg	30.6	30.5	30.5	30.5	30.5	30.4	30.3	30.4	30.4	30.4
CO_2 - biogenic	Mg	25.0	24.9	24.8	24.9	24.8	24.8	24.7	24.8	24.7	24.8
CO_2 - non-biogenic	Mg	5.7	5.7	5.6	5.7	5.6	5.6	5.6	5.6	5.6	5.6
TSP	kg	143.8	143.8	143.8	143.8	143.8	143.8	143.8	143.8	143.8	143.8
PM_{10}	kg	143.8	143.8	143.8	143.8	143.8	143.8	143.8	143.8	143.8	143.8
$PM_{2.5}$	kg	143.8	143.8	143.8	143.8	143.8	143.8	143.8	143.8	143.8	143.8
As	g	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4
Cd	g	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9
Cr	g	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3
Cu	g	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Hg	g	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9
Pb	g	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
PCDD/F	mg	3.3	3.3	3.3	3.3	3.3	3.2	3.2	3.3	3.2	3.3
Benzo[b]fluoranthene	g	11.9	11.8	11.8	11.8	11.8	11.8	11.7	11.8	11.8	11.8
Benzo[k]fluoranthene	g	4.2	4.2	4.2	4.2	4.2	4.1	4.1	4.2	4.1	4.1
Benzo[a]pyrene	g	7.5	7.5	7.4	7.5	7.4	7.4	7.4	7.4	7.4	7.4
Indeno[1,2,3-cd]pyrene	g	8.1	8.1	8.1	8.1	8.1	8.0	8.0	8.1	8.0	8.1

Table A3.2c Emission factors for accidental detached building fires, 2000-2009.

Detached houses		2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
SO_2	kg	250.7	256.2	258.4	260.0	261.0	260.3	261.9	256.9	258.2	259.5
NO_X	kg	18.7	19.1	19.3	19.4	19.5	19.4	19.6	19.2	19.3	19.4
NMVOC	kg	93.7	95.7	96.5	97.2	97.5	97.2	97.8	96.0	96.5	96.9
CH_4	kg	40.6	41.5	41.8	42.1	42.3	42.1	42.4	41.6	41.8	42.0
CO	kg	262.3	268.0	270.3	272.0	273.1	272.3	274.0	268.7	270.1	271.4
CO_2 - total	Mg	30.7	31.3	31.6	31.8	31.9	31.8	32.0	31.4	31.6	31.7
CO_2 - biogenic	Mg	25.0	25.5	25.7	25.9	26.0	25.9	26.1	25.6	25.7	25.9
CO_2 - non-biogenic	Mg	5.7	5.8	5.9	5.9	5.9	5.9	5.9	5.8	5.8	5.9
TSP	kg	143.8	143.8	143.8	143.8	143.8	143.8	143.8	143.8	143.8	143.8
PM_{10}	kg	143.8	143.8	143.8	143.8	143.8	143.8	143.8	143.8	143.8	143.8
$PM_{2.5}$	kg	143.8	143.8	143.8	143.8	143.8	143.8	143.8	143.8	143.8	143.8
As	g	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4
Cd	g	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9
Cr	g	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3
Cu	g	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Hg	g	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9
Pb	g	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
PCDD/F	mg	3.3	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4
Benzo[b]fluoranthene	g	11.9	12.1	12.2	12.3	12.4	12.3	12.4	12.2	12.2	12.3
Benzo[k]fluoranthene	g	4.2	4.3	4.3	4.3	4.4	4.3	4.4	4.3	4.3	4.3
Benzo[a]pyrene	g	7.5	7.7	7.7	7.8	7.8	7.8	7.8	7.7	7.7	7.8
Indeno[1,2,3-cd]pyrene	g	8.1	8.3	8.4	8.4	8.5	8.4	8.5	8.3	8.4	8.4

Table A3.2d Emission factors for accidental detached building fires, 2010.

