umweltbundesamt

Austria's Informative Inventory Report (IIR) 2008

Submission under the UNECE Convention on Long-range Transboundary Air Pollution

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Project management
Traute Köther

Authors
Michael Anderl
Elisabeth Kampel
Traute Köther
Barbara Muik
Katja Pazdernik
Barbara Schodl
Stephan Poupa
Daniela Wappel
Manuela Wieser

Editor
Brigitte Read

Layout and typesetting
Ute Kutschera

Reviewed and approved by
Manfred Ritter

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EXECUTIVE SUMMARY

The report "Austria's Informative Inventory Report (IIR) 2008" provides a complete and comprehensive description of the methodologies used for the compilation of Austrian's Air Emission Inventory ("Österreichische Luftschadstoff-Inventur – OLI") as presented in Austria's 2008 submission under the Convention on Long-range Transboundary Air Pollution of the United Nations Economic Commission for Europe (UNECE/LRTAP).

The aim of this report is to document the methodology in order to facilitate understanding of the calculation of the Austrian air pollutant emission data. The more interested reader is kindly refereed to the background literature cited in this document.

As a party to the UNECE/LRTAP Convention Austria is required to annually report data on emissions of air pollutants covered in the Convention and its Protocols: these are the main pollutants NO_x, SO_2, NMVOC, NH_3 and CO, Particulate Matter (PM), Persistent Organic Pollutants (POPs) and Heavy Metals (HM). To be able to meet this reporting requirement Austria compiles an Air Emission Inventory ("Österreichische Luftschadstoff-Inventur – OLI") which is updated annually. The preparation and review of Austria's Air Emission Inventory are the responsibility of the Department Emissions & Climate Change of the Umweltbundesamt.

This report follows the regulations under the UNECE/LRTAP Convention and its Protocols that define standards for national emission inventories. In 2002 the Executive Body adopted guidelines for estimating and reporting of emission data, which are necessary to ensure that the transparency, accuracy, consistency, comparability, and completeness (TACCC) of reported emissions are adequate for current LRTAP requirements (EB.AIR/GE.1/2002/7 and its supporting addendum). The emission data presented in this report were compiled according to these guidelines for estimating and reporting emission data, which also define the format of reporting emission data (Nomenclature for Reporting – NFR) as well as standards for providing supporting documentation which should ensure the transparency of the inventory.

The complete set of tables in the NFR format, including sectoral reports, sectoral background tables and footnotes to the NFR tables, are submitted separately in digital form only. A summary of emission data is presented in the Annex to this report.

The IIR 2008 at hand complements the reported emission data by providing background information. It follows the template for a "minimum version" of the "Informative Inventory Report" (IIR) as elaborated by the LRTAP Convention's "Task Force on Emission Inventories and Projections" (TFEIP). But also the structure of this report follows closely the structure of Austria's National Inventory Report (NIR) submitted annually under the United Nations Framework Convention on Climate Change (UNFCCC) which includes a complete and comprehensive description of methodologies used for compilation of Austria's greenhouse gas inventory[1].

The first chapter of this report provides general information on the institutional arrangements for inventory preparation, on the inventory preparation process, methodologies and data sources used and on QA/QC activities. Furthermore it presents the key source analysis and gives information on completeness and uncertainty of emission estimates.

Chapter 2 gives information on reduction or stabilization targets as set out in the Protocols to the Convention compared to actual emission trends.

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[1] UMWELTBUNDESAMT (2008): Austria's National Inventory Report 2008 – Submission under the United Nations Framework Convention on Climate Change; Wien.

The third chapter presents major changes (so called "recalculations") related to the previous submission (emission data report 2007 under the UNECE/LRTAP Convention) which are the result of continuous improvement of Austria's Air Emission Inventory. Data presented in this report replace data reported earlier under the reporting framework of the UNECE/LRTAP Convention.

Chapters 4 to 8 include detailed information on the methodologies and assumptions used for estimating NO_x, SO_2, NMVOC, NH_3 and CO, PM, POPs and HM emissions in Austria's Air Emissions Inventory (OLI).

The annex presents inter alia emission data for all pollutants for the year 2006 in NFR as well as trend tables for these gases and for heavy metals, POPs and particulate matter, as included in "Austria's Annual National Air Emissions Inventory 1980–2006. Submission under the Convention on Long-range Transboundary Air Pollution (CLRTAP)".

The preparation and review of Austria's National Air Emission Inventory are the responsibility of the Department "Emissions & Climate Change" of the Umweltbundesamt.

Project leader for the preparation of the Austrian Air Pollutant Inventory (OLI) is Stephan Poupa. Project leader for the preparation of the IIR 2008 is Traute Köther.

Specific responsibilities for the IIR 2008 have been as follows:

- Executive Summary — Traute Köther
- Chapter 1 Introduction — Traute Köther
- Chapter 2 Trends — Traute Köther
- Chapter 3 Major Changes — Michael Anderl, Traute Köther
- Chapter 4 Energy — Stephan Poupa
- Chapter 4 Transport — Barbara Schodl
- Chapter 4 Fugitive — Barbara Muik
- Chapter 5 Industry — Barbara Muik
- Chapter 6 Solvents — Traute Köther
- Chapter 7 Agriculture — Michael Anderl
- Chapter 8 Waste — Elisabeth Kampel, Katja Pazdernik
- Annexes — Traute Köther.

Any comments or suggestions regarding this report please direct to:

Traute Köther
Emissions & Climate Change
Umweltbundesamt
Spittelauer Lände 5 phone: +43-(0)1-313 04/5974
1090 Vienna, Austria fax: +43-(0)1-313 04/5959
E-Mail traute.koether@umweltbundesamt.at

http://www.umweltbundesamt.at/

1 INTRODUCTION

1.1 Institutional Arrangement for Inventory Preparation

Austria, as a party to the UNECE Convention on Long-range Transboundary Air Pollution (LRTAP)[2], has to report its national emissions of air pollutants annually. The formal reporting responsibility lies with the Minister for Agriculture, Forestry, Environment and Water Management[3].

Umweltbundesamt, as the federal environment agency in Austria, has been designated as single national entity responsible for the preparation of the annual air pollutant inventory by law. The Environmental Control Act[4] regulates responsibilities of environmental control in Austria and lists the tasks of the Umweltbundesamt. One task is to provide technical expertise and the data basis for the fulfilment of the emission related reporting obligations under the UNECE LRTAP Convention. To that end, the Umweltbundesamt prepares and annually updates the Austrian air emissions inventory („Österreichische Luftschadstoff-Inventur – OLI"), which covers greenhouse gases (GHG) and emissions of other air pollutants as stipulated in the reporting obligations further explained in the following chapters.

For the Umweltbundesamt a national air emission inventory that identifies and quantifies the sources of pollutants in a consistent manner is of a high priority. Such an inventory provides a common means for comparing the relative contribution of different emission sources and hence can be a basis for policies to reduce emissions.

Within the Umweltbundesamt, the department Emissions & Climate Change is responsible for the preparation of the inventory[5] and all work related to inventory preparation.

Umweltbundesamt is an ISO 17020 accredited inspection body for Greenhouse Gas Inventories (Id. No. 241) in accordance with the Austrian Accreditation Law (AkkG)[6] by decree of the Minister of Economics and Labour (BMWA), issued on 19.01.2006, valid from 23.12.2005.[7] The requirements of EN ISO/IEC 17020 (Type A)[8] are fulfilled.

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[2] http://www.unece.org/env/lrtap/

[3] http://www.lebensministerium.at/

[4] Umweltkontrollgesetz; Federal Law Gazette 152/1998
http://www.umweltbundesamt.at/fileadmin/site/umweltkontrolle/gesetze/ukg.pdf

[5] http://www.umweltbundesamt.at/umweltschutz/luft/emissionsinventur/

[6] Federal Law Gazette No. 468/1992 last amended by federal law gazette I No. 85/2002, by decree of the Minister of Economics and Labour, No. BMWA- 92.715/0036-I/12/2005, issued on 19 January, valid from 23 December 2005.
http://www.bmwa.gv.at/NR/rdonlyres/4E4C573C-4628-4B05-9DB6-D0A7C6E7EF81/216/Akkreditierungsgesetz_Englisch1.pdf

[7] http://www.bmwa.gv.at/NR/rdonlyres/E956BE3D-B8A9-4922-9A2A-420182E8ED7A/22576/Akkrd.pdf

[8] http://www.bmwa.gv.at/NR/rdonlyres/3F9073D6-1F51-4AB7-BBD3-687B82EC0479/0/LeitfadenL10zurAnwendungderISO17020V2.pdf

1.1.1 Austria's Obligations

Austria has to comply with the following air emission related obligations:

- Austria's obligation under the UNECE Convention on Long-range Transboundary Air Pollution (LRTAP): Austria signed the convention in 1979; since its entry into force in 1983 the Convention has been extended by eight protocols which identify specific obligations or measures to be taken by Parties. These obligations as well as information regarding the status of ratification are listed in Table 1.

Table 1: Protocols of UNECE Convention on Long-range Transboundary Air Pollution (LRTAP).

	Tools of UNECE Convention on Long-range Transboundary Air Pollution (LRTAP)	**Parties**	**entered into force**	**signed/ratified by Austria**
1984	Geneva Protocol on Long-term Financing of the Cooperative Programme for Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe (EMEP)	41	28.01.1988	16.12.1982 (r)
1985	Helsinki Protocol on the Reduction of Sulphur Emissions or their Transboundary Fluxes by at least 30 per cent	22	02.09.1987	09.07.1985 (s) 04.06.1987 (r)
1988	Sofia Protocol concerning the Control of Nitrogen Oxides or their Transboundary Fluxes	28	14.02.1991	01.11.1988 (s) 15.01.1990 (r)
1991	Geneva Protocol concerning the Control of Emissions of Volatile Organic Compounds or their Transboundary Fluxes	21	29.09.1997	19.11.1991 (s) 23.08.1994 (r)
1994	Oslo Protocol on Further Reduction of Sulphur Emissions	25	05.08.1998	14.06.1994 (s) 27.08.1998 (r)
1998	Aarhus Protocol on Heavy Metals	27	29.12.2003	24.06.1998 (s) 17.12.2003 (r)
1998	Aarhus Protocol on Persistent Organic Pollutants (POPs)	23	23.10.2003	24.06.1998 (s) 27.08.2002 (r)
1999	The 1999 Gothenburg Protocol to Abate Acidification, Eutrophication and Ground-level Ozone	18	17.05.2005	01.12.1999 (s)

Abbreviation: signed (s)/ratified (r)

Source: http://www.unece.org/env/lrtap/welcome.html

- Austria's annual obligations under the Directive 2001/81/EC of the European Parliament and of the Council of 23.10.2001 on national emission ceilings for certain atmospheric pollutants (NEC-Directive).[9] The Austrian implementation of the European NEC-Directive[10] also entails the obligation for a national emissions inventory of the covered air pollutants NO_x, SO_2, NMVOC and NH_3.
- Austria's annual obligations under the European Council Decision 280/2004/EC[11] "Monitoring Decision" (replacing Decision 389/1992/EEC amended by Decision 296/1999/EEC) concerning a mechanism for monitoring Community greenhouse gas emissions and for implementing the Kyoto Protocol.

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[9] http://www.umweltbundesamt.at/fileadmin/site/umweltthemen/luft/Richtlinie_2001.81.EG.pdf

[10] Emissionshöchstmengengesetz-Luft *EG-L* (*air emissions ceilings law*) BGBl. I, 34/2003 http://www.umweltbundesamt.at/fileadmin/site/umweltkontrolle/gesetze/EG-L.pdf

[11] http://europa.eu.int/eur-lex/pri/de/oj/dat/2004/l_049/l_04920040219de00010008.pdf

- Austria's obligation under the „United Nations Framework Convention on Climate Change (UNFCCC) (1992)[12] and the Kyoto Protocol (1997)[13].
- Obligation under the Austrian "ambient air quality law"[14] comprising the reporting of national emission data on SO_2, NO_x, NMVOC, CO, heavy metals (Pb, Cd, Hg), benzene and particulate matter (PM).
- Austria's obligation according to Article 15 of the European IPPC Directive 1996/61/EC[15] is to implement a European Pollutant Emission Register (EPER)[16]. Article 15 of the IPPC Directive can be associated with Article 6 of the Aarhus Convention[17] (United Nations: Aarhus 1998) which refers to the right of the public to access environmental information and to participate in the decision-making process of environmental issues.

1.1.2 National Inventory System Austria (NISA)

Regulations under the UNECE/LRTAP Convention and its Protocols define standards for the preparation of and reporting on national emission inventories. In 2002, the Executive Body adopted new guidelines for estimating and reporting emission data to ensure that the transparency, consistency, comparability, completeness and accuracy of reported emissions are adequate for current LRTAP needs (EB.AIR/GE.1/2002/7[18] and its supporting addendum).

The Austrian air emission inventory (OLI) covers all pollutants, i.e. air pollutants reported to UNECE and greenhouse gases as reported to the UNFCCC to streamline efforts and benefit from a common approach to inventory preparation in one single National Inventory System for Austria (NISA).

It is designed to comply with the (in general more stringent) standards for national emission inventories under the UNFCCC and the Kyoto Protocol and also meets all the requirements of the LRTAP Convention and other reporting obligations as presented above (chapter 1.1.1).

The "National Inventory System Austria" (NISA) includes all institutional, legal and procedural arrangements made for the preparation of emission inventories and for reporting and archiving inventory information and should ensure the quality of the inventory: timeliness, transparency, consistency, comparability, completeness and accuracy.

As there are many different obligations which are subject to continuous development, Austria's National Inventory System (NISA) has to be adapted continually to these changes. The present structure is illustrated in Figure 1.

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[12] http://unfccc.int/files/essential_background/convention/status_of_ratification/application/pdf/ratlist.pdf

[13] http://unfccc.int/files/essential_background/kyoto_protocol/application/pdf/kpstats.pdf

[14] Immissionsschutzgesetz-Luft *IG-L* (*ambient air quality law*) BGBl, I, 115/1997
http://www.umweltbundesamt.at/fileadmin/site/umweltkontrolle/gesetze/2001-IG-L.pdf

[15] http://eippcb.jrc.es/pages/Directive.htm

[16] see www.umweltbundesamt.at/eper/

[17] http://www.unece.org/env/pp/

[18] http://www.unece.org/env/eb/welcome.20.html

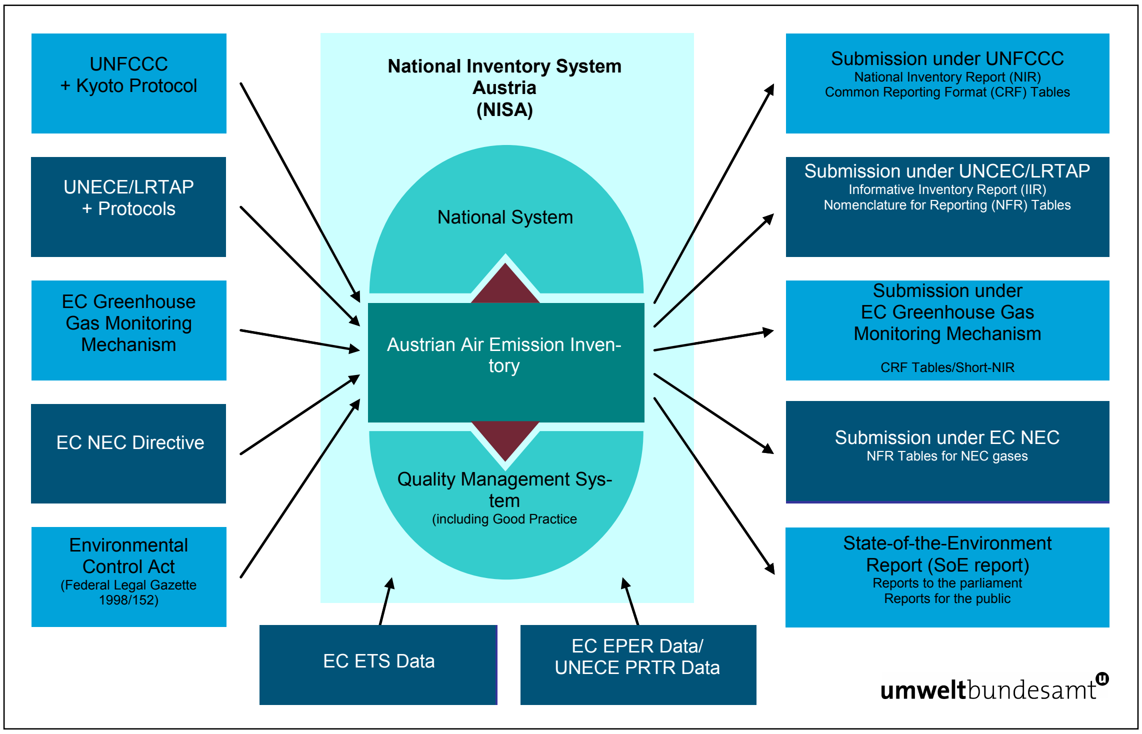

Figure 1: Structure of National Emission Inventory System Austria (NISA).

As illustrated in Figure 1 the Austrian Air Emission Inventory comprising all air pollutants stipulated by various national and international obligations is the centre of NISA. The national system as required under the Kyoto Protocol and the Quality Management System (ISO/IEC 17020) are incorporated into NISA as complementary sections.

A brief history of the development and the activities of NISA is given below:

- Austria established measurements for SO_2 under EMEP in 1978 (Cooperative Programme for Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe) and joined the UNECE in 1983. At that time Austria reported mainly SO_2 emissions.
- As an EFTA[19] country Austria participated in CORINAIR 90, which was an air emission inventory for Europe. It was part of the CORINE[20] work plan set up by the European Council of Ministers in 1985. The aim of CORINAIR 90[21] was to produce a complete, consistent and transparent emission inventory for the pollutants: SO_x as SO_2, NO_x as NO_2, NMVOC, CH_4, CO, CO_2, N_2O and NH_3.
- As a Party to the Convention, Austria signed the UNFCCC on June 8th, 1992 and subsequently submitted its instrument of ratification on February 28th, 1994.[22]
- In 1994 the first so-called Austrian Air Emission Inventory (OLI) was carried out.

[19] European Free Trade Association; http://www.efta.int/

[20] Coordination d'Information Environmentale

[21] http://reports.eea.eu.int/92-9167-036-7/en

[22] http://unfccc.int/parties_and_observers/parties/items/2146.php

- In 1997 emission data were reported for a time period (for each of the years from 1980 to 1995) for the first time.
- In 1998 also emissions of heavy metals, POPs and fluorinated compounds (SF_6, PFCs, HFCs) were included in the inventory.
- Inventory data for particulate matter (PM) were included in the inventory in 2001.

For more details on NISA see the report "NISA – NATIONAL INVENTORY SYSTEM AUSTRIA – Implementation Report"[23] which presents an overview of NISA and evaluates its compliance with the guidelines for national systems under Article 5, paragraph 1, of the Kyoto Protocol as specified under the Marrakesh Accord (decision 20/CP.7)[24].

1.1.3 Reporting obligation under the UNECE/LRTAP Convention and its Protocols

As a minimum requirement, each Party shall report on emissions of the substances relevant to the Protocol to which they are a Party, as required by that Protocol. Since Austria has signed all eight protocols of the UNECE/LRTAP Convention, the annual reporting obligation enfolds emission data of four groups: main pollutants, particulate matter (PM), heavy metals, and POPs. Table 2 gives the present set of components which have to be reported (minimum) and which can be reported voluntarily (additional).

Table 2: Emission Reporting Programme: YEARLY (MINIMUM and ADDITIONAL).

YEARLY	Components (Minimum and ***additional***)	Reporting years
A. National totals		
1. Main pollutants	SO_x, NO_x, NH_3, NMVOC, CO	from 1980 to 2006
2. Particulate matter	PM2.5, PM10, TSP	for 1990, 1995, and for 1999 to 2006
3. Heavy metals	Pb, Cd, Hg, *As, Cr, Cu, Ni, Se, Zn*	from 1990 to 2006
4. POPs	aldrin, chlordane, chlordecone, DDT, dieldrin, endrin, heptachlor, hexachlorobenzene (HCB), mirex, toxaphene, hexachlor-ocyclohexane (HCH), hexabromobiphenyl, polychlorinated biphenyls (PCBs), dioxins/furans (PCDD/F), polycyclic aromatic hydrocarbons (PAHs), short-chain chlorinated paraffins (SCCP), pentachlorophenol (PCP)	from 1990 to 2006
B. Sector emissions		
1. Main pollutants	SO_x, NO_x, NH_3, NMVOC, CO	from 1980 to 2006
2. Particulate matter	PM2.5, PM10, TSP	for 1990, 1995, and for 1999 to 2006
3. Heavy metals	Pb, Cd, Hg, *As, Cr, Cu, Ni, Se, Zn*	from 1990 to 2006
4. POPs	aldrin, chlordane, chlordecone, DDT, dieldrin, endrin, heptachlor, HCB, mirex, toxaphene, HCH, hexabromobiphenyl, PCBs, PCDD/F, PAHs, SCCP, PCP	from 1990 to 2006

[23] http://www.umweltbundesamt.at/fileadmin/site/publikationen/REP0004.pdf

[24] http://unfccc.int/cop7/accords_draft.pdf

Table 3: Emission Reporting Programme: 5-YEARLY (MINIMUM and ADDITIONAL as well as FOR REVIEW AND ASSESSMENT PURPOSES).

5-YEARLY: MINIMUM REPORTING		
C. Gridded data in the EMEP 50 x 50 km² grid		
1. National totals	Main pollutants, PM, Pb, Cd, Hg, PAHs, HCB, dioxins/furans	1990, 1995, 2000, 2005 (PM: 2000)
2. Sector emissions		
D. Emissions from large point sources		
	Main pollutants, HM, PCDD/F, PAH, HCB, PM	2000, 2005
E. Historical and Projected activity data and projected national total emissions		
1. National total emissions	See table IV 2A in EB/AIR/GE.1/2002/7	2010, 2015, 2020
2. Energy consumption	See tables IV 2B, 2C in EB.AIR/GE.1/2002/7	1990, 1995, 2000, 2005, 2010, 2015 and 2020
3. Energy consumption for transport sector	See table IV 2D in EB.AIR/GE.1/2002/7	1990, 1995, 2000, 2005, 2010, 2015 and 2020
4. Agricultural activity	See table IV 2E in EB.AIR/GE.1/2002/7	1990, 1995, 2000, 2005, 2010, 2015 and 2020
5-YEARLY: ADDITIONAL REPORTING/FOR REVIEW AND ASSESSMENT PURPOSES		
VOC speciation/Height distribution/Temporal distribution		Parties are encouraged to review the information used for modelling at the Meteorological Synthesizing Centres available for review at http://webdab.emep.int/ and the Additional Reporting Tables
Land-use data/Mercury breakdown		
% of toxic congeners of PCDD/F emissions		
Pre-1990 emissions of PAHs, HCB, PCDD/F and PCB		
Information on natural emissions		

Emission estimates should be prepared using the methodologies agreed upon by the Executive Body. These are in particular:

- EMEP/CORINAIR Emission Inventory Guidebook
  - 3rd edition October 2002 UPDATE. Technical report No 30[25]
  - 2006, Technical report No 11/2006[26]
  - 2007, Technical report No 16/2007.[27]
- EEA core set of indicators – Guide, Technical report No 1/2005[28]
- Recommendations for Revised Data Systems for Air Emission Inventories, Topic report No 12/1996[29]
- Guidance Report on preliminary assessment under EC air quality directives, Technical report No 11[30].

[25] http://reports.eea.europa.eu/EMEPCORINAIR3/en/page002.html

[26] http://reports.eea.eu.int/EMEPCORINAIR3/en

[27] http://reports.eea.europa.eu/EMEPCORINAIR5/en/page002.html

[28] http://reports.eea.eu.int/technical_report_2005_1/en

[29] http://reports.eea.eu.int/92-9167-033-2/en

[30] http://reports.eea.eu.int/TEC11a/en/tab_relations_RLR

Further other internationally applied methodologies and guidelines including:

- Integrated Pollution Prevention and Control (IPPC)[31] and European Pollutant Emission Register (EPER)[32]
- IPPC Best Available Techniques Reference Documents[33]
- Guidelines for Emission Inventory Reporting from the Large Combustion Plant Directive[34]
- Organization for Economic Co-operation and Development (OECD) and Pollution Release and Transfer Register (PRTR) Guidance[35]
- Revised 1996 Intergovernmental Panel on Climate Change (IPCC) Guidelines for National Greenhouse Gas Inventories[36] and the IPCC Good Practice Guidance[37]
- 2006 IPCC Guidelines for National Greenhouse Gas Inventories[38].

1.2 Inventory Preparation Process

The present Austrian Air Pollutant Inventory for the period 1980 to 2006 was compiled according to the recommendations for inventories as set out by the UNECE Executive Body[39] in the guidelines mentioned above.

The preparation of the inventory includes the following three stages as illustrated below.

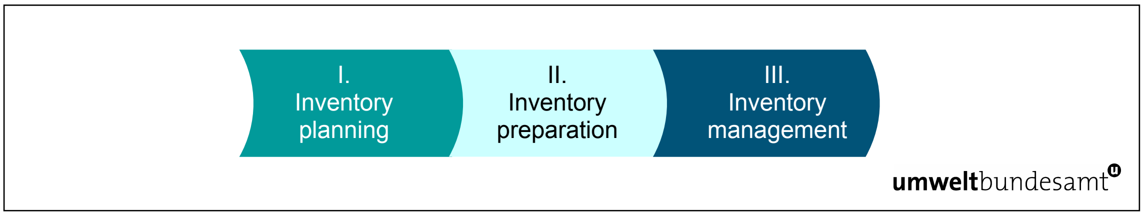

Figure 2: Three stages of inventory preparation.

I Inventory planning

In the first stage specific responsibilities are defined and allocated: as mentioned before, the Umweltbundesamt has the overall responsibility for the national inventory, comprising greenhouse gases as well as other air pollutants.

Inventory planning also includes planning of how to distribute available resources, and thus, as resources are limited, also includes a prioritization of planned improvements. Considerations on which part of the inventory (in terms of pollutants and/or sectors) to focus efforts to improve the inventory include political or public awareness due to current environmental problems or emis-

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[31] http://eippcb.jrc.es/ and http://europa.eu.int/comm/environment/ippc/index.htm

[32] http://www.eper.cec.eu.int/eper/default.asp

[33] http://eippcb.jrc.es/pages/FActivities.htm

[34] http://rod.eionet.eu.int/show.jsv?id=9&aid=500&mode=A

[35] http://www.oecd.org/department/0,2688,en_2649_34411_1_1_1_1_1,00.html

[36] http://www.ipcc-nggip.iges.or.jp/public/gl/invs1.htm

[37] http://www.ipcc-nggip.iges.or.jp/public/gp/english/

[38] http://www.ipcc-nggip.iges.or.jp/public/2006gl/index.htm

[39] http://www.unece.org/env/eb/welcome.html

sion reduction limits that are hard to meet. A tool to prioritize between sectors within the inventory is the key source analysis, where efforts are focused on important sources/sectors in terms of emissions, trends or concerning the influence on the overall quality of the inventory.

In the Austrian improvement programme emphasis has been laid on the so-called NEC gases SO_x, NO_x, NMVOC, and NH_3 where continuous efforts have been taken to improve the inventory. However, in the previous year, emissions from HM, PM and POPs have been re-evaluated and updated where possible.

Within the inventory system specific responsibilities for the different emission source categories are defined ("sector experts") as well as for all activities related to the preparation of the inventory, including QA/QC, data management and reporting.

Emissions of air pollutants are estimated together with greenhouse gases in a single data base based on the CORINAIR[40] systematic, which was formerly also used as reporting format under the UNECE. This nomenclature was designed by the ETC/ACC[41] to estimate emissions of all kind of air pollutants as well as greenhouse gases.

The CORINAIR system's nomenclature is called SNAP[42], which may be expanded to adapt to national circumstances by so-called SPLIT codes, and additionally each SNAP/SPLIT category can be extended using a fuel code.

II Inventory preparation

In the second stage, the inventory preparation process, sector experts collect activity data, emission factors and all relevant information needed for finally estimating emissions. The sector experts are also responsible for methodological choices and for contracting studies, if needed.

As the source of emission factors and/or the methodology of emission estimation for HM, POPs and PM is different compared to the "main" pollutants for a lot of source categories, emission inventories for these pollutants were prepared in studies that were contracted out; however, the incorporation into the inventory system and the update of emission calculations for subsequent years is the responsibility of the sector experts.

All data collected together with emission estimates are fed into a database (see below), where data sources are documented for future reconstruction of the inventory.

As mentioned above, the Austrian Inventory is based on the SNAP systematic, and has to be transformed into the current reporting format under the LRTAP Convention – the NFR[43] format. Additionally to actual emission data also background tables of the NFR are filled in by the sector experts, and finally QA/QC procedures as defined in the inventory planning process are carried out before the data is submitted under the UNECE/LRTAP.

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[40] CORINAIR: CORINE – CO-oRdination d'INformation Environnementale and include a project to gather and organise information on emissions into the air relevant to acid deposition; Council Decision 85/338/EEC (OJ, 1985)

[41] European Topic Centre on Air Emissions http://air-climate.eionet.europa.eu/

[42] **SNAP** (Selected Nomenclature for sources of Air Pollution) 90 or 97 respectivley means the stage of development

[43] **NFR** – Nomenclature For Reporting – is a classification system developed by the UN/ECE TFEIP for the Reporting Guidelines described in eb.air.ge.1.2001.6.e.doc

III Inventory management

For the inventory management a reliable data management to fulfil the data collecting and reporting requirements is needed. As mentioned above, data collection is performed by the different sector experts and the reporting requirements grow rapidly and may change over time.

Data management is carried out by using MS Excel™ spreadsheets in combination with Visual Basic™ macros, which is a very flexible system that can easily be adjusted to new requirements. The data is stored on a central network server which is backed up daily for the needs of data security. The inventory management also includes quality management (see Chapter 1.5) as well as documentation on QA/QC activities.

1.3 Methodologies and Data Sources Used

For large point sources the Umweltbundesamt preferably uses – after careful assessment of plausibility of this data – emission data that are reported by the "operator" of the source because these data usually reflect the actual emissions better than data calculated using general emission factors, as the operator has the best information about the actual circumstances.

If such data is not available, and for area sources, national emission factors are used or, if there are no national emission factors, international emission factors are used to estimate emissions. Where no applicable data is found, standard emission factors e.g. from the CORINAIR Guidebook are applied.

The following table presents the main data sources for activity data as well as information on who did the actual calculations.

Table 4: Main data sources for activity data and emission values.

Sector	Data Sources for Activity Data	Emission Calculation
Energy	• energy balance[44] from STATISTIK AUSTRIA[45] • EU-ETS[46] • steam boiler data base[47] administrated by UMWELTBUNDESAMT • data from industry[48] • national studies	Umweltbundesamt, plant operators
Industry	• national production statistics from STATISTIK AUSTRIA • import/export statistics from STATISTIK AUSTRIA • EU-ETS[46] • direct information from industry • direct information from associations of industry	Umweltbundesamt, plant operators
Solvent and Other Product Use	• production statistics • consumption statistics • import/export statistics } from STATISTIK AUSTRIA	Contractors: Forschungsinstitut für Energie u. Umweltplanung, Wirtschaft und Marktanalysen/Institut für industrielle Ökologie (IIÖ)[49]
Agriculture	• national agricultural statistics „Grüner Bericht"[50] from STATISTIK AUSTRIA • national report on water protection „Gewässerschutzbericht" from LEBENSMINISTERIUM[51] • national studies • direct information from agricultural association	Contractors: University of Natural Resources and Applied Life Sciences, Research Center Seibersdorf, Austria
Waste	• database on landfills administrated by UMWELTBUNDESAMT • National reports from STATISTIK AUSTRIA • sewage plant inventory administrated by UMWELTBUNDESAMT • national report on water protection „Gewässerschutz bericht" from LEBENSMINISTERIUM[51]	Umweltbundesamt

[44] compatible with requirements of the International Energy Agency (IEA Joint Questionnaires)

[45] STATISTIK AUSTRIA (2006): Energiebilanzen 1970 (1988) – 2005: Dokumentation der Methodik. Wien. http://www.statistik.at/web_de/wcmsprod/groups/gd/documents/stddok/023997.pdf#pagemode=bookmarks

[46] European Union Greenhouse Gas Emission Trading Scheme

[47] reporting obligation to § 10 (7) of LRG-K; data are used to verify the data from the national energy balance

[48] Data are used to verify the data from the national energy balance.

[49] Research Institute for Energy and Environmental Planning, Economy and Market Analysis Ltd./Institute for Industrial Ecology, Austria

[50] http://www.gruenerbericht.at/cms/index.php

[51] http://www.wassernet.at/article/articleview/20149/1/5728

1.3.1 Main Data Suppliers

STATISTIK AUSTRIA

- The main data supplier for the Austrian air emission inventory is *STATISTIK AUSTRIA*[52], which provides the underlying energy data. The Austrian energy balances are based on several databases mainly prepared by the Ministry of Economic Affairs and Labour[53], „Bundeslastverteiler" and STATISTIK AUSTRIA. Their methodology follows the International Energy Agency (IEA)[54] and Eurostat[55] conventions. The aggregates of the balances, for example transformation input and output or final energy use, are harmonised with the IEA tables as well as their sectoral breakdown which follows the NACE[56] classification.
- Activity data for some sources is obtained from STATISTIK AUSTRIA which provides statistics on production data[57]. The methodology of the statistics changed in 1996, no data is available for that year and there are some product groups that are not reported anymore in the new statistics.
- Activity data needed for the calculation of non energetic emissions are based on several statistics collected by STATISTIK AUSTRIA and national and international studies.
- Activity data for Solvent and Other Product Use are based on import/export statistics also prepared by STATISTIK AUSTRIA.

INFORMATION FROM INDUSTRY

- Activity data and emission values for some sub categories in the industry sector are obtained from association of industries or directly from individual plants. If emission data are reported (e.g. by the plant owner) this data is – after assessment of plausibility – taken over into the inventory.

DATABASES

- Operators of steam boilers with more than 50 MW report their NO_x, SO_2, CO and TSP emissions and their activity data directly to the steam boiler data base administrated by the Umweltbundesamt (see Table 4).
- Operators of landfill sites also report their activity data directly to Umweltbundesamt. Emissions for the years 1998–2005 are calculated on the basis of these data.
- EPER: The European Pollutant Emission Register (EPER) is the first Europe-wide register for emissions from industrial facilities both to air and to water. The legal basis of EPER is Article 15 of the IPPC Directive (EPER Decision 2000/479/EG)[58], the scope is to provide information to the public[59].

  It is covering 50 pollutants including NO_x, SO_2, NMVOC, NH_3, CO, heavy metals, POPs and particulate matter (PM). However, emissions only have to be reported if they exceed certain thresholds.

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[52] www.statistik.at

[53] Bundesministerium für Wirtschaft und Arbeit (BMWA); www.bmwa.gv.at

[54] http://www.iea.org/

[55] www.europa.eu.int/comm/eurostat/

[56] Classification of Economic Activities in the European Community

[57] "Industrie und Gewerbestatistik" published by STATISTIK AUSTRIA for the years until 1995; "Konjunkturstatistik im produzierenden Bereich" published by STATISTIK AUSTRIA for the years 1997 to 2005.

[58] http://www.umweltbundesamt.at/fileadmin/site/daten/EPER/EPER_Entscheidung_EK.pdf

[59] data can be obtained from: http://www.umweltbundesamt.at/eper/

The Umweltbundesamt implemented EPER in Austria using an electronic system that enabled the facilities and the authorities to fulfil the requirements of the EPER decision electronically via the internet.

The Austrian industrial facilities had to report their annual emissions of the year 2001 or 2002 and 2004. There were about 400 facilities in Austria that had to report to EPER. As the thresholds for reporting emissions are relatively high only about 130 of them reported emissions according to the EPER Regulation. The plausibility of the reports is checked by competent authorities. The Umweltbundesamt finally checked the data for completeness and consistency with the national inventory.

However, data from EPER could not be used as data source for the national inventory. The EPER report only contains very little information beyond the emission data, the only information included is whether emissions are estimated, measured or calculated, also included is one activity value that is often not useful in the context of emissions. Additionally emission information of EPER is not complete regarding NFR sectors, and it is difficult to include this point source information when no background information (such as fuel consumption data) is available.

Thus the top-down approach of the national inventory was considered more reliable and data of EPER was not used as point source data for the national inventory but for verification purposes only.

LITERATURE

- National and sometimes international studies are also used as data suppliers (references are given in the sector analysis chapters).

Studies on HM, POPs and PM emissions

Emissions of HM and some POPs have already been estimated in the course of CORINAIR 1990 and 1994, respectively[60]. With these data and other Austrian publications as a basis comprehensive emission inventories of HM, POPs and PM for different years were prepared by contractors of the Umweltbundesamt and incorporated into the inventory system afterwards.

- WINDSPERGER, A. et. al. 1999: Entwicklung der Schwermetallemissionen – Abschätzung der Emissionen von Blei, Cadmium und Quecksilber für die Jahre 1985, 1990 und 1995 gemäß der CORINAIR-Systematik. Institut für Industrielle Ökologie und Österreichisches Forschungszentrum Seibersdorf. Wien. (Nicht veröffentlicht).

  Development of Heavy Metal Emissions – Estimation of emissions of Lead, Cadmium and Mercury for the years 1985, 1990 and 1995 according to the CORINAIR-systematics. Department for industrial ecology *and Austrian Research Centers Seibersdorf. Vienna. (not published).*

- Österreichische Emissionsinventur für Cadmium, Quecksilber und Blei.

  Austrian emission inventory for Cd, Hg and Pb 1995–2000 prepared by FTU – Forschungsgesellschaft Technischer Umweltschutz GmbH. Vienna November 2001 (not published).

- HÜBNER, C. 2001: Österreichische Emissionsinventur für POPs 1985–1999. FTU – Forschungsgesellschaft Technischer Umweltschutz GmbH. Werkvertrag des Umweltbundesamt, IB-650. Wien. (Nicht veröffentlicht).

[60] ORTHOFER, R. (1996); HÜBNER, C. (1996); HÜBNER, C. & WURST, F. (1997); HÜBNER, C. (2000)

Austrian emission inventory for POPs 1985–1999. Prepared by FTU – Research Center Technical environment protection (Ltd.). Study commissioned by Umweltbundesamt IB-650. Vienna. (not published).

- WINIWARTER, W.; TRENKER, C.; HÖFLINGER, W. 2001: Österreichische Emissionsinventur für Staub. Österreichisches Forschungszentrum Seibersdorf. Wien.

  Austrian emission inventory for PM. Austrian Research Centers Seibersdorf. Vienna.

- WINIWARTER, W.; SCHMID-STEJSKAL, H. & WINDSPERGER, A. (2007): Aktualisierung und Verbesserung der österreischen Luftschadstoffinventur für Schwebstaub. Systems research – Austrian Research Centers & Institut für Industrielle Ökologie. Wien.

  Updating and Improvement of the Austrian Air Emission Inventory (OLI) for PM. Systems research – Austrian Research Centers & Department for industrial ecology. Vienna.

1.3.2 Summary of methodologies applied for estimating emissions

In Table 5 a summary of methodologies applied for estimating emissions is given.

The following abbreviations are used:

- D DEFAULT
- L Literature
- CS COUNTRY SPECIFIC
- PS PLANT SPECIFIC

Dark shaded cells indicate that no such emissions arise from this source; light shaded cells (green) indicate key sources.

Table 5: Summary of methodologies applied for estimating emissions.

NFR	Description	SO_2	NO_x	NMVOC	NH_3	CO	Cd	Hg	Pb	PAH	Diox	HCB	TSP	PM10	PM2.5
1 A 1 a	Public Electricity and Heat Production	PS, CS	PS, CS	CS	CS	PS, CS	D/CS	D/CS	D/CS	L/CS	L/CS	L/CS	PS, CS	PS, CS	PS, CS
1 A 1 b	Petroleum refining	PS	PS		CS	PS	CS	CS	CS	L/CS	L/CS	CS	PS	PS	PS
1 A 1 c	Manufac.of Solid fuels a. Oth. Energy Ind.		CS	CS	CS	CS					L/CS	CS	CS	CS	CS
1 A 2 mobile	Other mobile in industry	CS	CS	CS	CS	CS	CS	CS	CS	L/CS	L/CS	CS	CS	CS	CS
1 A 2 stat (l)	Manuf. Ind. & Constr. stationary LIQUID	PS, CS	PS, CS	PS, CS	CS	PS, CS	D/CS	D/CS	D/CS	L/CS	L/CS	CS	PS, CS	PS, CS	PS, CS
1 A 3 a	Civil Aviation	CS	CS	CS	CS	CS	CS	CS	CS				CS	CS	CS
1 A 3 b 1	R.T., Passenger cars	CS	CS	CS	CS	CS	CS	CS	CS	L/CS	L/CS	CS	CS	CS	CS
1 A 3 b 2	R.T., Light duty vehicles	CS	CS	CS	CS	CS	CS	CS	CS	L/CS	L/CS	CS	CS	CS	CS
1 A 3 b 3	R.T., Heavy duty vehicles	CS	CS	CS	CS	CS	CS	CS	CS	L/CS	L/CS	CS	CS	CS	CS
1 A 3 b 4	R.T., Mopeds & Motorcycles		CS	CS	CS	CS	CS	CS	CS	L/CS	L/CS	CS			
1 A 3 b 5	R.T., Gasoline evaporation			CS											
1 A 3 b 6	R.T., Automobile tyre and break wear						L						CS	CS	CS
1 A 3 c	Railways	CS	CS	CS	CS	CS	D/CS	D/CS	D/CS	L/CS	L/CS	CS	CS	CS	CS
1 A 3 d	Navigation	CS	CS	CS	CS	CS	CS	CS	CS	L/CS	L/CS	CS	CS	CS	CS
1 A 3 e	Other	NA	CS	CS	CS	CS						CS	CS	CS	CS
1 A 4 mob	Other Sectors – mobile	CS	CS	CS	CS	CS	CS	CS	CS	L/CS	L/CS	CS	CS	CS	CS
1 A 4 stat (b)	Other Sectors stationary BIOMASS	CS	CS	CS	CS	CS	D/CS	D/CS	D/CS	L/CS	L/CS	CS	CS	CS	CS
1 A 5	Other	CS	CS	CS	CS	CS	CS	CS	CS	L/CS	L/CS	CS	CS	CS	CS

NFR	Description	SO_2	NO_x	NMVOC	NH_3	CO	Cd	Hg	Pb	PAH	Diox	HCB	TSP	PM10	PM2.5
1 B	FUGITIVE EMISSIONS FROM FUELS	PS		D, PS									CS	CS	CS
2 A	MINERAL PRODUCTS					L							CS	CS	CS
2 B	CHEMICAL INDUSTRY	CS	CS	CS	PS	CS	CS	CS	CS				CS	CS	CS
2 C	METAL PRODUCTION	CS	CS	CS		CS	CS	CS	CS	CS	CS	CS	CS	CS	CS
2 D	OTHER PRODUCTION		CS	L		CS				CS	CS	CS	CS	CS	CS
2 G	OTHER				CS										
3	SOLVEN & OTHER PRODUCT USE			CS			PS		CS						
4 B 1	Cattle				CS										
4 B 3	Sheep				D										
4 B 4	Goats				D										
4 B 6	Horses				D										
4 B 8	Swine				CS										
4 B 9	Poultry				D										
4 B-13	Other				D										
4 D	AGRICULTURAL SOILS		D	D	D								L	L	L
4 F	FIELD BURNING OF AGRIC. RESIDUES	CS	CS	CS	D	CS	CS	CS	CS	CS	CS	CS			
4 G	Agriculture – Other												D	D	D
6	WASTE	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS

1.4 Key Source Analysis

To help prioritising efforts in inventory preparation, the identification of key sources is a helpful tool. A key source is a source within an inventory which has a strong influence on the total inventory's properties such as the absolute emission level, the trend of emissions or the quality of the inventory regarding its certainty or uncertainty.

As stated in the "Good Practice Guidance for LRTAP Emission Inventories" (see Part B of the EMEP/CORINAIR Emission Inventory Guidebook, 3rd edition), the choice of parameter which is considered key also depends on the application of the inventory: for compliance assessments the trend is essential, whereas in the case that emission reporting obligations are formulated as emission ceilings, the emission level uncertainty is relevant.

However, quantitative uncertainties for the current inventory have not been assessed (for further information see Chapter 1.6). A simplified approach is to only analyse absolute emission levels, and according to the GPG for GHG inventories this quantitative approach is a so-called Tier 1 analysis, the "level assessment"[61].

In a first step, a level assessment for all pollutants reported to the LRTAP convention was performed and reported in this report. For the next years also a qualitative approach for the gases covered by the multi-effects protocol is planned ("Tier 2 analysis"). In this approach sources are identified whose uncertainty of emission levels has a significant effect on the total inventories uncertainty. As for these pollutants absolute emission ceilings have to be met, the uncertainty of reported emissions is – as mentioned above – essential.

Level Assessment

For the level assessment the contribution from each source (fraction of total emission) is listed and ranked until 95% of the total emission is accounted for. The analysis was made for the last year of the inventory (2006).

However, in a first step the source categories have to be aggregated according to applied methodologies: sources estimated using the same methodology and the same source of activity data and emission factors are aggregated.

Identification of Source Categories

This is an important step in terms of correlation of input data, which could otherwise falsify results of a key source analysis which usually assumes that input data are not dependent on each other.

A very detailed analysis e.g. on the level of detail given in the NFR might result in many categories with the same source of (correlating) input data, whereas on the other hand a high level of aggregation could mask some information. That's why the identification of source categories for the key source analysis was made in two steps:

After an initial analysis at a high level of aggregation further splits were made for categories that contributed significantly to total emissions of one pollutant, but only if the methodologies for the sub-sources are not the same (e.g. Solvent and Other Product Use the methodology for NMVOC emissions uses the same input data for all sub-sources, and the input data are dependant on each other, which is why no further dissaggregation was made).

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[61] The so-called "trend assessment" is also a Tier 1 approach using not the absolute emission value but the trend of emissions as key parameter

For reasons of transparency, the same level of aggregation for all pollutants was used.