Detached houses		2010
SO_2	kg	261.5
NO_x	kg	19.5
NMVOC	kg	97.7
CH_4	kg	42.3
CO	kg	273.6
CO_2 - total	Mg	32.0
CO_2 - biogenic	Mg	26.1
CO_2 - non-biogenic	Mg	5.9
TSP	kg	143.8
PM_{10}	kg	143.8
$PM_{2.5}$	kg	143.8
As	g	1.35
Cd	g	0.85
Cr	g	1.29
Cu	g	2.99
Hg	g	0.85
Pb	g	0.42
PCDD/F	mg	3.4
Benzo[b]fluoranthene	g	12.4
Benzo[k]fluoranthene	g	4.4
Benzo[a]pyrene	g	7.8
Indeno[1.2.3-cd]pyrene	g	8.5

Table A3.3a-d shows the emission factors for accidental undetached house fires, 1980-2010.

Table A3.3a Emission factors for accidental undetached building fires, 1980-1989.

Undetached houses		1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
SO_2	kg	208.2	208.3	208.4	208.1	208.1	208.0	207.8	207.6	207.4	207.0
NO_X	kg	15.6	15.6	15.6	15.6	15.5	15.5	15.5	15.5	15.5	15.5
NMVOC	kg	77.8	77.8	77.9	77.8	77.7	77.7	77.7	77.6	77.5	77.4
CH_4	kg	33.7	33.7	33.7	33.7	33.7	33.7	33.7	33.6	33.6	33.5
CO	kg	217.8	217.9	218.0	217.8	217.7	217.6	217.4	217.2	216.9	216.6
CO_2 - total	Mg	25.5	25.5	25.5	25.5	25.4	25.4	25.4	25.4	25.4	25.3
CO_2 - biomasse	Mg	20.7	20.8	20.8	20.7	20.7	20.7	20.7	20.7	20.7	20.6
CO_2 - non-bio	Mg	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7
TSP	kg	61.6	61.6	61.6	61.6	61.6	61.6	61.6	61.6	61.6	61.6
PM_{10}	kg	61.6	61.6	61.6	61.6	61.6	61.6	61.6	61.6	61.6	61.6
$PM_{2.5}$	kg	61.6	61.6	61.6	61.6	61.6	61.6	61.6	61.6	61.6	61.6
As	g	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Cd	g	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
Cr	g	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Cu	g	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3
Hg	g	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
Pb	g	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
PCDD/F	mg	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7
Benzo[b]fluoranthene	g	9.9	9.9	9.9	9.9	9.8	9.8	9.8	9.8	9.8	9.8
Benzo[k]fluoranthene	g	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
Benzo[a]pyrene	g	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2
Indeno[1,2,3-cd]pyrene	g	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7

Table A3.3b Emission factors for accidental undetached building fires, 1990-1999.

Undetached houses		1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
SO_2	kg	206.6	206.2	206.1	206.1	206.1	206.4	206.8	207.5	208.2	209.1
NO_X	kg	15.4	15.4	15.4	15.4	15.4	15.4	15.5	15.5	15.6	15.6
NMVOC	kg	77.2	77.1	77.0	77.0	77.0	77.1	77.3	77.5	77.8	78.1
CH_4	kg	33.5	33.4	33.4	33.4	33.4	33.4	33.5	33.6	33.7	33.8
CO	kg	216.2	215.8	215.7	215.6	215.7	216.0	216.4	217.1	217.8	218.7
CO_2 - total	Mg	25.3	25.2	25.2	25.2	25.2	25.2	25.3	25.4	25.5	25.6
CO_2 - biogenic	Mg	20.6	20.6	20.5	20.5	20.5	20.6	20.6	20.7	20.7	20.8
CO_2 - non-biogenic	Mg	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7
TSP	kg	61.6	61.6	61.6	61.6	61.6	61.6	61.6	61.6	61.6	61.6
PM_{10}	kg	61.6	61.6	61.6	61.6	61.6	61.6	61.6	61.6	61.6	61.6
$PM_{2.5}$	kg	61.6	61.6	61.6	61.6	61.6	61.6	61.6	61.6	61.6	61.6
As	g	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Cd	g	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
Cr	g	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Cu	g	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3
Hg	g	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
Pb	g	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
PCDD/F	mg	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7
Benzo[b]fluoranthene	g	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.9	9.9
Benzo[k]fluoranthene	g	3.4	3.4	3.4	3.4	3.4	3.4	3.5	3.5	3.5	3.5
Benzo[a]pyrene	g	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2
Indeno[1,2,3-cd]pyrene	g	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.8