In the following the rationale for the aggregation per sector is given:

1 A Combustion Activities

1 A Combustion Activities is the most important sector for emissions reported to UNECE. To account for this fact and help prioritising efforts this sector was analysed in greater detail.

As methodologies for mobile and stationary sources are generally different, this split was used for all sub categories. Furthermore, for mobile sources the different means of transport were considered separately, and additionally the sub category road transport was further disaggregated as it is an important source for many pollutants.

For stationary sources a split following the third level of the NFR was used (1 A 2, 1 A 4), and additionally a fuel split was made, except for 1 A 1 Energy Industries where the disaggregation followed NFR level four with no fuel split and 1 A 5 where no further split was made as this category is of minor importance in terms of emission levels.

The following figure explains the disaggregation used for 1 A Combustion Activities.

1 A Combustion Activities			
1 A 1 Energy Industries	1 A 1 a Public Electricity and Heat Production		
	1 A 1 b Petroleum refining		
	1 A 1 c Manufacture of Solid fuels and Other Energy Industries		
1 A 2 Manufacturing Industries and Constructions		● Stationary sources	● Liquid Fuels ● Solid Fuels ● Gaseous Fuels ● Biomass ● Other
		● Mobile sources	
1 A 3 Transport	1 A 3 a Civil Aviation		
	1 A 3 b Road Transport	● Passenger Cars ● Light Duty Vehicles ● Heavy Duty Vehicles ● Mopeds & Motorcycles ● Gasoline Evaporation ● Automobile Tyre and Breakwear	
	1 A 3 c Railways		
	1 A 3 d Navigation		
	1 A 3 e Other		
1 A 4 Other Sectors		● Stationary sources	● Liquid Fuels ● Solid Fuels ● Gaseous Fuels ● Biomass ● Other
		● Mobile sources	
1 A 5 Other			

Figure 3: Disaggregation used for 1 A Combustion Activities.

1 B Fugitive Emissions

No further disaggregation as emission data has the same source for all sub categories.

2 Industrial Processes

Level two of the NFR was used (2 A/2 B/2 C/2 D) as emission data has the same source for most sub categories or, in the case of 2 C Metal Production, one sub-source is clearly dominating.

3 Solvent and Other Product Use

No further disaggregation as one model was used for all NMVOC emissions and considering other pollutants only HM emissions arise from one sub category.

4 Agriculture

Level two of the NFR was used (4 B/4 D/4 F); only the sub category 4 B was further disaggregated as this is an important source for NH_3 and the methodology is different for the animal categories.

6 Waste

No further disaggregation was used as this category is of minor importance concerning emissions of pollutants reported to the UNECE.

The applied aggregation resulted in 44 source categories (not including categories that are not relevant for Austria).

Results of the Level Assessment

As the analysis was made for all different pollutants reported to the UNECE and as these pollutants differ in their way of formation, most of the identified categories are key for one pollutant or more: as in last year's analysis, 33 key sources were identified. The results of the analysis are presented in Table 6.

However, compared to last year's analysis, two additional key sources were identified, and two sources identified in last year's analysis were not identified in this year's analysis (this is due to recalculations, for explanations for recalculations please refer to Chapter 3):

- Additional sources
  - 6 Waste
  - 1 A 3 b 4 Road Traffic: Mopeds & Motorcycles
- Sources identified in last year's analysis but not in this year's
  - 1 A 3 c Railways
  - 1 A 4 Other Sectors stationary – other.

Table 6: Level Assessment for the year 2006.

Level Assessment 2007		SO_2	NO_x	NMVOC	NH_3	CO	Cd	Hg	Pb
					[%]				
1 A 1 a	Public Electricity and Heat Production	14.61	4.66	0.41	0.40	0.52	9.22	19.79	10.28
1 A 1 b	Petroleum refining	12.97	1.51		0.15	0.06	15.35	1.06	2.05
1 A 1 c	Manufacture of Solid fuels and Other Energy Industries	0.00	0.66	0.00	0.02	0.01	0.00	0.00	0.00
1 A 2 mobile	Other mobile in industry	2.04	5.74	1.14	0.01	0.86	3.70	0.01	0.00
1 A 2 stat (l)	Manuf. Ind. and Constr. stationary LIQUID	8.57	1.17	0.07	0.09	0.57	5.44	5.14	4.11
1 A 2 stat (s)	Manuf. Ind. and Constr. stationary SOLID	20.29	2.68	0.28	0.00	18.56	0.15	9.33	0.33
1 A 2 stat (g)	Manuf. Ind. and Constr. stationary GASEOUS	0.33	3.47	0.03	0.17	0.52	0.00	0.00	0.00
1 A 2 stat (b)	Manuf. Ind. and Constr. stationary BIOMASS	3.16	1.57	0.08	0.17	0.33	3.41	3.21	3.34
1 A 2 stat (s)	Manuf. Ind. and Constr. stationary OTHER	1.80	1.09	0.19	0.00	0.65	4.74	8.53	14.13
1 A 3 a	Civil Aviation	0.25	0.34	0.16	0.00	0.36	0.01	0.00	0.00
1 A 3 b 1	R.T., Passenger cars	0.24	18.52	6.25	3.45	24.21	0.31	0.12	0.07
1 A 3 b 2	R.T., Light duty vehicles	0.04	2.65	0.39	0.08	1.12	0.04	0.02	0.00
1 A 3 b 3	R.T., Heavy duty vehicles	0.19	36.33	2.61	0.09	1.97	0.19	0.07	0.02
1 A 3 b 4	R.T., Mopeds & Motorcycles		0.19	1.09	0.00	2.73	0.00	0.00	0.00
1 A 3 b 5	R.T., Gasoline evaporation			2.05					
1 A 3 b 7	R.T., Automobile road abrasion						7.59		
1 A 3 c	Railways	0.20	0.60	0.10	0.00	0.05	0.01	0.02	0.01
1 A 3 d	Navigation	0.05	0.20	0.36	0.00	0.37	0.00	0.00	0.00
1 A 3 e	Other		0.54	0.00		0.01			
1 A 4 mob	Other Sectors - mobile	0.18	7.85	4.57	0.01	4.90	0.16	0.01	0.00
1 A 4 stat (l)	Other Sectors stationary LIQUID	16.08	1.96	0.05	0.38	0.82	0.27	0.07	0.02
1 A 4 stat (s)	Other Sectors stationary SOLID	10.54	0.24	1.03	0.00	3.13	3.60	6.07	3.56
1 A 4 stat (g)	Other Sectors stationary GASEOUS	0.00	1.23	0.01	0.12	0.38			

Level Assessment 2007		SO_2	NO_x	NMVOC	NH_3	CO	Cd	Hg	Pb
					[%]				
1 A 4 stat (b)	Other Sectors stationary BIOMASS	2.93	3.62	18.13	0.58	33.78	25.35	14.04	14.87
1 A 4 stat (o)	Other Sectors stationary OTHER	0.33	0.03	0.02	0.00	0.02	0.39	0.14	0.26
1 A 5	Other	0.14	0.09	0.03		0.10			
1 B	FUGITIVE EMISSIONS FROM FUELS	0.59		1.82					
2 A	MINERAL PRODUCTS					1.25			
2 B	CHEMICAL INDUSTRY	2.69	0.20	0.77	0.11	1.42	0.06	0.01	0.01
2 C	METAL PRODUCTION	1.60	0.05	0.27		0.34	19.70	30.31	46.81
2 D	OTHER PRODUCTION		0.48	1.71		0.10			
2 G	OTHER				0.00				
3	SOLVENT AND OTHER PRODUCT USE			55.31					
4 B 1	Cattle				55.92				
4 B 2	Buffalo								
4 B 3	Sheep				1.21				
4 B 4	Goats				0.21				
4 B 6	Horses				1.11				
4 B 7	Mules and Asses								
4 B 8	Swine				14.19				
4 B 9	Poultry				7.88				
4 B-13	Other				0.16				
4 D	AGRICULTURAL SOILS		2.30	0.98	11.85				
4 F	FIELD BURNING OF AGRICULTURAL RESIDUES	0.00	0.01	0.06	0.06	0.13	0.16	0.03	0.08
4 G	OTHER								
6	WASTE	0.20	0.02	0.05	1.59	0.75	0.13	2.01	0.06

Level Assessment 2007		PAH	Diox	HCB	TSP	PM10	PM2.5
					%		
1 A 1 a	Public Electricity and Heat Production	0.16	1.80	0.80	1.53	2.42	3.90
1 A 1 b	Petroleum refining	0.03	0.05	0.01	0.13	0.22	0.35
1 A 1 c	Manufacture of Solid fuels and Other Energy Industries	0.00	0.00	0.00	0.10	0.17	0.32
1 A 2 mobile	Other mobile in industry	1.19	0.21	0.04	4.27	6.01	9.36
1 A 2 stat (l)	Manuf. Ind. and Constr. stationary LIQUID	0.04	0.62	0.13			
1 A 2 stat (s)	Manuf. Ind. and Constr. stationary SOLID	0.06	0.39	0.05			
1 A 2 stat (g)	Manuf. Ind. and Constr. stationary GASEOUS	0.02	1.16	0.23			
1 A 2 stat (b)	Manuf. Ind. and Constr. stationary BIOMASS	0.56	2.98	0.48			
1 A 2 stat (s)	Manuf. Ind. and Constr. stationary OTHER	0.26	6.50	2.55			
1 A 3 a	Civil Aviation				0.10	0.17	0.33
1 A 3 b 1	R.T., Passenger cars	7.70	0.96	0.19	2.69	4.65	8.90
1 A 3 b 2	R.T., Light duty vehicles	1.76	0.23	0.05	0.58	1.00	1.92
1 A 3 b 3	R.T., Heavy duty vehicles	7.89	1.38	0.28	2.45	4.23	8.11
1 A 3 b 4	R.T., Mopeds & Motorcycles	0.59	0.01	0.00			
1 A 3 b 5	R.T., Gasoline evaporation						
1 A 3 b 7	R.T., Automobile road abrasion				13.53	7.78	4.48
1 A 3 c	Railways	0.17	0.04	0.01	2.15	1.33	0.94
1 A 3 d	Navigation	0.05	0.02	0.00	0.04	0.07	0.14
1 A 3 e	Other				0.01	0.01	0.01
1 A 4 mob	Other Sectors – mobile	1.81	0.43	0.09	15.88	24.92	43.42
1 A 4 stat (l)	Other Sectors stationary LIQUID	0.30	0.34	0.03			
1 A 4 stat (s)	Other Sectors stationary SOLID	3.04	6.02	7.59			
1 A 4 stat (g)	Other Sectors stationary GASEOUS	0.03	0.41	0.04			
1 A 4 stat (b)	Other Sectors stationary BIOMASS	69.34	64.32	78.13			

Level Assessment 2007		**PAH**	**Diox**	**HCB**	**TSP**	**PM10**	**PM2.5**
					%		
1 A 4 stat (o)	Other Sectors stationary OTHER	0.22	0.50	0.42			
1 A 5	Other				0.06	0.10	0.19
1 B	FUGITIVE EMISSIONS FROM FUELS				0.79	0.64	0.39
2 A	MINERAL PRODUCTS				35.05	28.81	6.59
2 B	CHEMICAL INDUSTRY				0.64	0.64	0.65
2 C	METAL PRODUCTION	2.09	10.60	8.67	1.89	2.30	1.93
2 D	OTHER PRODUCTION	0.42	0.30	0.06	1.36	0.94	0.72
2 G	OTHER						
3	SOLVENT AND OTHER PRODUCT USE				0.59	1.01	1.94
4 B 1	Cattle						
4 B 2	Buffalo						
4 B 3	Sheep						
4 B 4	Goats						
4 B 6	Horses						
4 B 7	Mules and Asses						
4 B 8	Swine						
4 B 9	Poultry						
4 B-13	Other						
4 D	AGRICULTURAL SOILS				14.67	11.40	4.86
4 F	FIELD BURNING OF AGRICULTURAL RESIDUES	2.26	0.33	0.07			
4 G	OTHER				1.25	0.97	0.41
6	WASTE	0.00	0.38	0.08	0.25	0.21	0.13

Keys sources are listed in bold, highlighted boxes show for which pollutants the category is key. The given percentage is the contribution of the category to national total emissions, blank fields indicate that no such emissions occur from this source.

1.5 Quality Assurance and Quality Control (QA/QC)

A quality management system (QMS) has been designed to contribute to the objectives of *good practice guidance (GPG)*, namely to improve transparency, consistency, comparability, completeness and confidence in national inventories of emissions estimates.

The QMS was primarily developed to meet the requirement of reporting greenhouse gas emissions under the Kyoto Protocol. For this reason the emphasis was placed on greenhouse gases. All air pollutants are covered by the QMS; however, in the first instance the inspection body applied to accreditation for greenhouse gases only.

The *Department of Air Emissions* of the Umweltbundesamt has decided to implement a QMS based on the International Standard ISO 17020 *General Criteria for the operation of various types of bodies performing inspections*[62]. Consequently the QMS contains all relevant features of international standard such as strict independence, impartiality and integrity of accredited bodies. Furthermore the QMS ensures the fulfilment of requirements as stipulated in Chapter 8 of the IPCC-GPG[63].

The QMS was fully implemented by the end of 2003, and the accreditation audit of the *Department for Air Emissions* as inspection body took place in autumn 2005. In January 2006, the official notification concerning the accreditation for greenhouse gases of the *Department for Air Emissions* was received.[64/65]

QA/QC Activities

QA/QC activities for non-GHG focus on Tier 1 and Tier 2 quality control procedures, they follow largely the procedures described in the LRTAP GPG. Also Tier 1 Quality Assurance procedures are performed, however they are not made by a third party but as a so-called 2nd party audit (e.g. the data manager who is not directly involved in the preparation of the inventory of the different sectors is performing checks as listed below).

QA/QC activities are performed at all stages of inventory preparation, they include during

- inventory preparation/data collection (performed by sector experts):
  - checking if applied methodology is applicable or if any comments have been made e.g. by the review team, incorporating last year's planned improvements
  - transparent and comprehensible documenting and archiving that allows reproduction of the inventory
- data processing (performed by data manager):
  - electronic checks to screen for incomplete estimates and calculation errors
  - visual checks to screen for time series consistency
- preparation of inventory report (performed by sector experts):
  - check for transcription errors by comparison of data in reporting format with data/information in the inventory database.
  - check for plausibility of estimates by comparison with previous estimates using automatically produced data sheets showing recalculation differences

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[62] The International Standard ISO 17020 has replaced the European Standard EN 45004.

[63] Good Practice Guidance by the Intergovernmental Panel on Climate Change

[64] Akkreditierungsbescheid (certificate of accreditation) GZ BMWA-92.715/0036-I/12/2005

[65] For more information see Austria's National Inventory Report 2007 - Submission under the UNFCCC

1.6 Uncertainty Assessment

So far, no quantitative uncertainty assessment for any of the pollutants or pollutant groups relevant for this report has been made. For GHGs a comprehensive uncertainty assessment has already been performed.[65]

However, the quality of estimates for all relevant pollutants has been rated using qualitative indicators as suggested in Chapter "GPG for LRTAP emission inventories" of the EMEP/CORINAIR Guidebook. The definition of the ratings is given in Table 7, the ratings for the emission estimates are presented in Table 9.

Table 7: Definitions of qualitative rating.

Rating	Definition	Typical Error Range
A	An estimate based on a large number of measurements made at a large number of facilities that fully represent the sector	10 to 30%
B	An estimate based on a large number of measurements made at a large number of facilities that represent a large part of the sector	20 to 60%
C	An estimate based on a number of measurements made at a small number of representative facilities, or an engineering judgement based on a number of relevant facts	50 to 150%
D	An estimate based on single measurements, or an engineering calculation derived from a number of relevant	100 to 300%
E	An estimate based on an engineering calculation derived from assumptions only	order of magnitude

Source: Chapter "GPG for LRTAP emission inventories" of the EMEP/CORINAIR Guidebook

Furthermore, for HM and POPs qualitative „quality indicators" have been assigned to each emission value, and based on these values, a „semi-quantitative" value for the overall uncertainty of the HM and POPs emission inventory was calculated. As uncertainties for HM and POP emissions are generally relatively high (related to uncertainties to e.g. main pollutants or CO_2) and often difficult to determine, this „semi-quantitative" approach is considered to be a good approximation.

First, the main influences on the uncertainty of emission data were identified and the criteria were graded for every emission source:

- Influence on the uncertainty mainly related to the emission factor
  - (i) data availability (1 = representative sample, 2–4 = fair/medium/poor data availability, 5 = no measured data/indirect estimation);
  - (ii) the variation of the emission values (difference of measured or reported values: 10^1 = 1, …, 10^5 or more = 5).
- Influence on the uncertainty mainly related to the activity data
  - (iii) the homogeneity of emitters (1 = similar, …, 3 = different);
  - (iv) quality of activity data (1 = good, …, 3 = poor).

An arithmetic mean of the different grades was calculated; as the first two criteria have a higher impact on the uncertainty of the emission value, there were five grades were to choose from compared to three grades for the other two criteria. Thus the arithmetic mean is more dependent on the more important criteria. This resulted in a single quality indicator for each emission value.

To estimate the overall inventory uncertainty the quality indicators of the different emission sources were weighted according to the share in total emissions and the mean was calculated; This resulted in a single quality indicator for the overall inventory (for total emissions of one pollutant).

Statistically it can be deduced that an increase of the quality indicator by a value of 1 corresponds to a decrease in the quality and thus a increase in the variation by a factor of 2.

Finally, to calculate the variation of total emissions ("uncertainty") from of the weighted quality indicator the following assumption was made: as emission values are usually asymmetrically distributed, the „true" value (the value used for the inventory) reflects the geometrical mean value of the distribution. Using this assumption the variation of total emissions can be calculated using the following formula:

$$\frac{x}{\sqrt{2\exp(QI)}} \leq x \leq x \bullet \sqrt{2\exp(QI)}$$

QI…weighed quality indicator

x…"true" emission value (value used in the inventory)

The following table presents the results for HM and POPs. For POP emissions a factor of about 3 was determined, and a factor of about 2 for HM emissions.

Table 8: Variation of total emissions ("uncertainty") of HM and POP emissions.

Uncertainty[66]	1999			2000	
	Emission [kg]	Variation		Emission [t]	Variation
Dioxin/Furan	0.18	0.08–0.4	Cd	0.97	0.5–2.1
HCB	47	20–130	Hg	0.88	0.5–1.7
PAHs	28 000	10 000–80 000	Pb	12.4	6.0–26

[66] The analysis was performed in 2001 for emission data of 1999 for POPs and 2000 for HM. As emissions have been recalculated since then the presented emission values differ slightly from values reported now.

Table 9: Quality of emission estimates.

NFR	Description	SO_2	NO_x	NMVOC	NH_3	CO	Cd	Hg	Pb	PAH	Diox	HCB	TSP	PM10	PM2.5
1 A 1 a	**Public Electricity and Heat Production**	**A**	**A**	D	E	A	**C**	**C**	**C**	C	**C**	C	**B**	**C**	**C**
1 A 1 b	**Petroleum refining**	**A**	**A**		E	A	**C**	C	**C**	D	D	D	A	B	B
1 A 1 c	Manufacture of Solid fuels & Other Energy Ind.		B	D	E	D					D	D	B	B	B
1 A 2 mobile	**Other mobile in industry**	A	**B**	**B**	C	**B**	C	C	C	D	D	D	**B**	**B**	**B**
1 A 2 stat (l)	**Manuf. Ind. and Constr. stationary LIQUID**	**A**	**B**	D	E	C	**C**	**B**	**C**	C	E	D	C	C	**C**
1 A 3 a	Civil Aviation	A	B	B	C	B	B	B	B				B	B	B
1 A 3 b 1	**R.T., Passenger cars**	A	**B**	**B**	**C**	**B**	B	B	C	**C**	**D**	D	**B**	**B**	**B**
1 A 3 b 2	**R.T., Light duty vehicles**	A	**B**	B	C	B	B	B	C	**C**	D	D	B	**B**	**B**
1 A 3 b 3	**R.T., Heavy duty vehicles**	**A**	**B**	**B**	C	**B**	B	B	C	**C**	**D**	D	**B**	**B**	**B**
1 A 3 b 4	**R.T., Mopeds & Motorcycles**		B	B	C	**B**	B	B	C	D	D	D			
1 A 3 b 5	**R.T., Gasoline evaporation**			**B**											
1 A 3 b 6	**R.T., Automobile tyre and break wear**						**C**	C	C				**C**	**C**	**C**
1 A 3 c	**Railways**	A	B	B	C	B	B	B	C	D	D	D	**B**	**B**	B
1 A 3 d	Navigation	A	B	B	C	B	B	B	C	D	D	D	B	B	B
1 A 3 e	Other		A	D	E	C						D	C	C	C
1 A 4 mob	**Other Sectors – mobile**	A	**B**	**B**	C	**B**	C	C	C	**D**	D	D	**B**	**B**	**B**
1 A 4 stat (b)	**Other Sectors stationary BIOMASS**	**A**	**B**	**C**	E	**C**	**C**	**C**	**D**	**D**	**E**	**D**	**C**	**C**	**C**
1 A 5	Other	B	C	C	D	C	C	C	C	D	D	D	C	C	C

NFR	Description	SO_2	NO_x	NMVOC	NH_3	CO	Cd	Hg	Pb	PAH	Diox	HCB	TSP	PM10	PM2.5
1 B	**FUGITIVE EMISSIONS FROM FUELS**	A		**A**									D	D	D
2 A	**MINERAL PRODUCTS**					**C**							**D**	**D**	**D**
2 B	**CHEMICAL INDUSTRY**	**B**	B	**D**	A	**D**	A	A	B				A	A	A
2 C	**METAL PRODUCTION**	**C**	B	C		B	**B**	**B**	**C**	**C**	**C**	**C**	**B**	**B**	**B**
2 D	**OTHER PRODUCTION**		B	**B**		B				E	E	E	D	D	D
2 G	OTHER				E										
3	**SOLVENT AND OTHER PRODUCT USE**			**A**			B		B						
4 B 1	**Cattle**				**B**										
4 B 3	**Sheep**				**B**										
4 B 4	Goats				B										
4 B 6	Horses				B										
4 B 8	**Swine**				**B**										
4 B 9	**Poultry**				**B**										
4 B-13	Other				B										
4 D	**AGRICULTURAL SOILS**		**B**	E	**B**								**D**	**D**	**D**
4 F	**FIELD BURNING OF AGRIC. RESIDUES**	E	E	E	E	E	E	E	E	**E**	E	E			
4 G	**Agriculture – Other**												**D**	**D**	**D**
6	**WASTE**	D	D	C	C	**C**	B	B	B	D	D	B	D	D	D

Abbreviations: see Table 7;
(dark shaded cells indicate that no such emissions arise from this source, light shaded cells (green) indicate that source is a key source for this pollutant)

1.7 Completeness

The inventory is complete with regard to reported gases, reported years and reported emissions from all sources, and also complete in terms of geographic coverage.

Geographic Coverage

The geographic coverage is complete. There is no territory in Austria not covered by the inventory.

However, if fuel prices vary considerably in neighbouring countries, fuel sold within the territory of a Party is used outside its territory (so-called 'fuel export'). Austria has experienced a considerable amount of 'fuel export' in the last few years.

In the 2002 UNECE Emission Reporting Guidelines, Parties are given the choice of whether to report emissions on the basis of fuel used or fuel sold to the final consumer but should clearly state the basis of their calculations in their submissions.

In reports to the UNECE/LRTAP, emissions from mobile sources are reported on the basis of fuel sold. Emissions from 'fuel export' are therefore included in the Austrian Total.[67]

Gases, Reporting Years

In accordance with the Austrian obligation, all relevant pollutants mentioned in Table 2 (minimum reporting programme) are covered by the Austrian inventory and are reported for the years 1980–2006 for the main pollutants, from 1985 onwards for POPs and HMs and for the years 1990, 1995 and from 2000 onwards for PM.

Sources

Notation keys are used according to the Guidelines for Estimating and Reporting Emission Data under LRTAP (UNECE 2003 – see Table 10)[68] to indicate where emissions are not occurring in Austria, where emissions have not been estimated or have been included elsewhere as suggested by EMEP/CORINAIR. The main reason for different allocations to categories are the allocation in national statistics, insufficient information on the national statistics, national methods, and the impossibility to disaggregate emission declarations; explanations for each the case is given in the NFR-Table IV 1 F1–F4.

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[67] For more information, see UMWELTBUNDESAMT (2007): Austria's National Air Emission Inventory 1990–2005: Submission under Directive 2001/81/EC on national emission ceilings for certain atmospheric pollutants. Vienna. http://www.umweltbundesamt.at/fileadmin/site/publikationen/REP0058.pdf

[68] AIR POLLUTION STUDIES No. 15

Table 10: Notation keys used in the NFR.

Abbreviation	Meaning	Objective
NO	not occurring	for emissions by sources of compounds that do not occur for a particular compound or source category within a country;
NA	not applicable	is used for activities in a given source category which are believed not to result in significant emissions of a specific compound;
NE	not estimated	for existing emissions by sources of compounds that have not been estimated; Where "NE" is used in an inventory the Party should indicate why emissions could not be estimated.
IE	included elsewhere	for emissions by sources of compounds that are estimated but included elsewhere in the inventory instead of in the expected source category; Where "IE" is used in an inventory, the Party should indicate where in the inventory the emissions from the displaced source category have been included and the Party should give the reasons for this inclusion deviating from the expected category.
C	confidential	for emissions by sources of compounds which could lead to the disclosure of confidential information; Where "C" is used in an inventory, reference should be made to the Protocol provision that authorizes such practice.
NR	not relevant	According to Para. 9 in the Emission Guidelines, Emission inventory reporting should cover all years from 1980 onwards, if data are available. However, "NR" (Not Relevant) is introduced to ease the reporting where emissions are not strictly required by the different Protocols. E.g. for some Parties emissions of NMVOC prior to 1988.

2 TREND IN TOTAL EMISSIONS

2.1 Emission Targets

Stabilisation or reduction targets for SO_2, NO_x, NMVOC, NH_3, heavy metals and POPs respectively, have been set out in the different protocols of UNECE/LRTAP Convention mentioned in Chapter 1.1.3 and listed in Table 1. Information on these targets as well as on the status of Austria fulfilling these targets is provided below.

2.1.1 The 1985 Helsinki Protocol on the Reduction of Sulphur Emissions or their Transboundary Fluxes

The Protocol to the Convention on LRTAP on the Reduction of Sulphur Emissions or their Transboundary Fluxes by at least 30 per cent entered into force in 1987.[69] Twenty-one ECE countries are Parties to this Protocol, which aims at abating one of the major air pollutants. As a result of this Protocol, substantial cuts in sulphur emissions have been recorded in Europe: Taken as a whole, the 21 Parties to the 1985 Sulphur Protocol reduced 1980 sulphur emissions by more than 50% by 1993 (using the latest available figure, where no data were available for 1993). Also individually, based on the latest available data, all Parties to the Protocol have reached the reduction target. Eleven Parties have achieved reductions of at least 60%. Given the target year 1993 for the 1985 Sulphur Protocol, it can be concluded that all Parties to that Protocol have reached the target of reducing emissions by at least 30%.

In Austria, SO_2 emissions in the base year 1980 amouned to 345 Gg, by the year 1993 emissions were reduced to 53 Gg corresponding to a reduction of 84%. In 2006, SO_2 emissions in Austria amounted to 28 Gg, which is a decrease by 92% compared to 1980. This reduction could be archieved mainly due to lower emissions from residential heating, combustion in industries and energy industries.

2.1.2 The 1988 Sofia Protocol concerning the Control of Emissions of Nitrogen Oxides or their Transboundary Fluxes

In 1988 the Protocol concerning the Control of Emissions of Nitrogen Oxides or their Transboundary Fluxes was adopted in Sofia (Bulgaria).[70] This Protocol requires as a first step, to freeze emissions of nitrogen oxides or their transboundary fluxes. The general reference year is 1987[71].

Taking the sum of emissions of Parties to the NO_x Protocol in 1994, or a previous year, where no recent data are available, also a reduction of 9% compared to 1987 can be noted. Nineteen of the 25 Parties to the 1988 NO_x Protocol have reached the target and stabilized emissions at 1987[72] levels or reduced emissions below that level according to the latest emission data reported.

[69] http://www.unece.org/env/lrtap/sulf_h1.htm

[70] http://www.unece.org/env/lrtap/nitr_h1.htm

[71] with the exception of the United States that chose to relate its emission target to 1978

[72] or in the case of the United States 1978

The second step to the NO_x Protocol requires the application of an effects-based approach. Applying the multi-pollutant, multi-effect critical load approach, a new instrument being prepared at present should provide for further reduction of emissions of nitrogen compounds, including ammonia, and volatile organic compounds, in view of their contribution to photochemical pollution, acidification and eutrophication, and their effects on human health, the environment and materials, by addressing all significant emission sources.

The collection of scientific and technical information as a basis for a further reduction in nitrogen oxides and ammonia, considering their acidifying as well as nitrifying effects, is under way.

Austria was successful in fulfilling the stabilisation target set out in the Protocol: NO_x emissions decreased steadily from the base year 1987 until the mid-1990s and remained largely stable with only minor fluctuations until 1999. However, since then emissions have been increasing again, in 2001 emissions even slightly exceeded 1987 levels. The main reason for the increase of NO_x emissions are strongly increasing emissions from heavy duty vehicles, which is mainly caused by 'fuel export'.

Austrian NO_x emissions in the base year under this Protocol amounted to 214 Gg, by the year 1995 emissions were reduced to 181 Gg corresponding to a reduction of 16%. In 2006, NO_x emissions in Austria amounted to 225 Gg, which is an increase by 5% compared to 1987.[73]

2.1.3 The 1991 Geneva Protocol concerning the Control of Emissions of Volatile Organic Compounds or their Transboundary Fluxes

In November 1991, the Protocol to the Convention on Long-range Transboundary Air Pollution on the Control of Emissions of Volatile Organic Compounds (VOCs, i.e. hydrocarbons) or Their Transboundary Fluxes, the second major air pollutant responsible for the formation of ground level ozone, was adopted. It has entered into force on 29 September 1997.[74]

This Protocol specifies three options for emission reduction targets that have to be chosen upon signature or upon ratification:

(i) 30% reduction in emissions of volatile organic compounds (VOCs) by 1999 using a year between 1984 and 1990 as a basis;[75]

(ii) The same reduction as for (i) within a Tropospheric Ozone Management Area (TOMA) specified in annex I to the Protocol and ensuring that by 1999 total national emissions do not exceed 1988 levels;[76]

(iii) Finally, where emissions in 1988 did not exceed certain specified levels, Parties may opt for a stabilization at that level of emission by 1999.[77]

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[73] Please note that emissions from mobile sources are calculated based on fuel sold, which for the last few years is considerably higher than fuel used: emissions for 2006 based on fuel used amount to 173 Gg, which is about 23% less (see Chapter 1.7 Completeness for more information regarding 'fuel export', Austria's emissions based on fuel used – thus excluding 'fuel export' – are presented in Table 1 in the Annex).

[74] http://www.unece.org/env/lrtap/vola_h1.htm

[75] This option has been chosen by Austria, Belgium, Estonia, Finland, France, Germany, Netherlands, Portugal, Spain, Sweden and the United Kingdom with 1988 as base year, by Denmark with 1985, by Liechtenstein, Switzerland and the United States with 1984, and by Czech Republic, Italy, Luxembourg, Monaco and Slovakia with 1990 as base year

[76] Annex I specifies TOMAs in Norway (base year 1989) and Canada (base year 1988)

[77] This has been chosen by Bulgaria, Greece, and Hungary

Austria met the reduction target: in the base year NMVOC emissions amounted to 350 Gg, in 1999 emissions were reduced by 49% to 178 Gg. From 1999 to 2006 a further reduction of 4% (172 Gg) can be noted.

2.1.4 The 1998 Aarhus Protocol on Heavy Metals

The Executive Body adopted the Protocol on Heavy Metals on 24 June 1998 in Aarhus (Denmark).[78] It targets three particularly harmful metals: cadmium, lead and mercury. According to one of the basic obligations, Parties will have to reduce their emissions for these three metals below their levels in 1990 (or an alternative year between 1985 and 1995). The Protocol entered into force on 29th December 2003.

The Protocol aims to cut emissions from industrial sources (iron and steel industry, non-ferrous metal industry), combustion processes (power generation, road transport) and waste incineration. It lays down stringent limit values for emissions from stationary sources and suggests best available techniques (BAT) for these sources, such as special filters or scrubbers for combustion sources or mercury-free processes. The Protocol requires Parties to phase out leaded petrol. It also introduces measures to lower heavy metal emissions from other products, such as mercury in batteries, and proposes the introduction of management measures for other mercury-containing products, such as electrical components (thermostats, switches), measuring devices (thermometers, manometers, barometers), fluorescent lamps, dental amalgam, pesticides and paint.

Austria has chosen 1985 as a base year and current emissions are well below the level of the base year (see Chapter 2.4).

2.1.5 The 1998 Aarhus Protocol on Persistent Organic Pollutants (POPs)

The Executive Body adopted the Protocol on Persistent Organic Pollutants on 24 June 1998 in Aarhus (Denmark). It entered into force on 23 October 2003. It focuses on a list of 16 substances that have been singled out according to agreed risk criteria. The substances comprise eleven pesticides, two industrial chemicals and three by-products/contaminants. The ultimate objective is to eliminate any discharges, emissions and losses of POPs. The Protocol bans the production and use of some products outright (aldrin, chlordane, chlordecone, dieldrin, endrin, hexabromobiphenyl, mirex and toxaphene). Others are scheduled for elimination at a later stage (DDT, heptachlor, hexaclorobenzene, PCBs). Finally, the Protocol severely restricts the use of DDT, HCH (including lindane) and PCBs.

The Protocol includes provisions for dealing with the wastes of products that will be banned. It also obliges Parties to reduce their emissions of dioxins, furans, PAHs and HCB below their levels in 1990 (or an alternative year between 1985 and 1995). For the incineration of municipal, hazardous and medical waste, it lays down specific limit values.

Austria has chosen 1985 as a base year and current emissions are well below the level of the base year (see Chapter 2.5).

[78] http://www.unece.org/env/lrtap/hm_h1.htm

2.1.6 The 1999 Gothenburg Protocol to Abate Acidification, Eutrophication and Ground-level Ozone "Multi-Effect Protocol"

The Executive Body adopted the Protocol to Abate Acidification, Eutrophication and Ground-level Ozone in Gothenburg (Sweden) on 30 November 1999.

The Protocol sets emission ceilings for 2010 for four pollutants: sulphur, NO_x, VOCs and ammonia. These ceilings were negotiated on the basis of scientific assessments of pollution effects and abatement options. Parties whose emissions have a more severe environmental or health impact and whose emissions are relatively cheap to reduce will have to make the biggest cuts. Once the Protocol is fully implemented, Europe's sulphur emissions should be cut by at least 63%, its NO_x emissions by 41%, its VOC emissions by 40% and its ammonia emissions by 17% compared to 1990.

The Protocol also sets tight limit values for specific emission sources (e.g. combustion plant, electricity production, dry cleaning, cars and lorries) and requires best available techniques to be used to keep emissions down. VOC emissions from such products as paints or aerosols will also have to be cut. Finally, farmers will have to take specific measures to control ammonia emissions. Guidance documents adopted together with the Protocol provide a wide range of abatement techniques and economic instruments for the reduction of emissions in the relevant sectors, including transport.

It has been estimated that once the Protocol is implemented, the area in Europe with excessive levels of acidification will shrink from 93 million hectares in 1990 to 15 million hectares. That with excessive levels of eutrophication will fall from 165 million hectares in 1990 to 108 million hectares. The number of days with excessive ozone levels will be halved. Consequently, it is estimated that life-years lost as a result of the chronic effects of ozone exposure will be about 2 300 000 lower in 2010 than in 1990, and there will be approximately 47 500 fewer premature deaths resulting from ozone and particulate matter in the air. The exposure of vegetation to excessive ozone levels will be 44% down on 1990.

Information on emission trends of pollutants covered by this protocol is given in Chapter 2.2.

2.2 Emission Trends for Air Pollutants covered by the Multi- Effect Protocol as well as CO

Table 11 show national total emissions and trends (1990–2006) as well as emission targets[79] for air pollutants covered by the Multi-Effect Protocol.

Please note that emissions from mobile sources are calculated based on fuel sold in Austria, thus national total emissions include 'fuel export'.[80]

[79] For NO_x the National Emission Ceilings Directive (NEC Directive) of the European Union, who also signed the Multi-Effect Protocol, sets a tighter emission target for Austria than the LRTAP Protocol (103 Gg vs. 107 Gg).

[80] see Chapter 1.7 Completeness for more information regarding 'fuel export'; Austria's emissions based on fuel used – thus excluding 'fuel export' – are presented in the Annex.

Table 11: National total emissions and trends 1990–2006 as well as emission targets for air pollutants covered by the Multi-Effect Protocol and CO.

Year	Emission [Gg]				
	SO_2	NO_x	NMVOC	NH_3	CO
1990	74.33	192.41	283.18	71.05	1 444.11
1991	71.42	202.65	275.20	73.62	1 513.92
1992	55.03	191.89	250.43	72.06	1 481.31
1993	53.38	186.24	249.27	72.80	1 448.57
1994	47.61	180.70	231.16	73.99	1 379.37
1995	46.85	181.40	229.35	75.35	1 267.33
1996	44.61	203.81	221.54	73.11	1 246.13
1997	40.16	193.03	206.62	72.87	1 154.95
1998	35.57	208.09	191.80	72.98	1 109.26
1999	33.79	198.89	178.44	71.13	1 034.38
2000	31.62	205.35	177.11	69.14	959.09
2001	32.70	215.03	188.25	68.77	930.36
2002	31.64	224.58	188.79	67.62	898.57
2003	32.44	235.54	183.01	67.27	900.10
2004	26.93	233.29	176.02	66.46	857.50
2005	26.65	236.97	163.65	65.95	823.41
2006	28.46	225.16	171.63	65.81	785.35
Trend 1990–2006	**-62%**	**17%**	**-39%**	**-7%**	**-46%**
Absolute Emission Target 2010	**39.00**	**107.00**	**159.00**	**66.00**	**–**

2.2.1 SO_2 Emissions

In 1990, national total SO_2 emissions amounted to 74 Gg; emissions have decreased steadily since then and by the year 2006 emissions were reduced by 62% mainly due to lower emissions from residential heating, combustion in industries and energy industries.

As shown in Table 12, the main source for SO_2 emissions in Austria with a share of 94% in 1990 and 95% in 2006 is Category *1 A Fuel Combustion Activities*. Within this source residential heating has the highest contribution to total SO_2 emissions. SO_2 emissions have decreased steadily mainly due to lower emissions from residential heating, combustion in industries and energy industries, mainly caused by a switch-over from high sulfur fuels (like coal and heavy oil) to fuels with lower sulfur content, and the implementation of desulfurizsation units. The peak of SO_2 emissions in 2004 in Sector *Agriculture* (< 0.1% to national total) is due to a larger area of stubble fields burnt that year.

The 2010 national emission ceiling for SO_2 emissions in Austria as set out in Annex II of the Multi-Effects Protocol is 39 Gg (see Table 11) In 2006 Austrian total SO_2 emissions (28 Gg) were well below the ceiling.

Table 12: SO_2 emissions per NFR Category 1990 and 2006, their trend 1990–2006 and their share in total emissions.

NFR Category		SO_2 Emissions [Gg]		Trend	Share in National Total	
		1990	**2006**	**1990–2006**	**1990**	**2006**
1	Energy	72.03	27.18	-62%	97%	96%
1 A	*Fuel Combustion Activities*	*70.03*	*27.01*	*-61%*	*94%*	*95%*
1 B	*Fugitive Emissions from Fuels*	*2.00*	*0.17*	*-92%*	*3%*	*1%*
2	Industrial Processes	2.22	1.22	-45%	3%	4%
3	Solvent and Other Product Use	NA	NA			
4	Agriculture	< 0.01	< 0.01	-16%	< 1%	< 1%
6	Waste	0.07	0.06	-20%	<1%	< 1%
	National Total	74.33	28.46	-62%	100%	100%

2.2.2 NO_x Emissions

In 1990, national total NO_x emissions amounted to 192 Gg; emissions were slightly decreasing until the mid-1990 but have been increasing again in the last years: in 2006, they were about 17% above the level of 1990.

As can be seen in Table 13, the main source for NO_x emissions in Austria with a share of 94% in 1990 and 97% in 2006 is *Fuel Combustion Activities.* Within this source *road transport*, with about 59% of national total emissions, has the highest contribution to total NO_x emissions.

The 2010 national emission ceiling for NO_x emissions in Austria as set out in Annex II of the Multi-Effects Protocol is 107 Gg (in the European National Emissions Ceiling Directive the national emission ceiling is 103 Gg). With 225 Gg NO_x emissions in 2006 emissions in Austria are at the moment well above this ceiling – see Table 11.

Please note that emissions from mobile sources are calculated based on fuel sold, which for the last few years is considerably higher than fuel used: emissions for 2006 based on fuel used amount to 173 Gg, which is about 23% less, but still well above the emission ceiling set out in Annex II of the Multi-Effects Protocol.[81,67]

Table 13: NO_x emissions per NFR Category 1990 and 2006, their trend 1990–2006 and their share in total emissions.

NFR Category		NO_x Emissions [Gg]		Trend	Share in National Total	
		1990	**2006**	**1990–2006**	**1990**	**2006**
1	Energy	181.43	218.27	20%	94%	97%
1 A	*Fuel Combustion Activities*	*181.43*	*218.27*	*20%*	*94%*	*97%*
1 B	*Fugitive Emissions from Fuels*	*IE*	*IE*			
2	Industrial Processes	4.80	1.63	-66%	2%	1%
3	Solvent and Other Product Use	NA	NA			
4	Agriculture	6.09	5.21	-14%	3%	2%
6	Waste	0.10	0.05	-50%	< 1%	< 1%
	National Total	192.41	225.16	17%	100%	100%

[81] see Chapter 1.7 Completeness for more information regarding 'fuel export'; Austria's emissions based on fuel used – thus excluding 'fuel export' – are presented in Table 1 in the Annex.

2.2.3 NMVOC Emissions

In 1990 national total NMVOC emissions amounted to 283 Gg; emissions have decreased steadily since then and by the year 2006 emissions were reduced by 39%.

As can be seen in Table 14, the main sources of NMVOC emissions in Austria are *Fuel Combustion Activities* with a share of 50% in 1990 and 39% in 2006, and *Solvent and Other Product Use* with a contribution to the national total of 41% in 1990 and 55% in 2006 respectively.

NMVOC emissions decreased considerably in both main sectors: the reduction in the energy sector is due to decreasing emissions from road transport due to low emission combustion and also from residential heating, which is due to the replacement of ineffective heating systems.

The reduction in Sector Solvent and Other Product Use is due to legal abatement measures such exhaust systems and aftertreatment.

The national emission ceiling 2010 for NMVOC emissions in Austria as set out in Annex II of the Multi-Effects Protocol is 159 Gg (see Table 11). In 2006 Austria's NMVOC emissions amounted to 172 Gg, and thus Austria is 8% above this target.

Table 14: NMVOC emissions per NFR Category 1990 and 2006, their trend 1990–2006 and their share in total emissions.

NFR Category		NMVOC Emissions [Gg]		Trend	Share in National Total	
		1990	**2006**	**1990–2006**	**1990**	**2006**
1	Energy	153.12	70.12	-54%	54%	41%
1 A	Fuel Combustion Activities	*140.91*	*66.99*	*-52%*	*50%*	*39%*
1 B	Fugitive Emissions from Fuels	*12.22*	*3.12*	*-74%*	*4%*	*2%*
2	Industrial Processes	11.10	4.73	-57%	4%	3%
3	Solvent and Other Product Use	116.95	94.92	-19%	41%	55%
4	Agriculture	1.85	1.79	-3%	1%	1%
6	Waste	0.16	0.08	-50%	< 1%	< 1%
	National Total	**283.18**	**171.63**	**-39%**	**100%**	**100%**

2.2.4 NH_3 Emissions

In 1990, national total NH_3 emissions amounted to 71 Gg; emissions have slightly decreased over the period from 1990 to 2006, in 2006 emissions were 7% below 1990 levels.

As can be seen in Table 15, NH_3 emissions in Austria are almost exclusively emitted by the agricultural sector. The share in national total NH_3 emissions is about 93% for 2006. Within this source manure management – cattle has the highest contribution to total NH_3 emissions: the share in national total emissions of manure management of cattle was 56% in 2006.

The national emission ceiling 2010 for NH_3 emissions in Austria as set out in Annex II of the Multi-Effects Protocol is 66 Gg (see Table 11). In 2006 Austrian total NH_3 emissions (66 Gg) were just below this ceiling.

Table 15: NH_3 emissions per NFR Category 1990 and 2006, their trend 1990–2006 and their share in total emissions.

NFR Category		NH_3 Emissions [Gg]		Trend	Share in National Total	
		1990	**2006**	**1990–2006**	**1990**	**2006**
1	Energy	4.28	3.76	-12%	6%	6%
1 A	*Fuel Combustion Activities*	*4.28*	*3.76*	*-12%*	*6%*	*6%*
1 B	*Fugitive Emissions from Fuels*	*IE*	*IE*			
2	Industrial Processes	0.27	0.07	-72%	< 1%	< 1%
3	Solvent and Other Product Use	NA	NA			
4	Agriculture	66.12	60.93	-8%	93%	93%
6	Waste	0.38	1.04	177%	1%	2%
	National Total	**71.05**	**65.81**	**-7%**	**100%**	**100%**

2.2.5 Carbon monoxide (CO) Emissions

CO is a colourless and odourless gas, formed when carbon in fuel is not burned completely. It is a component of motor vehicle exhaust, other sources of CO emissions include industrial processes, non-transportation fuel combustion, and natural sources such as wildfires. Peak CO concentrations typically occur during the colder months of the year when CO automotive emissions are greater and night-time inversion conditions are more frequent.

In 1990 national total CO emissions amounted to 1 444 Gg; emissions have considerably decreased over the period from 1990 to 2006, in 2006 emissions were 46% below 1990 levels.