Table A3.3c Emission factors for accidental undetached building fires, 2000-2009.

Undetached houses		2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
SO_2	kg	209.8	210.1	210.5	210.8	211.2	210.5	211.2	212.0	212.8	213.8
NO_X	kg	15.7	15.7	15.7	15.8	15.8	15.7	15.8	15.8	15.9	16.0
NMVOC	kg	78.4	78.5	78.7	78.8	78.9	78.6	78.9	79.2	79.5	79.9
CH_4	kg	34.0	34.0	34.1	34.1	34.2	34.1	34.2	34.3	34.5	34.6
CO	kg	219.5	219.8	220.3	220.6	220.9	220.2	221.0	221.8	222.7	223.6
CO_2 - total	Mg	25.7	25.7	25.7	25.8	25.8	25.7	25.8	25.9	26.0	26.1
CO_2 - biogenic	Mg	20.9	20.9	21.0	21.0	21.0	21.0	21.0	21.1	21.2	21.3
CO_2 - non-biogenic	Mg	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8
TSP	kg	61.6	61.6	61.6	61.6	61.6	61.6	61.6	61.6	61.6	61.6
PM_{10}	kg	61.6	61.6	61.6	61.6	61.6	61.6	61.6	61.6	61.6	61.6
$PM_{2.5}$	kg	61.6	61.6	61.6	61.6	61.6	61.6	61.6	61.6	61.6	61.6
As	g	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Cd	g	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
Cr	g	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Cu	g	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3
Hg	g	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
Pb	g	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
PCDD/F	mg	2.7	2.7	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8
Benzo[b]fluoranthene	g	9.9	9.9	10.0	10.0	10.0	10.0	10.0	10.0	10.1	10.1
Benzo[k]fluoranthene	g	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.6	3.6
Benzo[a]pyrene	g	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.4	6.4
Indeno[1,2,3-cd]pyrene	g	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.9	6.9	6.9

Table A3.3d Emission factors for accidental undetached building fires, 2010.

Undetached houses		2010
SO_2	kg	214.6
NO_x	kg	16.0
NMVOC	kg	80.2
CH_4	kg	34.7
CO	kg	224.5
CO_2 - total	Mg	26.2
CO_2 - biogenic	Mg	21.4
CO_2 - non-biogenic	Mg	4.9
TSP	kg	61.6
PM_{10}	kg	61.6
$PM_{2.5}$	kg	61.6
As	g	0.6
Cd	g	0.4
Cr	g	0.6
Cu	g	1.3
Hg	g	0.4
Pb	g	0.2
PCDD/F	mg	2.8
Benzo[b]fluoranthene	g	10.2
Benzo[k]fluoranthene	g	3.6
Benzo[a]pyrene	g	6.4
Indeno[1.2.3-cd]pyrene	g	6.9

Table A3.4a-d presents the emission factors for accidental apartment building fires, 1980-2010.

Table A3.4a Emission factors for accidental apartment building fires, 1980-1989.

Apartment buildings		1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
SO_2	kg	119.4	119.4	119.5	119.6	119.8	120.1	120.3	120.4	120.3	120.2
NO_X	kg	8.9	8.9	8.9	8.9	9.0	9.0	9.0	9.0	9.0	9.0
NMVOC	kg	44.6	44.6	44.6	44.7	44.8	44.9	45.0	45.0	45.0	44.9
CH4	kg	19.3	19.3	19.3	19.4	19.4	19.4	19.5	19.5	19.5	19.5
CO	kg	124.9	124.9	125.0	125.2	125.4	125.6	125.9	125.9	125.9	125.8
CO2 - total	Mg	14.6	14.6	14.6	14.6	14.7	14.7	14.7	14.7	14.7	14.7
CO2 - biomasse	Mg	11.9	11.9	11.9	11.9	11.9	12.0	12.0	12.0	12.0	12.0
CO2 - non-bio	Mg	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7
TSP	kg	43.78	43.78	43.78	43.78	43.78	43.78	43.78	43.78	43.78	43.78
PM_{10}	kg	43.78	43.78	43.78	43.78	43.78	43.78	43.78	43.78	43.78	43.78
$PM_{2.5}$	kg	43.780	43.78	43.78	43.78	43.78	43.78	43.78	43.78	43.78	43.78
As	g	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
Cd	g	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Cr	g	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
Cu	g	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9
Hg	g	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Pb	g	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
PCDD/F	mg	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6
Benzo[b]fluoranthene	g	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7
Benzo[k]fluoranthene	g	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Benzo[a]pyrene	g	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6
Indeno[1,2,3-cd]pyrene	g	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9

Table A3.4b Emission factors for accidental apartment building fires, 1990-1999.

Apartment buildings		1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
SO_2	kg	120.2	120.2	120.3	120.3	120.3	120.4	120.4	120.4	120.4	120.4
NO_X	kg	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0
NMVOC	kg	44.9	44.9	45.0	44.9	45.0	45.0	45.0	45.0	45.0	45.0
CH_4	kg	19.5	19.5	19.5	19.5	19.5	19.5	19.5	19.5	19.5	19.5
CO	kg	125.8	125.8	125.9	125.8	125.9	125.9	126.0	125.9	126.0	126.0
CO_2 - total	Mg	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7
CO_2 - biogenic	Mg	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0
CO_2 - non-biogenic	Mg	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7
TSP	kg	43.78	43.78	43.78	43.78	43.78	43.78	43.78	43.78	43.78	43.78
PM_{10}	kg	43.78	43.78	43.78	43.78	43.78	43.78	43.78	43.78	43.78	43.78
$PM_{2.5}$	kg	43.78	43.78	43.78	43.78	43.78	43.78	43.78	43.78	43.78	43.78
As	g	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
Cd	g	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Cr	g	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
Cu	g	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9
Hg	g	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Pb	g	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
PCDD/F	mg	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6
Benzo[b]fluoranthene	g	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7
Benzo[k]fluoranthene	g	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Benzo[a]pyrene	g	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6
Indeno[1,2,3-cd]pyrene	g	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9

Table A3.4c Emission factors for accidental apartment building fires, 2000-2009.

Apartment buildings		2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
SO_2	kg	120.5	120.5	120.6	120.8	121.1	121.4	121.9	122.4	122.9	123.3
NO_X	kg	9.0	9.0	9.0	9.0	9.1	9.1	9.1	9.1	9.2	9.2
NMVOC	kg	45.0	45.0	45.1	45.1	45.3	45.4	45.5	45.7	45.9	46.1
CH_4	kg	19.5	19.5	19.5	19.6	19.6	19.7	19.7	19.8	19.9	20.0
CO	kg	126.0	126.1	126.2	126.4	126.7	127.0	127.5	128.0	128.6	129.0
CO_2 - total	Mg	14.7	14.7	14.8	14.8	14.8	14.8	14.9	15.0	15.0	15.1
CO_2 - biogenic	Mg	12.0	12.0	12.0	12.0	12.1	12.1	12.1	12.2	12.2	12.3
CO_2 - non-biogenic	Mg	2.7	2.7	2.7	2.7	2.7	2.7	2.8	2.8	2.8	2.8
TSP	kg	43.78	43.78	43.78	43.78	43.78	43.78	43.78	43.78	43.78	43.78
PM_{10}	kg	43.78	43.78	43.78	43.78	43.78	43.78	43.78	43.78	43.78	43.78
$PM_{2.5}$	kg	43.78	43.78	43.78	43.78	43.78	43.78	43.78	43.78	43.78	43.78
As	g	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
Cd	g	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Cr	g	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
Cu	g	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9
Hg	g	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Pb	g	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
PCDD/F	mg	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6
Benzo[b]fluoranthene	g	5.7	5.7	5.7	5.7	5.7	5.7	5.8	5.8	5.8	5.8
Benzo[k]fluoranthene	g	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.1	2.1
Benzo[a]pyrene	g	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.7	3.7	3.7
Indeno[1,2,3-cd]pyrene	g	3.9	3.9	3.9	3.9	3.9	3.9	3.9	4.0	4.0	4.0