As can be seen in Table 16, CO emissions in Austria are almost exclusively emitted by the energy sector, and more specifically, fuel combustion activities. The share in national total CO emissions is about 96% for 2006. Emissions decreased mainly due to decreasing emissions from road transport and residential heating, which is due to the switch-over to improved technologies. The peak of CO emissions in 2004 of Sector *Agriculture* (contribution < 1% to national total) is due to a larger area of stubble fields burnt that year.

Table 16: CO emissions per NFR Category 1990 and 2006, their trend 1990–2006 and their share in total emissions.

NFR Category		CO Emissions [Gg]		Trend	Share in National Total	
		1990	**2006**	**1990–2006**	**1990**	**2006**
1	Energy	1 385.17	754.06	-46%	96%	96%
1 A	*Fuel Combustion Activities*	*1 385.17*	*754.06*	*-46%*	*96%*	*96%*
1 B	*Fugitive Emissions from Fuels*	*IE*	*IE*			
2	Industrial Processes	46.37	24.37	-47%	3%	3%
3	Solvent and Other Product Use	NA	NA			
4	Agriculture	1.20	1.01	-16%	< 1%	< 1%
6	Waste	11.37	5.91	-48%	1%	1%
	National Total	**1 444.11**	**785.35**	**-46%**	**100%**	**100%**

2.3 Emission Trends for Particulate matter (PM)

Dust is a complex mixture consisting of both directly emitted and secondarily formed components of both natural and anthropogenic origin (e.g. dust, geological material, abraded particles and biological material) and has a rather inhomogeneous composition of sulphate, nitrate, ammonium, organic carbon, heavy metals, PAH and dioxins/ furans. PM is either formed during industrial production and combustion processes as well as during mechanical processes such as abrasion of surface materials and generation of fugitive dust or by secondary formation from SO_2, NO_x, NMVOC or NH_3.

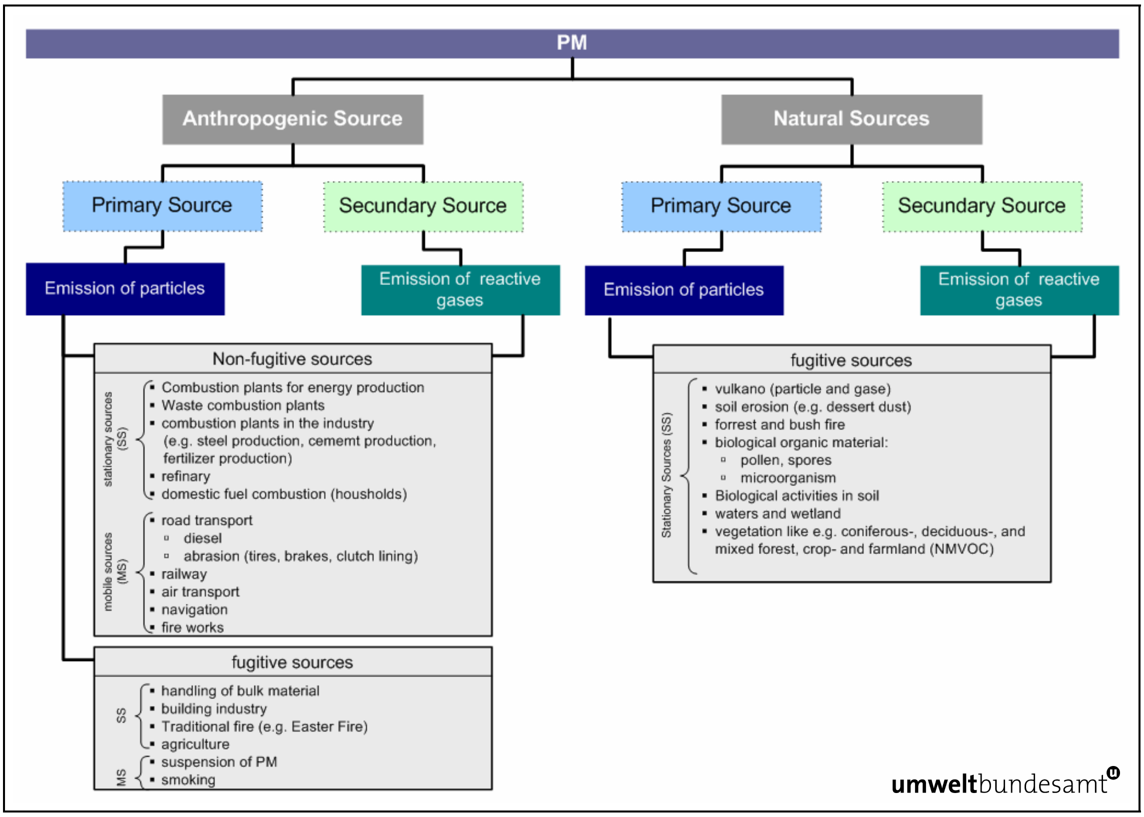

Figure 4: Schematic classification of PM sources.

PM does not only have effects on the chemical composition and reactivity of the atmosphere but also affects human and animal health and welfare. When breathed in, a particle-loaded atmosphere impacts on the respiratory tract. The observable effects are dependent on the particle size, that's why for legislative issues particulate matter (PM) is classified according to its size (see Figure 5).

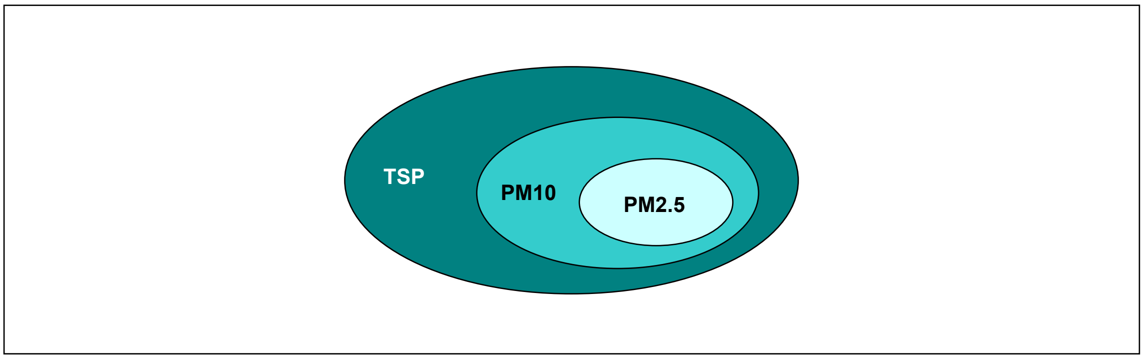

Figure 5: Distribution of TSP, PM10 and PM2.5 (schematic).

TSP emissions in Austria derive from industrial processes, road transport, agriculture and small heating installations. Fine particles often have a seasonal pattern: Whereas PM2.5 values are typically higher in the season when sulfates are more readily formed from SO_2 emissions from power plants, PM10 concentrations tend to be higher in the fourth calendar quarter because fine particle nitrates are more readily formed in cooler weather, and wood stove and fireplace use produces more carbon.

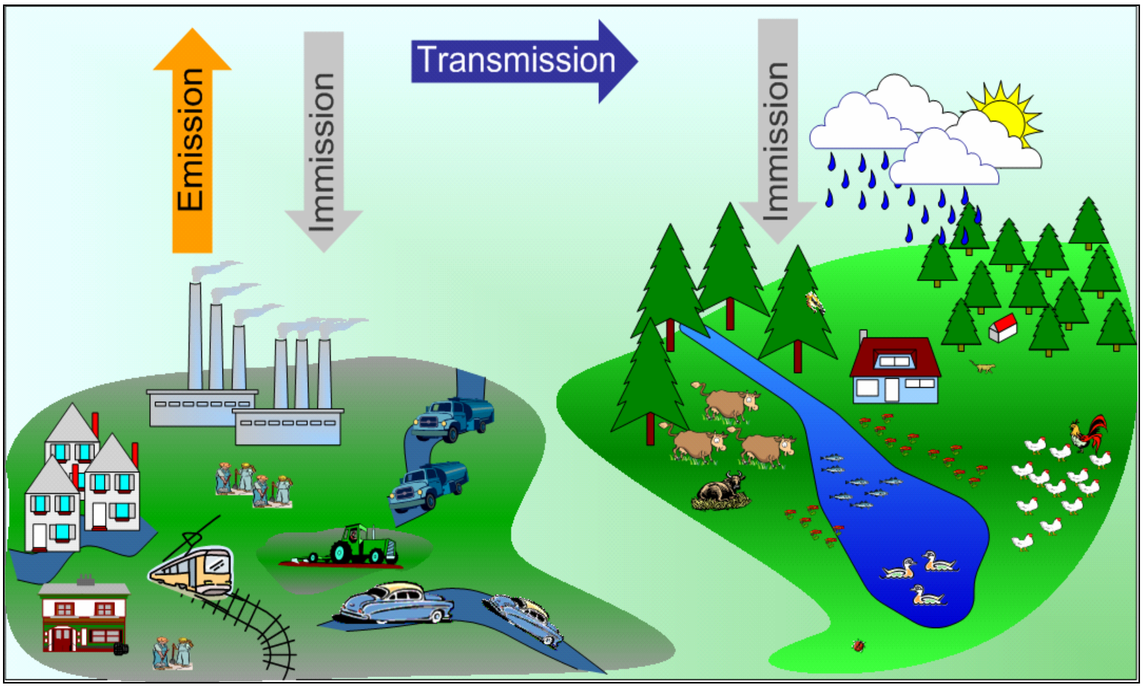

Figure 6: Interrelation of emission, transmission and immission.

Particulate matter (PM) emissions remained quite stable over the period 1990 to 2006: TSP emission increased by 9%, PM10 emission were about the same level as 1990, and PM2.5 emissions decreased by 8% over the period 1990 to 2006. Emission trends for PM from 1990 to 2006 are presented in Table 17 and Figure 7, and the emissions of PM are presented relative to 1990. Apart from industry and traffic, private households and the agricultural sector are considerable contributors to emissions of PM. The explanation for these trends is given in the following chapters.

Table 17: National total emissions and emission trends for particulate matter (PM) 1990–2006.

Year	**Emissions [Mg]**		
	TSP	**PM10**	**PM2.5**
1990	68 609	42 974	25 830
1995	71 593	43 442	25 212
1999	70 249	42 585	24 799
2000	74 069	43 925	24 487
2001	73 960	44 142	25 002
2002	73 643	43 547	24 533
2003	73 895	43 806	24 879
2004	74 382	43 702	24 425
2005	73 225	43 056	24 288
2006	75 030	43 465	23 740
Trend 1990–2006	***9%***	***1%***	***-8%***

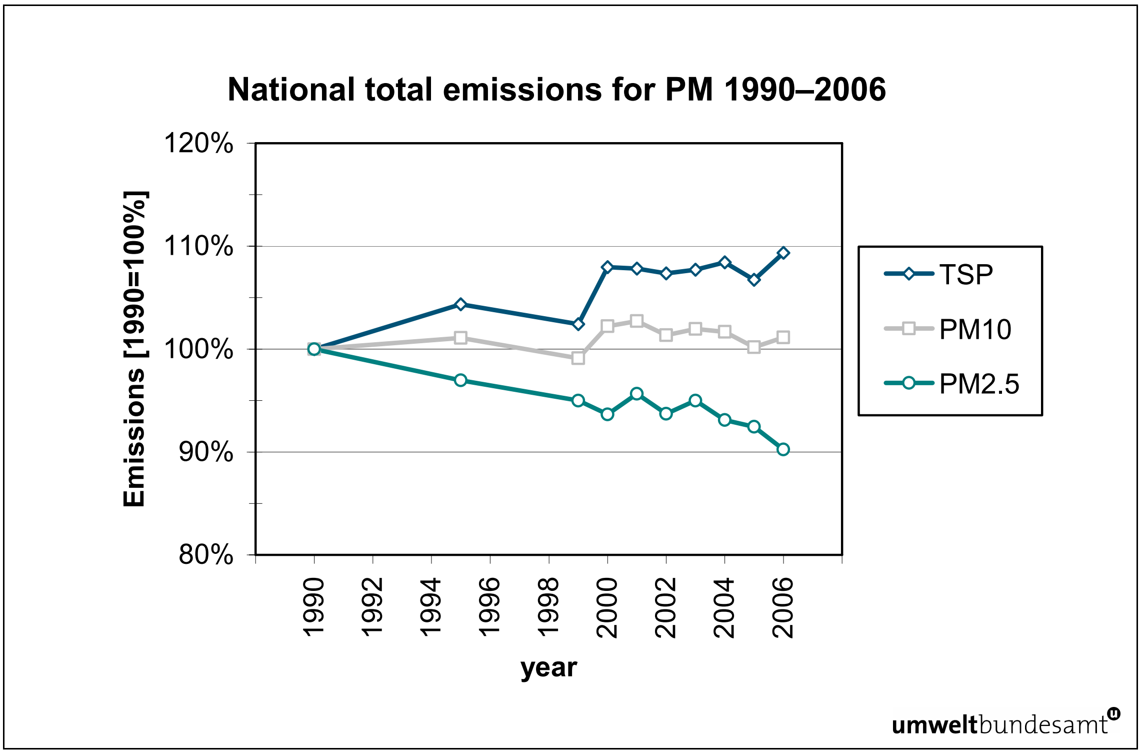

Figure 7: National total emissions for PM 1990–2006.

2.3.1 PM10 Emissions

PM10 is the fraction of suspended particulate matter in the air with an aerodynamic diameter (d_{ae}) of less than or equal to a 10 µm, which are collected with 50% efficiency by a PM10 sampling device. These particles are small enough to be breathable and could be deposited in lungs, which may cause deteriorated lung functions.

PM10 emissions and emission trends in Austria

National total PM10 emissions amounted to 43.0 Gg in 1990 and were almost on the same level as 2006 (emissions in 2006 amounted to 43.5 Gg – see Table 18).

As shown in Table 18 the main source for PM10 emissions in Austria are combustion processes in the energy sector with a share of 53% in national total emissions in 2006. These emissions are mainly due to fuel combustion activities in the sector:

- "*Other Sectors*" including fuel combustion in commercial and institutional building, households and in the area of agriculture and fishery (47% of emissions of *Sector 1 A*[82])
  - in *Households* (residential plants) (32% of emissions of *Sector 1 A*); small combustion plants and households oven and stove are main sources of PM10
  - in Agriculture and Forestry (12% of emissions of Sector 1 A); Off Road Vehicles and Other Machinery are important sources of PM10
- Transport activities including mechanical abrasion from road surfaces, and re-suspended dust from roads (36% of emissions of *Sector 1 A*)
  - *Automobile Road Abrasion* (15% of emissions of Sector 1 A) is an important PM10 source
  - Road transport activities with *Passenger cars* (9% of *Sector 1 A*) and *Heavy duty vehicles* (8% of emissions of *Sector 1 A*) represents the majority of PM sources
- *Manufacturing Industries and Construction* (11% of emissions of *Sector 1 A*) and *Energy Industrie*s (5% of emissions of *Sector 1 A*)

The *Sector Industrial Processes* has a share of 33% in national total PM10 emissions. Whithin this sector

- the subssector *Mineral products* is responsible for about 88% of the PM10 emission. The handling of bulk materials like mineral products and the activities in the field of civil engineering represents the majority of PM10 sources.
- The activities in the Iron and Steel Production are responsible for about 7% of PM10 emissions of *Sector Industrial Processes.*

Another source for PM10 emissions in Austria with a share of about 12% is the agricultural sector (livestock husbandry and cultivation).

The sectors *Fugitive Emissions from Fuels, Solvent and Other Product Use* and *Waste* are minor PM10 sources.

As presented in Figure 8 and Table 18, the emissions of PM10 are on the same level as in 1990. However, the achievements made by several appropriate measures in the sector *Energy* (NFR 1A) are:

- *Energy Industrie* and *Manufacturing Industries and Construction* by
  - application of abatement techniques such as flue gas collection and flue gas cleaning systems (already in the 1980)
  - installation of energy- and resource-saving production processes (already in the 1980)
  - substitution from high-emission fuels to low-emission (low-ash) fuels. (already in the 1980)
  - raising awareness for environmental production

[82] Sector 1 A: fuel combustion activities

The increase of PM10 emissions in the last decade is mainly due to the enourmous increase in energy consumption. Another reason of increasing PM10 emissions is the application of CO_2-neutral fuels such as biomass (wood, pellets, …) in district-heating plants. These fuels belong even with modern technology more to the group of high-emission fuels regarding PM.

- *Other Sector*, which includes commercial, institutional and residential combustion plants by
  - substitution of old installation with modern technology
  - installation of energy-saving combustion plants
  - connection to the district-heating networks or other public energy- and heating networks
  - substitution from high-emission fuels to low-emission (low-ash) fuels.
  - raising awareness for energy sawing and environmental task
- All the above mentioned measures are almost completely compensated by enormous increasing PM10 emission of the sector *Transportation* due to increased transport activities of both individual transport (passanger cars) and road/highway transport with heavy duty vehicles. These activities induce of course increasing PM emission from automobile tyre and brake wear as well as mechanical abrasion from road surfaces, and re-suspended dust from roads.

In the Sector *Industrial Processes* (NFR 2) generally an increasing emission trend of 10% in PM10 emission can be noted for the period 1990 to 2006 whereas

- especially in the iron and steel industry (*Metal production* (NFR2 C) efforts were made in reducing PM10 emission by introducing low-PM technologies, abatement techniques, flue gas collection and flue gas cleaning system etc.
- also in the *Chemical Industry* (NFR 2B) efforts were made in reducing PM10 emission due to protective enclosure process lines and bulk materials.

The increase in PM10 emission in the sector *Industrial processes* (NFR 2) is a result of increased activities in the sector *Mineral products* due to manifold construction activities.

In the Sector *Solvent and Other Product Use (NFR 3)*, which includes fireworks and smoking of tobacco an increasing emission trend of 8% in PM10 emission can be noted for the period 1990 to 2006.

In sector NFR 4 *Agriculture* PM10 emissions decreased slightly by about 4%.

- Tillage operations and harvesting activities *(Agricultural Soils* (NFR 4 D)) are the main sources for PM emissions. The decrease in agricultural production (soil cultivation, harvesting, etc.) is responsible for the decrease of 3% in PM10 emissions over the period 1990 to 2006.
- A comparatively small amount of the agricultural PM10 emissions result from animal husbandry (NFR 4 G), where a decreasing trend of 14% can be noted.

Within the source NFR 6 *Waste* the subcategory NFR 6 A *Solid Waste Disposal on Land* is the only source, except for 1990 where 6 C contribute to PM. PM10 emissions increase by about 30% in the period 1990 to 2006 due to underlying activity data. The increase of activity data and PM emission were mainly in the period 1998 to 2006.

Table 18: PM10 emissions per NFR Category 1990 and 2006, their trend 1990–2006 and their share in total emissions.

NFR Category		PM10 Emissions [Mg]		Trend	Share in National Total	
		1990	2006	1990–2006	1990	2006
1	Energy	23 962	23 340	-3%	56%	54%
1 A	Fuel Combustion Activities	23 658	23 062	-3%	55%	53%
1 A 1	*Energy Industries*	*997*	*1 219*	*22%*	*2%*	*3%*
1 A 2	*Manufacturing Industries and Construction*	*3 791*	*2 610*	*-31%*	*9%*	*6%*
1 A 3	*Transport*	*5 364*	*8 362*	*56%*	*12%*	*19%*
1 A 4	*Other Sectors*	*13 490*	*10 828*	*-20%*	*31%*	*25%*
1 A 5	*Other*	*16*	*44*	*185%*	*< 1%*	*< 1%*
1 B	Fugitive Emissions from Fuels	305	278	-9%	1%	1%
2	Industrial Processes	12 920	14 206	10%	30%	33%
2 A	Mineral Products	7 425	12 520	69%	17%	29%
2 B	Chemical Industry	565	280	-51%	1%	1%
2 C	Metal Production	4 561	998	-78%	11%	2%
2 D	Other Production	369	408	11%	1%	1%
3	Solvent and Other Product Use	407	439	8%	1%	1%
4	Agriculture	5 604	5 375	-4%	13%	12%
4 D	Agricultural Soils	5 110	4 952	-3%	12%	11%
4 G	Other	494	422	-14%	1%	1%
6	Waste	70	90	30%	< 1%	< 1%
	Total Emissions	**42 963**	**43 450**	**1%**		

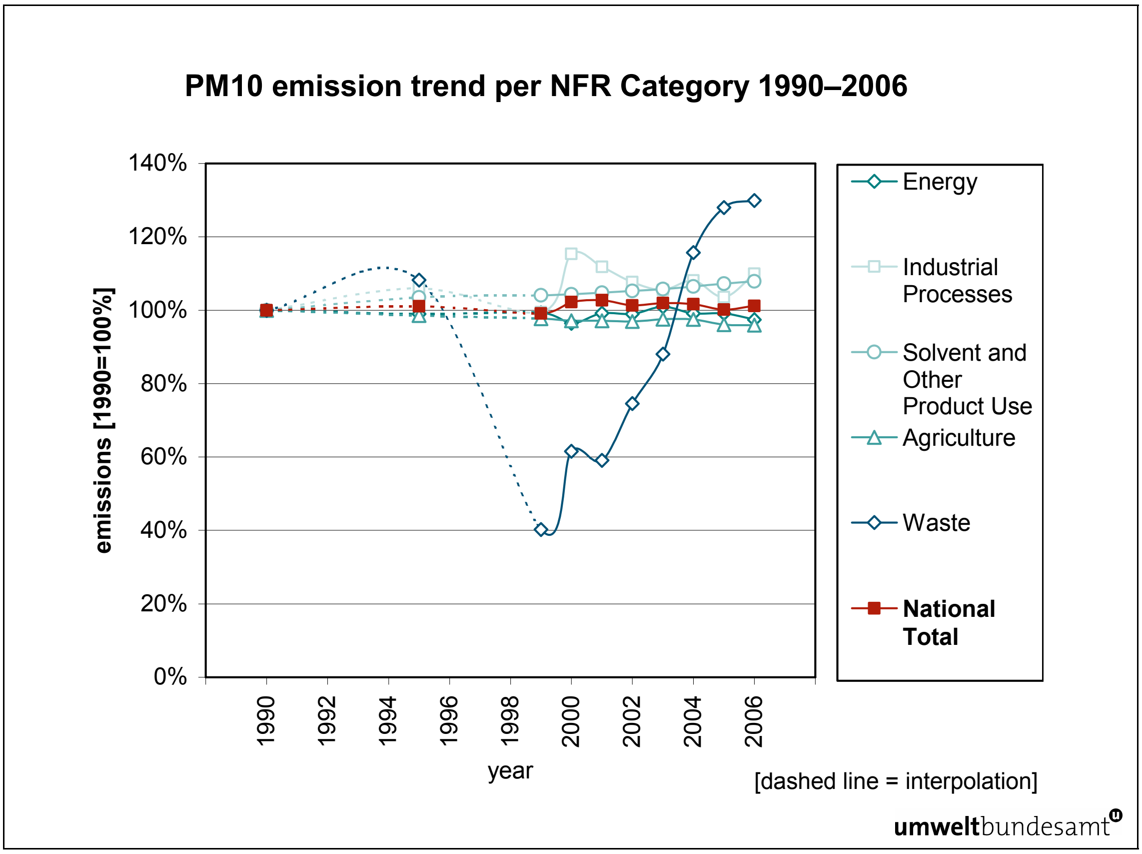

Figure 8: PM10 emission trend per NFR Category 1990–2006.

2.3.2 PM2.5 Emissions

The size fraction PM2.5 refers to particles with an aerodynamic diameter (d_{ae}) of less than or equal to 2.5 µm that are collected by measuring devices with 50% collection efficiency. Exposure to considerable amounts of PM2.5 can cause respiratory and circulatory complaints in sensitive individuals. PM2.5 also causes reductions in visibility and solar radiation due to enhanced scattering of light. Furthermore, aerosol precursors such as ammonia (the source of which is mainly agriculture) form PM2.5 as secondary particles through chemical reactions in the atmosphere.

PM2.5 emissions and emission trends in Austria

National total PM2.5 emissions amounted to 25 Gg in 1990 and have decreased steadily so that by the year 2006 emissions were reduced by 10% (to 23 Gg).

As it is shown in Table 19 PM2.5 emissions in Austria mainly arose from combustion processes in the energy sector with a share of 82% in the total emissions in 2006. Besides the sources already mentioned in the context of TSP and PM10, PM2.5 emissions resulted on a big scale from power plants with flue gas cleaning systems, which filter larger particles. The industrial processes sector had a share of 10% and the agricultural sector had a share of 5% in national total emissions.

In general the reduction of PM2.5 emission is due to the installation of flue gas collection and modern flue gas cleaning technologies in several branches.

Table 19: PM2.5 emissions per NFR Category 1990 and 2006, their trend 1990–2006 and their share in total emissions.

NFR Category		PM2.5 Emissions [Mg]		Trend	Share in National Total	
		1990	**2006**	**1990–2006**	**1990**	**2006**
1	Energy	19 942	18 764	-6%	79%	83%
1 A	Fuel Combustion Activities	19 847	18 676	-6%	79%	82%
1 A 1	*Energy Industries*	*850*	*1 037*	*22%*	*3%*	*5%*
1 A 2	*Manufacturing Industries and Construction*	*3 291*	*2 122*	*-36%*	*13%*	*9%*
1 A 3	*Transport*	*3 398*	*5 630*	*66%*	*14%*	*25%*
1 A 4	*Other Sectors*	*12 292*	*9 844*	*-20%*	*49%*	*43%*
1 A 5	*Other*	*15*	*44*	*191%*	*< 1%*	*< 1%*
1 B	Fugitive Emissions from Fuels	95	87	-8%	< 1%	< 1%
2	Industrial Processes	3 505	2 241	-36%	14%	10%
2 A	Mineral Products	990	1 493	51%	4%	7%
2 B	Chemical Industry	302	148	-51%	1%	1%
2 C	Metal Production	2 066	437	-79%	8%	2%
2 D	Other Production	148	163	11%	1%	1%
3	Solvent and Other Product Use	407	439	8%	2%	2%
4	Agriculture	1 245	1 194	-4%	5%	5%
4 D	Agricultural Soils	1 136	1 101	-3%	5%	5%
4 G	Other	110	94	-14%	< 1%	< 1%
6	Waste	23	28	25%	< 1%	< 1%
	Total Emissions	**25 122**	**22 667**	**-10%**		

2.3.3 Total suspended particulate matter (TSP) Emissions

Total suspended particulate matter (TSP) refers to the entire range of ambient air matter that can be collected, from the sub-micron level up to 100 µm in aerodynamic diameter (d_{ae}). Particles with a d_{ae} larger than 100 µm will not remain in air for a significant length of time. TSP remains in the air for relatively short periods of time and are therefore generally not carried long distances. As a result TSP tend to be a local rather than a regional problem, occurring close to industrial sources, such as metal processing plants and mining operations, along roads because of the re-suspension, and close to stables and agricultural crop land.

TSP emissions and emission trends in Austria

National total TSP emissions amounted to 69 Gg in 1990 and mounted to 75 Gg in 2006, which is an increase of about 9% (Table 20). TSP emissions in Austria derive from industrial processes, road transport, agriculture and small heating installations.

Table 20: TSP emissions per NFR Category 1990 and 2006, their trend 1990–2006 and their share in total emissions.

NFR Category		TSP Emissions [Mg]		Trend	Share in National Total	
		1990	**2006**	**1990–2006**	**1990**	**2006**
1	Energy	31 812	33 224	4%	46%	44%
1 A	Fuel Combustion Activities	31 165	32 635	5%	45%	44%
1 A 1	*Energy Industries*	*1 054*	*1 317*	*25%*	*2%*	*2%*
1 A 2	*Manufacturing Industries and Construction*	*4 342*	*3 199*	*-26%*	*6%*	*4%*
1 A 3	*Transport*	*10 981*	*16 164*	*47%*	*16%*	*22%*
1 A 4	*Other Sectors*	*14 772*	*11 910*	*-19%*	*22%*	*16%*
1 A 5	*Other*	*16*	*45*	*176%*	*< 1%*	*< 1%*
1 B	Fugitive Emissions from Fuels	647	589	-9%	1%	1%
2	Industrial Processes	23 769	29 202	23%	35%	39%
2 A	Mineral Products	15 455	26 286	70%	23%	35%
2 B	Chemical Industry	958	477	-50%	1%	1%
2 C	Metal Production	6 435	1 418	-78%	9%	2%
2 D	Other Production	922	1 020	11%	1%	1%
3	Solvent and Other Product Use	407	439	8%	1%	1%
4	Agriculture	12 453	11 944	-4%	18%	16%
4 D	Agricultural Soils	11 355	11 005	-3%	17%	15%
4 G	Other	1 098	939	-14%	2%	1%
6	Waste	145	191	31%	< 1%	< 1%
0	**Total Emissions**	**68 587**	**75 001**	**9%**		

As shown in Table 20 the main source for TSP emissions in Austria with a share of 44% were

- combustion processes in the energy sector (mainly small combustion plants, oven or stoves fired with wood or coke in households
- PM emission from automobile tyre and brake wear as well as mechanical abrasion from road surfaces, and re-suspended dust from roads.

In the energy sector neither an overall reducing nor an increasing trend could be noted (slight increase of 5%). The emissions within the energy sector are very inhomogeneous: the decrease of TSP emission in especially the manufacturing industries and construction branch is completely compensated by enormously increasing TSP emission from transportation activities.

The second main sector for TSP emission is the Sector *Industrial Processes* with a share of 39%. The increasing TSP emissions in this sector are due to intensive activities in mineral production and the construction branch.

The sector NFR 4 *Agriculture* has a contribution to the national total TSP emission of 16% in 2006. A slight decreasing trend of 3% can be noted due to dreasing activities.

2.4 Reassessment of the Austrian Air Emission Inventory (OLI) for Particulate matter (PM)

The Austrian Air Emission Inventory (OLI) for Particulate matter (PM) was reassessed within the scope of an external study[83] based on

- a previous quantitative estimate[84],
- the official Austrian emission inventory (OLI), and
- recent studies on the quantification of PM emissions.

In the course of the reassessment new emission sources were included, activity data and emission factors updated and methodologies improved.

The main conclusions of the study are that

- TSP emissions in Austria mainly arise from industrial processes, road transport, agriculture and small heating installations.
- Smaller size fractions (PM10, and especially PM2.5) are dominated by combustion emissions – PM2.5 emissions mainly arise from small heating installations, road transport and off-road transport".
- For small heating installations, increases in firewood consumptions – which are usually not very efficient in terms of emissions, thus resulting in higher PM emissions – have been more than counterbalanced by the introduction of efficient burners over the last decade, so overall emissions have decreased.

Furthermore, the concept of "potential emissions" was developed to describe a situation where huge discrepancies between reported amounts of material available for atmospheric release and their actual atmospheric occurrence are evident. The "potential emissions" are to be seen as upper boundaries to possible release fluxes, but require confirmation from atmospheric measurements before being accepted to the inventory – including them would double overall PM emissions (total suspended particles, TSP). Potential emissions were therefore not included here but can be found in WINIWARTER (2008).

Other conclusions of the study were:

- Further improvement of the inventory would require additional measurements for those sources where potential emissions play a role. Combustion emission estimates would strongly benefit from better activity estimates, specifically concerning the quantity of wood burnt in modern installations.
- The most promising abatement option is the phase-out of outdated technology. This includes old Diesel engines used in "other transport", as well as old, inefficient equipment to burn wood. Possible measures in limestone quarries could help reduce fugitive emissions.

Even though there are high uncertainties concerning PM emissions not only in terms of absolute emissions, but also regading the time and place/spot of emissions (PM emissions often are a temporal and local problem), the inventory data proved to be helpful in explaing source patterns of immission measurements in Austrian cities.

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[83] WINIWARTER, W.; SCHMID-STEJSKAL, H. & WINDSPERGER, A. (2007): Aktualisierung und Verbesserung der österreichischen Luftschadstoffinventur für Schwebstaub. Systems research – Austrian Research Centers &Institut für Industrielle Ökologie. Wien.

[84] WINIWARTER, W.; TRENKER, C.; HÖFLINGER, W. (2001): Österreichische Emissionsinventur für Staub. Österreichisches Forschungszentrum Seibersdorf. Wien.

2.5 Emission Trends for Heavy Metals

In general emissions of heavy metals decreased remarkably from 1985 to 2006. Emission trends for heavy metals from 1985 to 2006 are presented in Table 21. Emissions for all three priority heavy metals (Cd, Pb, Hg) are well below their 1985 level, which is the obligation for Austria as a Party to the Heavy Metals Protocol (see Chapter 2.1.4).

Table 21: National total emissions and emission trends for heavy metals 1985–2006.

Year	Emissions [Mg]		
	Cd	Hg	Pb
1985	3.10	3.74	326.79
1986	2.70	3.32	313.03
1987	2.21	2.84	302.13
1988	1.94	2.45	272.20
1989	1.74	2.24	239.34
1990	1.58	2.14	207.35
1991	1.53	2.04	171.75
1992	1.25	1.64	119.83
1993	1.16	1.39	86.20
1994	1.06	1.18	59.66
1995	0.97	1.20	16.07
1996	0.99	1.16	15.50
1997	0.97	1.13	14.49
1998	0.90	0.95	12.99
1999	0.98	0.94	12.50
2000	0.95	0.89	11.96
2001	0.98	0.95	12.10
2002	1.00	0.94	12.46
2003	1.03	0.98	12.68
2004	1.03	0.94	13.07
2005	1.10	1.00	13.71
2006	1.12	1.02	14.12
Trend 1985–2006	***-64%***	***-73%***	***-96%***

2.5.1 Cadmium (Cd) Emissions

Cadmium (Cd) has been ubiquitously distributed in the natural environment for millions of years. It occurs in the earth's crust with a content estimated to be between 0.08 and 0.5 ppm.[85] Unlike some other heavy metals, such as lead or mercury, which have been used since ancient times, Cd has been refined and utilized only since 100 years, but it was already discovered in 1817. The production and consumption of Cd has risen distinctly only since the 1940's. The primary uses are electroplated cadmium coatings, nickel-cadmium storage batteries, pigments, and stabilizers for plastics. Publicity about the toxicity of cadmium has affected the consumption significantly.

[85] Ullmann's Encyclopedia of Industrial Chemistry (2003): Cadmium and Cadmium Compounds. Wiley-VCH Verlag

For human beings Cd does not have a biological function unlike many other elements. The smoking (of tobacco) stands for an important exposure to Cd: smokers generally have about twice as high cadmium concentrations in the renal cortex compared to non-smokers. For the non-smoking population food is an important source of exposure because Cd is accumulated in the human and animal bodies due to its long half-life. Cd compounds and complexes are classified as an unambiguous carcinogenic working material.

Cadmium emissions and emission trends in Austria

National total Cd emissions amounted to 3.1 Mg in 1985, and amounted to 1.58 Mg in 1990; since then emissions have decreased steadily and by the year 2006 emissions were reduced by 64% (1.12 Mg).

As shown in Table 22 the main source for Cd emissions in Austria with a share of 80% is the energy sector. These emissions mainly arise from combustion of heavy fuel oil, wood and wood waste as well as black liquor. The sub sectors with the highest contribution to Cd emissions from the energy sector are residential plants with 21%, petroleum refining with 15%, road transportation with 8% and pulp, paper and print with 8% in 2006. The industrial processes sector contributed about 20% to national total Cd emission.

The overall reduction from 1985 to 2006 is mainly due to decreasing emissions from the industrial processes and energy sector because of a decrease in the use of heavy fuel oil and improved or newly installed flue gas abatement techniques. The significantly emission reduction in the Sector *Solvent and Other Product Use* results from the ban of Cd in paint.

Cd emissions are increasing again in the last few years, which is due to the growing activities in the industrial processes sector and energy sector. The increasing Cd-emission in the energy sector were due increasing use of wood and wooden litter in small combustion plants, the combustion of heavy fuel oil and residues from the petroleum processing in the refinery as well as the thermal utilisation of industrial residues and residential waste. The use of hard coal has increased also. Another reason is the continuously growing activity in the transport sector, especially of heavy duty vehicles.

Table 22: Cd emissions per NFR Category 1985 and 2006, their trend 1985–2006 and their share in total emissions.

NFR Category		Cd Emissions [Mg]			Trend		Share in National Total		
		1985	**1990**	**2006**	**1985–2006**	**1990–2006**	**1985**	**1990**	**2006**
1	Energy	2.08	1.06	0.90	-57%	-15%	67%	67%	80%
1 A	*Fuel Combustion Activities*	2.08	1.06	0.90	-57%	-15%	67%	67%	80%
1 B	*Fugitive Emissions f. Fuels*	NA	NA	NA					
2	Industrial Processes	0.84	0.46	0.22	-73%	-51%	27%	29%	20%
3	Solvent a. Other Product Use	< 0.01	< 0.01	NA			< 1%	< 1%	
4	Agriculture	0.04	<0.01	< 0.01	-96%	-16%	1%	< 1%	< 1%
6	Waste	0.14	0.06	< 0.01	-99%	-98%	4%	4%	< 1%
	National Total	**3.10**	**1.58**	**1.12**	**-64%**	**-29%**	**100%**	**100%**	**100%**

2.5.2 Mercury (Hg) Emissions

Mercury (Hg) has been ubiquitously distributed in the natural environment for millions of years. It occurs in the earth's crust with a content estimated to be about $4 \cdot 10^{-5}$%.[86] Because of its special properties, mercury has had a number of uses for a long time: the conventional application is the thermometer, barometer, and hydrometer; other important areas of use are the lighting industry and for electrical components. Mercury forms alloys with a large number of metals, these alloys also have a wide range of applications.

Mercury emissions and emission trends in Austria

In 1985 national total Hg emissions amounted to 3.7 Mg and amounted to 2.1 Mg in 1990; emissions have decreased steadily and by the year 2006 emissions were reduced by 73%.

As it is shown in Table 23 Hg emissions mainly arise from the energy sector by combustion processes with a share of 68% of the total emissions in 2006. These emissions are composed of emissions from combustion of coal, heavy fuel oil and waste in manufacturing idustries and construction, the combustion of wood, wood waste and coal in residential plants and combustion of coal and heavy fuel oil in public electricity and heat production.

Process related emissions in the sector industrial processes (especially metal industries) account for about 30% of national total Hg emissions in 2006. Hg emissions mainly arise from the same sub-sectors as Cd emissions, which are residential heating, industry and energy industries.

The overall reduction of about 73% for the period 1985 to 2006 was due to decreasing emissions from the industrial processes sector and residential heating due to a decrease in the use of heavy fuel oil and wood as fuel and also due to improved emission abatement techniques in industry. Several bans in different industrial sub-sectors as well in the agriculture sector lead to the sharp fall of total Hg emission in Austria.

Table 23: Hg emissions per NFR Category 1985 and 2006, their trend 1985–2006 and their share in total emissions.

NFR Category		Hg Emissions [Mg]			Trend		Share in National Total		
		1985	1990	2006	1985–2006	1990–2006	1985	1990	2006
1	Energy	2.98	1.56	0.69	-77%	-56%	80%	73%	68%
1 A	*Fuel Combustion Activities*	2.98	1.56	0.69	-77%	-56%	80%	73%	68%
1 B	*Fugitive Emissions f. Fuels*	NA	NA	NA					
2	Industrial Processes	0.67	0.53	0.31	-54%	-41%	18%	25%	30%
3	Solvent a. Other Product Use	NA	NA	NA					
4	Agriculture	0.01	< 0.01	< 0.01	-96%	-16%	< 1%	< 1%	< 1%
6	Waste	0.09	0.05	0.02	-76%	-62%	2%	3%	2%
	National Total	**3.74**	**2.14**	**1.02**	**-73%**	**-52%**			

[86] Ullmann's Encyclopedia of Industrial Chemistry Copyright (2003): Mercury and Mercury Compounds.

2.5.3 Lead (Pb) Emissions

In the past, automotive sources were the major contributor of lead emissions to the atmosphere. Due to Austrian regulatory efforts to reduce the content of lead in gasoline the contribution of air emissions of lead from the transportation sector has drastically declined over the past two decades. Today, industrial processes, primarily metals processing, are the major sources of lead emissions. The highest air concentrations of lead are usually found in the vicinity of smelters and battery manufacturers. Exposure to lead occurs mainly through inhalation of air and ingestion of lead in food, water, soil, or dust. It accumulates in the blood, bones, and soft tissues and can adversely affect the kidneys, liver, nervous system, and other organs. Lead can also be deposited on the leaves of plants, which pose a hazard to grazing animals and humans through ingestion via food chain.

Lead emissions and emission trends in Austria

In 1985 national total Pb emissions amounted to 327 Mg and to 207 Mg in 1990; emissions have decreased steadily and by the year 2006 emissions were reduced by 96% (14 Mg).

As it is shown in Table 23 today's Pb emissions mainly arise from the energy sector by combustion processes with a share of about 53% of the Austrian Pb emissions. In 1985 the main emission source for Pb emissions with a share of about 79% was the sector energy especially the sub-sector *road transport*. From 1990 to 1995 Pb emissions from this sector decreased by 100% due to prohibition of the addition of lead to petrol.

In addition to emission reduction in the energy sector the sector industrial proesses reduced its emissions remarkably due to improved dust abatement technologies. The significantly emission reduction in the sector solvent and other product use results from the ban of Pb in this production field or products.

Table 24: Pb emissions per NFR Category 1985 and 2006, their trend 1985–2006 and their share in total emissions.

NFR Category		Pb Emissions [Mg]			Trend		Share in National Total		
		1985	**1990**	**2006**	**1985–2006**	**1990–2006**	**1985**	**1990**	**2006**
1	Energy	258.20	174.17	7.49	-97%	-96%	79%	84%	53%
1 A	*Fuel Combustion Activities*	258.20	174.17	7.49	-97%	-96%	79%	84%	53%
1 B	*Fugitive Emissions f. Fuels*	NA	NA	NA					
2	Industrial Processes	62.45	32.09	6.61	-89%	-79%	19%	15%	47%
3	Solvent a. Other Product Use	0.06	0.07	NA			< 1%	< 1%	
4	Agriculture	0.23	0.01	0.01	-95%	-16%	< 1%	< 1%	< 1%
6	Waste	5.85	1.02	0.01	-100%	-99%	2%	< 1%	< 1%
	National Total	**326.79**	**207.35**	**14.12**	**-96%**	**-93%**			

2.6 Emission Trends for POPs

Emissions of Persistent Organic Pollutants (POPs) decreased remarkably from 1985 to 2006. As can be seen in Table 25, emissions for all three POPs are well below their 1985 level, which is the obligation for Austria as a Party to the POPs Protocol (see Chapter 1.1.1).

The most important source for POPs in Austria is residential heating. In the 80s industry and waste incineration were still important sources regarding POP emissions. Due to legal regulations concerning air quality emissions from industry and waste incineration decreased remarkably from 1990 to 1993, which is the main reason for the overall decrease in national total POP emissions.

Table 25: Emissions and emission trends for POPs 1985–2006.

Year	**Emission**		
	PAH [Mg]	**Dioxin [g]**	**HCB [kg]**
1985	27.05	187.13	106.31
1986	26.32	186.04	103.76
1987	26.23	187.93	106.55
1988	24.65	173.21	97.96
1989	24.26	164.27	94.72
1990	17.30	160.27	91.77
1991	17.89	134.99	84.44
1992	13.33	76.47	69.51
1993	10.12	66.77	63.84
1994	9.28	56.06	51.79
1995	9.62	58.27	52.93
1996	10.72	59.64	55.64
1997	9.29	59.33	51.78
1998	8.94	56.15	49.01
1999	8.80	53.59	47.56
2000	8.21	51.99	44.15
2001	8.89	54.35	47.35
2002	8.71	42.57	45.02
2003	9.04	43.31	45.60
2004	8.99	42.75	43.86
2005	9.19	44.65	45.58
2006	8.73	43.69	43.10
Trend 1985–2006	***-68%***	***-77%***	***-59%***

2.6.1 Polycyclic Aromatic Hydrocarbons (PAH) Emissions

The polycyclic aromatic hydrocarbons (PAH) are molecules built up of benzene rings which resemble fragments of single layers of graphite. PAHs are a group of approximately 100 compounds. Most PAHs in the environment arise from incomplete burning of carbon-containing materials like oil, wood, garbage or coal. Fires are able to produce fine PAH particles, they bind to ash particles and sometimes move long distances through the air. Thus PAHs have been ubiquitously distributed in the natural environment since thousands of years.

Out all different compounds of the pollutant group of PAHs, the four compounds benz(a)pyren, benzo(b)fluoranthen, benzo(k)fluoranthen and indeno(1,2,3-cd)pyren are used as indicators for the purposes of emission inventories, which has been specified in the UNECE POPs Protocol mentioned above.

PAH emissions and emission trends in Austria

In 1985 national total PAH emissions amounted to about 27 Mg and amounted to about 17 Mg in 1990; emissions have decreased steadily and by the year 2006 emissions were reduced by about 68% (to 9 Mg in 2006).

In 1985 the main emission sources for PAH emissions were the Sectors Energy (44%), Industrial processes (29%) and Agriculture (26%). In 2006 the main source regarding PAH emissions is *Energy* with a share in the national total of 95%. From 1985 to 2006 PAH emissions from Agriculture decreased remarkably by 97% due to prohibition of open field burning, PAH emissions from the sector Industrial processes decreased by 97% due to the shut down of primary aluminium production in Austria, which was a main source for PAH emissions.

Table 26: PAH emissions per NFR Category 1985 and 2006, their trend 1985–2006 and their share in total emissions.

NFR Category		PAH Emissions [Mg]			Trend		Share in National Total		
		1985	**1990**	**2006**	**1985–2006**	**1990–2006**	**1985**	**1990**	**2006**
1	Energy	11.95	9.47	8.31	-30%	-12%	44%	55%	95%
1 A	*Fuel Combustion Activities*	11.95	9.47	8.31	-30%	-12%	44%	55%	95%
1 B	*Fugitive Emissions from Fuels*	NA	NA	NA					
2	Industrial Processes	7.88	7.44	0.22	-97%	-97%	29%	43%	3%
3	Solvent a. Other Product Use	0.15	0.15	NA		1%	1%		
4	Agriculture	7.07	0.24	0.20	-97%	-18%	26%	1%	2%
6	Waste	0.00	0.00	0.00	-91%	-89%	< 1%	< 1%	< 1%
	National Total	**27.05**	**17.30**	**8.73**	**-68%**	**-50%**			

2.6.2 Dioxins and Furan

Dioxins form a family of toxic chlorinated organic compounds that share certain chemical structures and biological characteristics. Several hundred of these compounds exist and are members of three closely related families: the chlorinated dibenzo(p)dioxins (CDDs), chlorinated dibenzofurans (CDFs) and certain polychlorinated biphenyls (PCBs). Dioxins bio-accumulate in humans and wildlife due to their fat solubility and 17 of these compounds are especially toxic.