Table A3.4d Emission factors for accidental apartment building fires, 2010.

Apartment buildings		2010
SO_2	kg	123.5
NO_x	kg	9.2
NMVOC	kg	46.1
CH_4	kg	20.0
CO	kg	129.2
CO_2 - total	Mg	15.1
CO_2 - biogenic	Mg	12.3
CO_2 - non-biogenic	Mg	2.8
TSP	kg	43.78
PM_{10}	kg	43.78
$PM_{2.5}$	kg	43.78
As	g	0.4
Cd	g	0.3
Cr	g	0.4
Cu	g	0.9
Hg	g	0.3
Pb	g	0.1
PCDD/F	mg	1.6
Benzo[b]fluoranthene	g	5.8
Benzo[k]fluoranthene	g	2.1
Benzo[a]pyrene	g	3.7
Indeno[1.2.3-cd]pyrene	g	4.0

Table A3.5 presents the average building floor space for detached houses, undetached houses and apartments.

Table A3.5 Average floor space in building types.

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
Detached houses	154	154	154	154	154	154	155	156	156	156
Undetached houses	130	130	130	130	130	130	129	129	129	129
Apartment buildings	74	74	74	74	75	75	75	75	75	75
Industrial buildings	500	500	500	500	500	500	500	500	500	500
Additional buildings	20	20	20	20	20	20	20	20	20	20
Continued	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Detached houses	156	156	155	155	155	155	155	155	155	155
Undetached houses	129	128	128	128	128	129	129	129	130	130
Apartment buildings	75	75	75	75	75	75	75	75	75	75
Industrial buildings	500	500	500	500	500	500	500	500	500	500
Additional buildings	20	20	20	20	20	20	20	20	20	20
Continued	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Detached houses	156	160	161	162	163	162	163	160	161	162
Undetached houses	131	131	131	131	132	131	132	132	133	133
Apartment buildings	75	75	75	75	75	76	76	76	77	77
Industrial buildings	500	500	500	500	500	500	500	500	500	500
Additional buildings	20	20	20	20	20	20	20	20	20	20

Continued	2010	2011
Detached houses	163	164
Undetached houses	134	132
Apartment buildings	77	78
Industrial buildings	500	500
Additional buildings	20	20

DANISH EMISSION INVENTORY FOR WASTE INCINERATION AND OTHER WASTE

Inventories until year 2011

This report contains detailed methodological issues, activity data, emission factors, uncertainties and references for waste incineration without energy recovery and other waste source categories of the Danish emission inventories 2013. The emissions are calculated for the years 1980-2011 according to reporting requirements. Calculations include the categories; human and animal cremation, composting, accidental building and vehicle fires and production of biogas, and the pollutants; SO_2, NO_x, NMVOC, CH_4, CO, CO_2, N_2O, NH_3, As, Cd, Cr, Cu, Hg, Ni, Pb, Se, Zn, HCB, PCDD/F, PAHs and PCBs.

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