Dioxins are formed as a result of combustion processes such as commercial or municipal waste incineration and from burning fuels like wood, coal or oil as a main source of dioxins. Dioxins can also be formed when household trash is burned and as a result of natural processes such as forest fires. Dioxins enter the environment also through the production and use of organochlorinated compounds: chlorine bleaching of pulp and paper, certain types of chemical manufacturing and processing, and other industrial processes are able to create small quantities of dioxins. Cigarette smoke also contains small amounts of dioxins.

Thanks to stringent legislation and modern technology dioxin emissions due to combustion and incineration as well as due to chemical manufacturing and processes have been reduced dramatically. Nowadays domestic combustion as well as thermal processes in metals extraction and processing have become more significant.

Dioxin/Furan emissions and emission trends in Austria

In 1985 national total dioxin/furan emissions amounted to about 187 g and amounted to about 160 g in 1990; emissions have decreased steadily and by the year 2006 emissions were reduced by about 77% (to 44 g in 2006).

In 1985 the main sources for dioxin/furan emissions were the Sectors *Energy* (59%) and *Industrial Processes* (especially iron and steel production) (27%). In 2006 the main sector regarding dioxin/furan emissions is *Energy* with a share in National Total of 88%.

From 1985 to 2006 PAH emissions from the sectors *Waste* and *Solvents and Other Product Use* decreased by almost 100% due to stringent legislation and modern technology. The dioxin emissions of the sectors *Agriculture* and *Industrial processes* decreased by 97% and 91%, respectivley, due to prohibition of open field burning and improved emission abatement technologies in iron and steel industries.

Table 27: Dioxin emissions per NFR Category 1985 and 2006, their trend 1985–2006 and their share in total emissions.

NFR Category		Dioxin Emissions [g]			Trend		Share in National Total		
		1985	1990	2006	1985–2006	1990–2006	1985	1990	2006
1	Energy	109.69	101.84	38.62	-65%	-62%	59%	64%	88%
1 A	*Fuel Combustion Activities*	*109.69*	*101.84*	*38.62*	*-65%*	*-62%*	*59%*	*64%*	*88%*
1 B	*Fugitive Emissions from Fuels*	*NA*	*NA*	*NA*					
2	Industrial Processes	51.30	39.00	4.76	-91%	-88%	27%	24%	11%
3	Solvent & Other Product Use	5.19	1.06	NA			3%	1%	–
4	Agriculture	5.05	0.18	0.15	-97%	-18%	3%	< 1%	< 1%
6	Waste	15.90	18.19	0.17	-99%	-99%	8%	11%	< 1%
	National Total	**187.13**	**160.27**	**43.69**	**-77%**	**-73%**			

2.6.3 Hexachlorobenzene (HCB) Emissions

Hexachlorobenzene (HCB) has been widely employed as a fungicide on seeds, especially against the fungal disease 'bunt' that affects some cereal crops. The marketing and use of hexachlorobenzene as a plant protection product was banned in the European Union in 1988.

As there is no more hexachlorobenzene production in the EU, the only man-made releases of hexachlorobenzene are as unintentional by-product; it is emitted from the same chemical and thermal processes as Dioxins/Furans and formed via a similar mechanism.

It is released to the environment as an unintentional by-product in chemical industry (production of several chlorinated hydrocarbons such as drugs, pesticides or solvents) and in metal industries and is formed in combustion processes in the presence of chlorine.

HCB emissions and emission trends in Austria

In 1985 national total HCB emissions amounted to about 106 g and amounted to about 92 g in 1990; emissions have decreased steadily and by the year 2006 emissions were reduced by about 597% (to 43 g in 2006).

In 1985 the two main sources for HCB emissions were the sectors *Energy* (78%) and *Industrial processes* (12%). In 2006 the main sector of HCB emissions is *Energy* with a share in National Total of 91%.

From 1985 to 2006 HCB emissions from the sectors *Waste* and *Agriculture* as well as *Solvents and Other Products Use* decreased remarkably by 94% and more due to stringent legislation and modern technology. HCB emissions of the sectors *Industrial processes* and *Energy* decreased by 72% or 53% respectively due to improved dust abatement technologies. National total emissions decreased by 59% in the period from 1985 to 2006.

Table 28: Hexachlorbenzene (HCB) emissions per NFR Category 1985 and 2006, their trend 1985–2006 and their share in total emissions.

NFR Category		HCB Emissions [g]			Trend		Share in National Total		
		1985	**1990**	**2006**	**1985–2006**	**1990–2006**	**1985**	**1990**	**2006**
1	Energy	83.21	72.57	39.27	-53%	-46%	78%	79%	91%
1 A	*Fuel Combustion Activities*	*83.21*	*72.57*	*39.27*	*-53%*	*-46%*	*78%*	*79%*	*91%*
1 B	*Fugitive Emissions from Fuels*	*NA*	*NA*	*NA*					
2	Industrial Processes	13.27	9.71	3.76	-72%	-61%	12%	11%	9%
3	Solvent and Other Product Use	7.71	9.05	NA			7%	10%	
4	Agriculture	1.01	0.04	0.03	-97%	-18%	1%	< 1%	< 1%
6	Waste	1.11	0.39	0.03	-97%	-91%	1%	< 1%	< 1%
0	**National Total**	**106.31**	**91.77**	**43.10**	**-59%**	**-53%**	**100%**	**100%**	**100%**

3 MAJOR CHANGES

3.1 Relation to data reported earlier

As a result of the continuous improvement of Austria's National Air Emission Inventory, emissions of some sources have been recalculated based on updated data or revised methodologies, thus emission data for 1990 to 2005 submitted this year differ from data reported previously.

The figures presented in this report replace data reported earlier by the Umweltbundesamt under the reporting framework of the UNECE/LRTAP Convention and NEC Directive of the European Union.

Explanations for recalculations per sector are given in Chapter 3.3.

The main recalculation concerning all sectors was the reassessment of the Austrian Air Emission Inventory (OLI) for PM within the scope an external study [83]. Explanations for the recalcaulations per sector are given below.

Table 29: Recalculation difference of Austria's PM emissions compared to the previous submission.

	TSP	PM10	PM2.5
1990	-25%	-10%	-10%
2000	-17%	-4%	-7%
2005	-20%	-5%	-7%

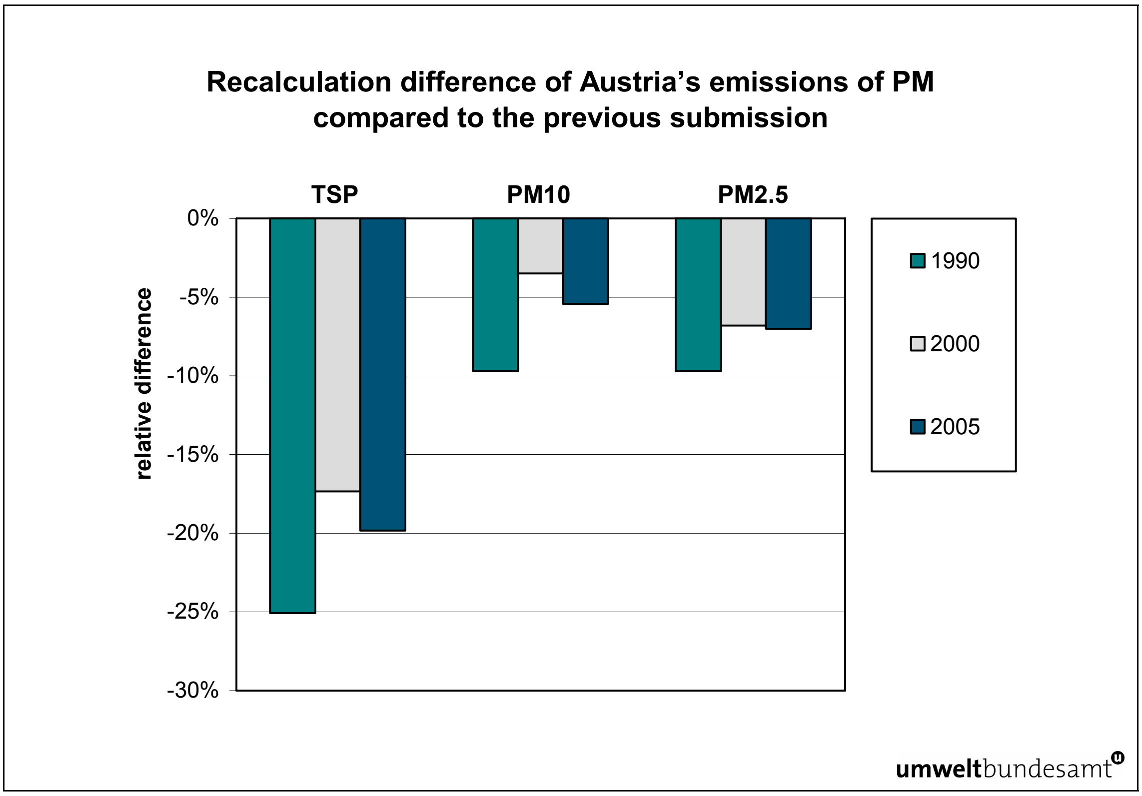

Figure 9: Recalculation difference of Austria's emissions of PM compared to the previous submission.

3.2 Explanations and Justifications for Recalculations

Compiling an emission inventory includes data collecting, data transfer and data processing. Data has to be collected from different sources, for instance

- national statistics
- associations
- plant operators
- studies
- personal information
- other publications.

The provided data must be transferred from different data formats and units into a unique electronic format to be processed further. The calculation of emissions by applying methodologies on the collected data and the final computing of time series into a predefined format (NFR) are further steps in the preparation of the final submission. Finally the submission must be delivered in due time. Even though a QA/QC system gives assistance so that potential error sources are minimized it is necessary to make some revisions – so called recalculations – under the following circumstances:

- An emission source was not considered in the previous inventory.
- A source/data supplier has delivered new data because previous data were preliminary data only (by estimation, extrapolation) or the methodology has been improved.
- Occurrence of errors in data transfer or processing: wrong data, unit-conversion, software errors, et al.
- Methodological changes: a new methodology must be applied to fulfil the reporting requirements because one of the following reasons:
  - to decrease uncertainties;
  - an emission source becomes a key source;
  - consistent input data needed for applying the methodology is no longer accessible;
  - input data for more detailed methodology is now available;
  - methodology is no longer appropriate.

3.3 Major Changes by Sector

This chapter describes the methodological changes by sector made to the inventory since the previous submission.

3.3.1 Major Changes SECTOR 1 ENERGY

Fuel Combustion (1A)

Changes in Allocation

From 2002 to 2005 sinter magnesite plants have been shifted from category *1 A 2 b Non Ferrous Metals* to category *1 A 2 f Other Industry.*

Update of activity data and NCVs

Update of activity data and NCVs are following the updates of the IEA compliant energy balance compiled by the federal statistics authority STATISTIK AUSTRIA.

Energy balance update and corrections

Correction of residual fuel oil NCVs from 1995 to 2005 (e.g. +2% in 1999, +1% in 2005).

Correction of hard coal NCVs from 1999 to 2001 and from 2004 to 2005 (e.g -4.5% in 2000; -0.2% in 2005).

Correction of brown coal NCVs from 1999 to 2001 and for 2005 (e.g +0.2% in 1999; +3.9% in 2001).

Correction of petrol coke and 'other oil products' NCVs 1994 to 1996 (+0.2%).

Correction of NCVs affects fuel consumption calculation (conversion of tonnes or cubic meters to TJ) and therefore leads to changes in emissions alculation for the respecity fuels and periods as mentioned above.

Update of activity data (in 'tonnes' or 'cubic metres' per category) mainly affects the period 1999 to 2004. Transformation input has been revised to improve the compliance between transformation input and electricity and heat production (more reliable efficiencies). National fossil fuel consumption are not affected by this update but consumption and emissions have been shifted between categories 1.A.1 (public energy plants) and 1.A.2 (auto producers plants) and/or between final energy consumption and transformation input.

1 A 3 b Transport – Road Transportation

Update of statistical energy data, particularly the biodiesel consumption.

1 A 3 e Other Transportation – pipeline compressors

Update of 2004 natural gas consumption according to the updated national energy balance.

1 A 4 a Commercial/Institutional and *1 A 4 b Residential*

New sources like charcoal production, barbecue, bonfire, open firepits are incorporated.

1 A 4 Other Sectors – Mobile Sources

Update of statistical energy data for railways (coal, diesel, electricity) up to 2000.

Improvements of methodologies and emission factors:

1 A 1 a Public Electricity and Heat Production

Gap-filling of missing NO_X emission declarations by means of EPER data (GUD Leopoldau 2000 to 2006).

Update of NH_3 emissions factor of coal plants according to actual measurements.

1.A.2.a Iron and Steel

Update of 2005 SO_2 emissions according to new information from industry (VOEST).

1.A.2.d Pulp and Paper

Update of 2005 PM emissions according to a report published by the Austrian paper manufacturing industry.

1 A 2 f Cement Production

Update of emissions 2003–2005 according to a study of the Austrian cement manufacturing industry.

1.A.2.f Other Industry

PM emissions from cement and limestone kilns are now included under NFR 2 A 1 and 2 A 2.

1 A 4 b Residential

Update of heating type split from 2001 onwards by means of 2004 houshold census data. This affects calculation of CO, NMVOC, NO_x (and POPs) emissions from residential heatings.

Fuel consumption of new biomass-, gas- and oil-heatings have been revised from the year 2000 onwards by means of boiler sales statistics. This affects calculation of CO, NMVOC, NO_x, (PM and POPs) emissions from residential heatings.

1 A 3 b Road Transport

All emission factors for passenger cars, light goods vehicles and motorcycles have been updated. The source of the new emission factors is the EU project ARTEMIS (Assessment and Reliability of Transport Emission Models and Inventory Systems). In ARTEMIS a new set of real world driving cycles was developed (CADC, Common ARTEMIS Driving Cycle; http://www.trl.co.uk/artemis/introduction.htm). This CADC results, for most exhaust gas components, in clearly different emission factors compared to the former ones (UMWELTBUNDESAMT 2004: Handbook Emission Factors for Road Transport (HBEFA); Version 2.1. www.hbefa.net). In the majority of cases the emission levels are significantly higher, primarily for NO_x.

Furthermore a new transport model has been implemented. New data with reference to vehicle-kilometres, ton-kilometres and passenger-kilometres was used. The current figures show for 2005 approximately 8% more vehicle kilometres in Austria than the former set of traffic activity data.

All these changes in the traffic numbers and in the emission factors clearly show effects on the total transport-related emissions set out in the inventory (for the whole time series).

New estimates for Offroad-Abrasion

1 A 5 b Military

1 A 4 c 2 Agriculture (off-site)

1 A 4 c 2 Forestry

1 A 2 f Industry

FUGITIVE EMISSIONS (1 B)

Update of activity data:

1 B 2 Fugitive emissions from fuels

Activity data for 2005 were updated due to updated energy statistics and updated information on the gas distribution network.

Table 30: Recalculation difference of Austria's PM emissions compared to the previous submission in Sector 1.

	1990			2000			2005		
	Δ %	OLI 2006	OLI 2007	Δ %	OLI 2006	OLI 2007	Δ %	OLI 2006	OLI 2007
PM2.5 [Mg]									
1A	*-6%*	21 041	19 847	*-2%*	19 172	18 859	*-1%*	19 413	19 146
1A1	*9%*	780	850	*10%*	521	572	*13%*	752	847
1A2	*-2%*	3 357	3 291	*0%*	2 601	2 605	*-6%*	2 146	2 021
1A3	*-40%*	5 622	3 398	*-20%*	6 866	5 471	*-18%*	7 453	6 090
1A4	*9%*	11 268	12 292	*11%*	9 166	10 194	*12%*	9 020	10 145
1A5	*1%*	15	15	*1%*	17	18	*0%*	42	42
1B	=	95	95	*0%*	82	82	*0%*	91	91
PM10 [Mg]									
1A	*-1%*	23 920	23 658	*4%*	21 934	22 842	*5%*	22 326	23 459
1A1	*8%*	926	997	*8%*	619	666	*11%*	893	993
1A2	*3%*	3 668	3 791	*8%*	2 846	3 061	*3%*	2 396	2 477
1A3	*-23%*	6 985	5 364	*-6%*	8 464	7 946	*-4%*	9 131	8 792
1A4	*9%*	12 326	13 490	*12%*	9 988	11 150	*13%*	9 864	11 154
1A5	*4%*	15	16	*3%*	17	18	*1%*	42	43
1B		305	305	*0%*	263	263	*0%*	290	289

3.3.2 Major Changes SECTOR 2 INDUSTRIAL PROCESSES

Update of activity data

2 D 1 Other Production – Pulp and Paper (chipboard production)

Activity data for 2005 has been updated.

2 D 2 Other Production – Food and Drink (Bread, Wine, Beer and Spirits)

Activity data for 2005 has been updated.

Improvements of methodologies and emission factors

2 Industrial Processes

Updating methodology and emission factors for handling bulk materials according VDI guidelines 3790.

2 A 1 Cement Production and *2 A 2 Lime Production*

PM emissions from cement and limestone kilns from 1 A 2 f Other Industry are now included under 2 A 1 and 2 A 2.

2 A 7 *Construction and demolition*

Updating methodology and emission factors for handling bulk materials according CEIPMEIP (2002).

Table 31: Recalculation difference of Austria's PM emissions compared to the previous submission in Sector 2.

	1990			2000			2005		
	∆ %	OLI 2006	OLI 2007	∆ %	OLI 2006	OLI 2007	∆ %	OLI 2006	OLI 2007
PM2.5 [Mg]									
2	-32%	5 189	3 505	-41%	5 018	2 938	-48%	4 444	2 329
2A	-63%	2 681	990	-62%	3 613	1 377	-63%	3 606	1 331
2B	-32%	441	302	0%	138	138	0%	141	141
2C	=	2 066	2 066	=	1 267	1 267	=	697	697
2D	29418%	1	148	51828%	0	156	53384%	0	160
PM10 [Mg]									
2	-7%	13 846	12 920	1%	14 814	14 901	-1%	13 452	13 383
2A	-14%	8 624	7 425	-3%	11 614	11 312	-4%	11 578	11 110
2B	-14%	660	565	0%	262	262	0%	267	267
2C	=	4 561	4 561	=	2 937	2 937	=	1 605	1 605
2D	33430%	1	369	43190%	1	390	44486%	1	401
TSP [Mg]									
2	-6%	25 170	23 769	2%	28 743	29 341	1%	26 734	27 069
2A	-13%	17 789	15 455	-2%	24 103	23 730	-3%	23 990	23 324
2B	1%	945	958	=	447	447	=	456	456
2C	=	6 435	6 435	=	4 190	4 190	=	2 286	2 286
2D	41787%	2	922	51146%	2	974	52681%	2	1 003

3.3.3 Major Changes SECTOR 3 SOLVENT USE

Improvements of methodologies and emission factors:

3 D 4

New sources like fireworks and tobacco are incorporated.

3.3.4 Major Changes SECTOR 4 AGRICULTURE

Improvements of methodologies and emission factors

4 D PM emissions from Soil Cultivation and Harvesting

Emission calculation and emissions factors based on ÖTTL & FUNK (2007) and HINZ (2007).

Incorporating a climate factor.

4 G Particle emissions from animal husbandry

Update of PM emission factors according to RAINS-Model (LÜKEWILLE et al., 2001) and KLIMONT et al. (2001).

Table 32: Recalculation difference of Austria's PM emissions compared to the previous submission in Sector 4

	1990			2000			2005		
	Δ %	OLI 2006	OLI 2007	Δ %	OLI 2006	OLI 2007	Δ %	OLI 2006	OLI 2007
PM2.5 [Mg]									
4	*-45%*	2 256	1 245	*-39%*	1 989	1 210	*-44%*	2 144	1 197
4D	*-23%*	1 465	1 136	*-11%*	1 251	1 114	*-19%*	1 355	1 102
4G	*-86%*	791	110	*-87%*	738	96	*-88%*	789	95
PM10 [Mg]									
4	*-41%*	9 440	5 604	*-36%*	8 457	5 445	*-43%*	9 379	5 385
4D	*-18%*	6 209	5 110	*-7%*	5 361	5 012	*-14%*	5 767	4 959
4G	*-85%*	3 231	494	*-86%*	3 096	434	*-88%*	3 611	426
TSP [Mg]									
4	*-63%*	33 603	12 453	*-58%*	29 145	12 100	*-62%*	31 841	11 966
4D	*-62%*	29 725	11 355	*-56%*	25 430	11 137	*-60%*	27 508	11 020
4G	*-72%*	3 877	1 098	*-74%*	3 715	964	*-78%*	4 333	946

3.3.5 Major Changes SECTOR 6 WASTE

Update of activity data

6 A 1 Managed waste disposal on land

Activity data (1998 to 2005) has been updated. According to the Austrian Landfill Ordinance, the operators of landfill sites have to report their activity data annually. Based on reports received after the due date and updates, the amount of deposited waste changed (< 10%) compared to the previous submission.

According to the recommendation of the ERT, the double counting of deposited waste due to the clean-up of former waste deposit sites was corrected and resulted in lower amounts of deposited waste in 2002 and 2003.

6 D Other

Sewage sludge is no longer considered a separate waste fraction for composting as it can be assumed that it is already accounted for in the waste fraction undergoing mechanical-biological treatment. Emissions from mechanical-biological treatment are considered in this source category.

Activity data for mechanical-biological treatment have been updated for the years 2003–2005, as new data were available.

Activity data for separately collected bio-waste were updated from 2001–2005, because new data from the waste Management Concepts and Plans of the nine Federal Provinces (Bundesländer) were available.

Improvements of methodologies and emission factors

6 A 1 Managed waste disposal on land

Emission factors were updated.

Table 33: Recalculation difference of Austria's PM emissions compared to the previous submission in Sector 6.

	1990			2000			2005		
	Δ %	OLI 2006	OLI 2007	Δ %	OLI 2006	OLI 2007	Δ %	OLI 2006	OLI 2007
PM2.5 [Mg]									
6	-13%	26	23	-19%	17	13	2%	27	28
PM10 [Mg]									
6	-13%	80	70	-19%	53	43	2%	87	89
TSP [Mg]									
6	-13%	168	145	-19%	112	91	2%	184	188

3.4 Recalculations per Gas

The following tables present the implication on emission trends of the methodological changes made as summarized in Chapter 3.3. Changes in the use of notation keys are also shown in the tables[87].

[87] a "=" in the field for relative difference indicates that reported emissions do not differ from the previous submission; blank fields indicate that no such emissions occur from this sector;

3.4.1 Recalculation difference of particle matter emissions with respect to submission 2006

In the following the recalculation difference of particle matter emissions with respect to submission 2006 is depicted in the following Table.

Detailed explanations are provided in chapters 3.1 and 3.3.

Table 34: Recalculation difference of PM emissions in general with respect to submission 2006.

		Relative difference			Absolute difference [Mg]					
		1990∆ %	2000∆ %	2005∆ %	1990	1995	2002	2003	2004	2005
TSP										
1	Energy	*-3%*	*2%*	*3%*	-820	-348	333	648	703	960
2	Industrial Processes	*-6%*	*2%*	*1%*	-1401	-65	-163	-269	478	335
3	Solvent & Other Product Use	*NEW*	*NEW*	*NEW*	407	421	428	430	433	436
4	Agriculture	*-63%*	*-58%*	*-62%*	-21149	-17052	-18566	-16212	-21856	-19876
6	Waste	*-13%*	*-19%*	*2%*	-22	-25	-17	-25	-21	4
0	**Total Emissions**	***-25%***	***-17%***	***-20%***	**-22986**	**-17068**	**-17985**	**-15428**	**-20264**	**-18140**
PM10										
1	Energy	*-1%*	*4%*	*5%*	-263	142	762	977	983	1 132
2	Industrial Processes	*-7%*	*1%*	*-1%*	-926	-209	-306	-353	0	-68
3	Solvent & Other Product Use	*NEW*	*NEW*	*NEW*	407	421	428	430	433	436
4	Agriculture	*-41%*	*-36%*	*-43%*	-3 837	-3 205	-3 401	-3 170	-4 298	-3 994
6	Waste	*-13%*	*-19%*	*2%*	-11	-12	-8	-12	-10	2
0	**Total Emissions**	***-10%***	***-4%***	***-5%***	**-4 629**	**-2 862**	**-2 525**	**-2 128**	**-2 892**	**-2 491**
PM2.5										
1	Energy	*-6%*	*-2%*	*-1%*	-1 194	-946	-481	-336	-381	-267
2	Industrial Processes	*-32%*	*-41%*	*-48%*	-1 683	-1 878	-2 240	-2 209	-2 189	-2 115
3	Solvent & Other Product Use	*NEW*	*NEW*	*NEW*	407	421	428	430	433	436
4	Agriculture	*-45%*	*-39%*	*-44%*	-1 011	-806	-850	-748	-1 035	-947
6	Waste	*-13%*	*-19%*	*2%*	-3	-4	-3	-4	-3	1
0	**Total Emissions**	***-12%***	***-10%***	***-11%***	**-3 484**	**-3 212**	**-3 145**	**-2 867**	**-3 175**	**-2 892**

4 ENERGY (NFR SECTOR 1)

Key source: NO_x, SO_2, NMVOC, CO, Cd, Pb, Hg, PAH, DIOX, HCB, TSP, PM10, PM2.5

Sector *1 Energy* considers emissions originating from *fuel combustion activities*

- 1 A 1 Energy Industries
- 1 A 2 Manufacturing Industries and Construction
- 1 A 3 Transport
- 1 A 4 Other Sectors (commercial and residential)
- 1 A 5 Other (Military)

as well as fugitive emissions from fuels (NFR 1 B)

- 1 B 1 Solid fuels
- 1 B 2 Oil and natural gas.

4.1 Emission Trends in Energy (NFR Sector 1)

In general in 2006, NFR Category *1 Energy* is the main source of emissions in Austria. The total fuel consumption increased by 37% from 824 425 TJ in 1990 to 1 132 909 TJ in 2006. Emissions from NFR Sector *1 Energy* and trends for the period from 1990 to 2005 as well as the national share for 1990 and 2006 are presented in Table 36.

Regarding emissions of NEC gases and CO the Sector *1 Energy* was in 2006 the main source with a share of about

- 96% of in national total SO_2 emissions;
- 96% of in national total CO emissions and
- 97% of in national total NO_x emissions.

The energy sector is – with a share of about 41% of total NMVOC emissions – the second largest emitter of NMVOC in Austria but is – with a contribution of 6% – only minor source regarding NH_3 emissions.

Furthermore Sector *1 Energy* was responsible for more than 88% of each reported POP emissions (PAH, dioxin/furan and HCB).

Whereas in 2006 44% of total TSP emissions resulted from Sector *1 Energy,* the share of PM10 and PM2.5 amount to 54% and 83% respectively. The higher share of finest particles is due to efficient combustion, waste gas treatment and installation of filters, which mainly hold off larger particles.

Sector *Energy* is also an important source for heavy metals emissions; in 2006 the energy sector was responsible for 80% of total Cd emissions, 68% of total Hg emissions, and 53% of total Pb emissions.

Table 35 presents the source categories from the energy sector and their contribution to national total emissions. Furthermore sources which are key sources of the Austrian inventory are highlighted (for details of the key source analysis see Chapter 1.4).

Table 35: Key source in NFR Sector 1 Energy.

Pollutant	Source category													
	1 A 1 a	**1 A 1 b**	**1 A 1 c**	**1 A 2 stat (l)**	**1 A 2 stat (s)**	**1 A 2 stat (g)**	**1 A 2 stat (b)**	**1 A 2 stat (s)**	**1 A 4 stat (l)**	**1 A 4 stat (s)**	**1 A 4 stat (g)**	**1 A 4 stat (b)**	**1 A 4 stat (o)**	**1 A 5**
	Public Electricity and Heat Production	**Petroleum refining**	**Manufacture of Solid fuels and Other Energy Industries**	**Manuf. Ind. and Constr. stationary LIQUID**	**Manuf. Ind. and Constr. stationary SOLID**	**Manuf. Ind. and Constr. stationary GASEOUS**	**Manuf. Ind. and Constr. stationary BIOMASS**	**Manuf. Ind. and Constr. stationary OTHER**	**Other Sectors stationary LIQUID**	**Other Sectors stationary SOLID**	**Other Sectors stationary GASEOUS**	**Other Sectors stationary BIOMASS**	**Other Sectors stationary OTHER**	**Other**
SO_2	**14.6%**	**13.0%**	**0.0%**	**8.6%**	**20.3%**	0.3%	**3.2%**	**1.8%**	**16.1%**	**10.5%**	0.0%	**2.9%**	0.3%	**0.1%**
NO_x	**4.7%**	**1.5%**	0.7%	**1.2%**	**2.7%**	**3.5%**	**1.6%**	1.1%	**2.0%**	0.2%	**1.2%**	**3.6%**	0.0%	0.1%
NMVOC	0.4%		0.0%	0.1%	0.3%	0.0%	0.1%	0.2%	0.0%	**1.0%**	0.0%	**18.1%**	0.0%	0.0%
NH_3	0.4%	0.2%	0.0%	0.1%	0.0%	0.2%	0.2%	0.0%	0.4%	0.0%	0.1%	0.6%	0.0%	0.0%
CO	0.5%	0.1%	0.0%	0.6%	**18.6%**	0.5%	0.3%	0.7%	**0.8%**	**3.1%**	0.4%	**33.8%**	0.0%	0.1%
Cd	**9.2%**	**15.3%**	0.0%	**5.4%**	0.1%	0.0%	**3.4%**	**4.7%**	0.3%	**3.6%**	0.0%	**25.3%**	0.4%	0.0%
Hg	**19.8%**	1.1%	0.0%	**5.1%**	**9.3%**	0.0%	**3.2%**	**8.5%**	0.1%	**6.1%**	0.0%	**14.0%**	0.1%	0.0%
Pb	**10.3%**	2.1%	0.0%	**4.1%**	0.3%	0.0%	**3.3%**	**14.1%**	0.0%	**3.6%**	0.0%	**14.9%**	0.3%	0.0%
PAH	0.2%	0.0%	0.0%	0.0%	0.1%	0.0%	0.6%	0.3%	0.3%	**3.0%**	0.0%	**69.3%**	0.2%	0.0%
Diox	**1.8%**	0.1%	0.0%	0.6%	0.4%	**1.2%**	**3.0%**	**6.5%**	0.3%	**6.0%**	0.4%	**64.3%**	0.5%	0.0%
HCB	0.8%	0.0%	0.0%	0.1%	0.1%	0.2%	0.5%	**2.5%**	0.0%	**7.6%**	0.0%	**78.1%**	0.4%	0.0%
TSP	**1.5%**	0.1%	0.1%											0.1%
PM10	**2.4%**	0.2%	0.2%											0.1%
PM2.5	**3.9%**	0.3%	0.3%											0.2%

Note: grey shaded are key sources

4.1.1 NEC gases and CO Emissions

SO_2 Emissions (key source)

SO_2 emissions from NFR Category 1 Energy were reduced over the period from 1990 to 2006: as can be seen in Table 36 and Table 37 in 1990 emissions amounted to 72 Gg, in 2006 they were 62% lower (27 Gg).

The strong reduction of SO_2 emissions from combustion processes was achieved by application of abatement techniques as well as use of low-sulphur fuels.

The share of SO_2 emissions from this sector in national total emissions was about 97% in 1990 and about 96% in 2006. Within this source the main sources for SO_2 emissions are NFR 1 A 2 *Manufacture of Solid fuels and Other Energy Industries* and NFR 1 A 4 *Other Sectors* with a contribution of 25% and 45%, respectivley.

NO_x Emissions (key source)

As can be seen in Table 36 and Table 38, NO_x emissions from the Sector *Energy* increased over the period from 1990 to 2006. In 1990 they amounted to 181 Gg, in the year 2006 they were about 17% above 1990 levels (218 Gg). Even if efforts were made regarding emission control in combustion plants, this was counterbalanced by increasing activity of the transport sector in passenger as well as freight transport (NFR *1 A 3 Transport)*.

The share of NO_x emissions from this sector in national total NO_x emissions amounted to about 94% in 1990 and about 97% in 2006. The main source for NO_x emissions in NFR *1 Energy* with a contribution of 53% in 1990 and 60% in 2006 is *1 A 3 Transport*, here especially road transport. Other important sources are NFR 1 A 2 *Manufacture of Solid fuels and Other Energy Industries* and NFR 1 A 4 *Other Sectors* with each a contribution of 15% in national total.

NMVOC Emissions (key source)

In 2006 NFR Category *1 Energy* was the second largest sector regarding NMVOC emissions in Austria. In 1990 the contribution to national total emissions was 54% (154 Gg) compared to 40% (70 Gg) in 2006 due to exhaust-gas limits for vehicles and increasing number of diesel-driven vehicles as well as applied abatement techniques and improved biomass heatings in households.

NMVOC emissions from *1 Energy* are continuously decreasing: in the period from 1990 to 2006 emissions decreased by 54%, mainly due to decreasing emissions from NFR *1 A 3 Transport* and NFR *1 A 4 Other Sectors*, which are the main contributors to NMVOC emissions from the energy sector (see Table 36 and Table 39).

CO Emissions (key source)

NFR *1 Energy* is the largest sector regarding CO emissions. As can be seen in Table 36 and Table 41, CO emissions from the *Energy sector* decreased by 46% over the period 1990–2006. CO emissions amounted to about 1385 Gg in 1990 and to about 754 Gg in 2006. The main source for CO emissions of NFR Category *1 Energy* with a contribution of 43% in 2006 was NFR *1 A 4 Other Sectors*, here mainly residential biomass heatings.

The share of CO emissions from this sector in national total emissions even slightly increased from about 95% in 1990 to about 96% in 2006 because efforts regarding abatement techniques and improved combustion efficiency in all sub-sectors of NFR *1 Energy* as well as other sectors were counterbalanced by enormously increased individual transport and freight transport.

NH_3 Emissions

NH_3 emissions from NFR *1 Energy* is the second largest sector regarding NH_3 emissions but this sector is only a minor source of NH_3 emissions with a contribution to national total NH_3 emissions of 6% in 1990 and 2006.

NH_3 emissions from NFR *1 Energy* are decreasing: in 1990 emissions amounted to about 4.3 Gg, in the year 2006 they were about 12% lowerr than 1990 levels and amounted to about 3.8 Gg.

4.1.2 Particle Matter (PM) Emissions (key source)

The Sector *Energy* is an important source for PM emissions in Austria. All major sub categories are key sources of the Austrian Inventory regarding all three reported fractions of PM. As shown in Table 36 and Table 48 to Table 50 in the period from 1990 to 2006:

- **TSP** emissions increased by about 4% to 33 Gg, which is a share of 44% in total TSP emissions in 2006.
- **PM10** emissions decreased by about 3% to 23 Gg, which is a share of 54% in total TSP emissions in 2006.
- **PM2.5** emissions decreasd by about 6% to 19 Gg, which is a share of 83% in total TSP emissions in 2006.

In 2006 within this source NFR *1 A 3 Transport* and *1 A 4 Other Sectors* have the highest contribution to TSP, PM10 and PM2.5 emissions: 37% of the national TSP emissions, 44% of the national PM10 emissions and 68% of the national PM2.5. The high share of this sector in total PM2.5 emissions is due to diesel engines and applied abatement techniques which mainly reduce larger particles.

4.1.3 Heavy metal Emissions (key source)

The Sector *Energy* is also an important source for HM emissions in Austria. All major sub categories are key sources of the Austrian Inventory regarding all three reported HM. As shown in shown in Table 36 and Table 42 in the period from 1990 to 2006

- **Cd** emissions decreased by 15% to 0.9 Mg, which is a share of 80% in national total Cd emission in 2006.

  In 2006 within this source NFR *1 A 2* and *1 A 4* have the highest contribution to Cd emissions. 30% of national Cd emission resulted from NFR *1 A 4 Other Sectors*, where biomass is used for space and water heating in the commercial, agricultural and household sector, 25% arise from NFR *1 A 1 Energy Industries* and 17% from NFR *1 A 2 Manufacturing Industries and Construction*.

- **Hg** emissions decreased by 55% to 0.7 Mg, which is a share of 68% in national total Hg emissions in 2006.

  Within this source the three sub categories NFR *1 A 1 Energy Industries* and *1 A 4 Other Sectors* contribute each about one-fifth, and NFR *1 A 2 Manufacturing Industries and Constrution* contribute one-fourth to total Hg emissions. Overall Hg emissions could be reduced significantly by different abatement techniqes such as filter installation and wet flue gas treatment in industry and due to decreasing coal consumption in the residential sector.

- **Pb** emissions decreased by about 96% to 7.5 Mg, which is a share of 53% in national total Pb emission in 2006. The enoumous reduction was achieved by elimination of Pb in motor gasoline but also by different abatement techniqes such as filter installation and wet flue gas treatment. Within this source the sub categories NFR *1 A 2 Manufacturing Industries and Construtio*n and *1 A 4 Other Sectors* contribute each about one-fifth to total Pb emissions; NFR *1 A 1 Energy* contributes about 12%.

4.1.4 POP Emissions (key source)

The Sector *Energy* is also an important source for POP emissions in Austria. Several sub categories are key sources of the Austrian Inventory regarding all three reported POP. As shown in Table 36 in the period from 1990 to 2006

- **PAH** emissions decreased by about 12% to 8.8 Mg, which is a share of 95% in national total PAH emission in 2006.

  In 2006 within this source NFR *1 A 4 Other Sectors* has the highest contribution (75%) to PAH emissions, where biomass is mainly used for space and water heating in the commercial, agricultural and household sector. Emissions of NFR *1 A 3 Transport* contributes 18% to national PAH emissions.

- **Dioxin/furan** emissions decreased by about 62% to 39 g, which is a share of 88% in national total dioxin/furan emissions in 2006.

  As for PAH emissions, within this source NFR *1 A 4 Other Sectors* has the highest contribution (72%) to dioxin/furan emissions due to biomass heatings. Emissions of NFR *1 A 2 Manufacturing Industries and Constrution* amount to 12% of national dioxin/furan emissions.

- **HCB** emissions decreased by about 46% to 42 kg, which is a share of 92% in national total HCB emission in 2006.

  As for PAH and Dioxin/furan emissions, within this source NFR *1 A 4 Other Sectors* has the highest contribution (86%) to HCB emissions. Emissions of the others sub categories NFR *1 A 1*, NFR *1 A 2*, NFR *1 A 3* and NFR *1 A 5* contribute together only 5% of national HCB emissions.

Table 36: Emissions from NFR Sector 1 and trends 1990–2006.

Year	SO_2	NO_x	NMVOC	CO	NH_3	TSP	PM10	PM2.5	Cd	Hg	Pb	PAH	Dioxin	HCB
			[Gg]				[Mg]			[Mg]		[Mg]	[g]	[kg]
1990	72.03	181.43	153.12	1385.17	4.28	31811.93	23962.50	19941.51	1.06	1.56	174.17	9.47	101.84	72.57
1991	69.46	191.77	160.54	1459.72	5.85	NR	NR	NR	1.09	1.50	143.81	10.32	80.87	69.71
1992	53.32	181.32	152.39	1424.19	6.67	NR	NR	NR	0.97	1.18	100.67	9.40	53.86	56.94
1993	51.92	178.50	149.88	1389.45	7.45	NR	NR	NR	0.94	0.96	70.61	9.28	49.34	53.58
1994	46.14	172.61	138.58	1319.28	7.66	NR	NR	NR	0.88	0.76	47.31	8.40	44.54	48.04
1995	45.43	173.72	133.70	1211.36	7.49	32200.20	23717.21	19661.80	0.81	0.71	11.33	8.85	45.79	50.20
1996	43.27	196.48	131.19	1196.34	7.01	NR	NR	NR	0.84	0.71	11.18	9.57	48.22	53.15
1997	38.84	185.57	112.62	1106.65	6.52	NR	NR	NR	0.80	0.68	9.64	8.58	46.92	49.07
1998	34.33	200.67	106.59	1064.77	6.55	NR	NR	NR	0.74	0.60	8.23	8.30	44.45	46.45
1999	32.62	191.64	100.46	994.48	5.92	32714.34	23798.23	19617.63	0.80	0.65	7.53	8.32	40.74	44.75
2000	30.47	198.16	92.52	922.83	5.42	32097.98	23104.92	18941.75	0.76	0.64	6.42	7.78	37.69	41.02
2001	31.43	207.84	89.55	897.49	5.28	32928.52	23771.24	19510.76	0.80	0.70	6.70	8.47	40.55	44.32
2002	30.37	217.39	85.37	866.16	5.23	33010.37	23716.91	19417.76	0.80	0.66	6.76	8.29	39.08	41.80
2003	31.17	228.75	83.37	868.00	5.05	33725.61	24200.40	19770.00	0.83	0.70	6.95	8.62	40.04	42.36
2004	25.66	226.71	77.73	825.04	4.55	33401.68	23744.38	19281.92	0.83	0.65	7.12	8.50	39.08	40.48
2005	25.37	229.95	75.19	791.69	4.17	33535.63	23747.95	19236.67	0.88	0.67	7.16	8.77	40.31	41.82
2006	27.18	218.27	70.12	754.06	3.76	33224.22	23340.23	18763.85	0.90	0.69	7.49	8.31	38.62	39.27
Trend														
1990–2006	*-62.3%*	*20.3%*	*-54.2%*	*-45.6%*	*-12.1%*	*4.4%*	*-2.6%*	*-5.9%*	*-15.1%*	*-55.6%*	*-95.7%*	*-12.3%*	*-62.1%*	*-45.9%*
2005–2006	*7.1%*	*-5.1%*	*-6.8%*	*-4.8%*	*-9.8%*	*-0.9%*	*-1.7%*	*-2.5%*	*1.8%*	*3.5%*	*4.5%*	*-5.2%*	*-4.2%*	*-6.1%*
National Share														
1990	*96.9%*	*94.3%*	*54.1%*	*95.9%*	*6.0%*	*46.4%*	*55.8%*	*79.4%*	*67.1%*	*72.8%*	*84.0%*	*54.7%*	*63.5%*	*79.1%*
2006	*95.5%*	*96.9%*	*40.9%*	*96.0%*	*5.7%*	*44.3%*	*53.7%*	*82.8%*	*79.9%*	*67.6%*	*53.0%*	*95.2%*	*88.4%*	*91.1%*

Table 37: SO_2 emissions and trends from Sector 1 Energy Industries and source categories 1990–2006.

Year	0	1	1 A	1 A 1	1 A 2	1 A 3	1 A 4	1 A 5	1 B	1 B 1	1 B 2
	TOTAL	**ENERGY**	**FUEL COMBUSTION ACTIVITIES**	**Energy Industries**	**Manufactur. Industries & Construction**	**Transport**	**Other Sectors**	**Other**	**FUGITIVE EMISSIONS FROM FUELS**	**Solid fuels**	**Oil and natural gas**
					Gg						
1990	74.33	72.03	70.03	14.04	18.49	4.07	33.41	0.01	2.00	NA	2.00
1991	71.42	69.46	68.16	15.42	17.76	4.77	30.19	0.01	1.30	NA	1.30
1992	55.03	53.32	51.32	8.58	11.19	5.02	26.52	0.01	2.00	NA	2.00
1993	53.38	51.92	49.82	10.06	11.79	5.40	22.55	0.01	2.10	NA	2.10
1994	47.61	46.14	44.86	7.72	11.43	5.54	20.16	0.01	1.28	NA	1.28
1995	46.85	45.43	43.90	8.92	10.76	5.17	19.04	0.01	1.53	NA	1.53
1996	44.61	43.27	42.07	7.80	12.19	2.69	19.38	0.01	1.20	NA	1.20
1997	40.16	38.84	38.78	9.09	13.89	2.26	13.52	0.01	0.07	NA	0.07
1998	35.57	34.33	34.29	7.33	11.84	2.52	12.59	0.01	0.04	NA	0.04
1999	33.79	32.62	32.47	7.24	10.30	2.24	12.68	0.01	0.14	NA	0.14
2000	31.62	30.47	30.33	7.11	9.84	2.24	11.12	0.01	0.15	NA	0.15
2001	32.70	31.43	31.27	7.96	9.56	2.32	11.41	0.01	0.16	NA	0.16
2002	31.64	30.37	30.24	7.69	9.80	2.23	10.51	0.01	0.14	NA	0.14
2003	32.44	31.17	31.02	7.92	10.01	2.26	10.80	0.03	0.15	NA	0.15
2004	26.93	25.66	25.51	7.30	9.11	0.34	8.72	0.03	0.14	NA	0.14
2005	26.65	25.37	25.24	6.80	9.49	0.29	8.62	0.04	0.13	NA	0.13
2006	28.46	27.18	27.01	7.85	10.29	0.28	8.55	0.04	0.17	NA	0.17
Trend											
1990–2006	*-61.7%*	*-62.3%*	*-61.4%*	*-44.1%*	*-44.3%*	*-93.2%*	*-74.4%*	*223%*	*-91.7%*		*-91.7%*
2005–2006	*6.8%*	*7.1%*	*7.0%*	*15.5%*	*8.5%*	*-5.7%*	*-0.8%*	*5%*	*25.6%*		*25.6%*
Share in National Total											
1990		*96.9%*	*94.2%*	*18.9%*	*24.9%*	*5.5%*	*45.0%*	*0%*	*2.7%*		*2.7%*
2006		*95.5%*	*94.9%*	*27.6%*	*36.2%*	*1.0%*	*30.1%*	*0%*	*0.6%*		*0.6%*

Table 38: NO_x emissions and trends from Sector 1 Energy Industries and source categories 1990–2006.

Year	0	1	1 A	1 A 1	1 A 2	1 A 3	1 A 4	1 A 5	1 B	1 B 1	1 B 2
	TOTAL	**ENERGY**	**FUEL COMBUSTION ACTIVITIES**	**Energy Industries**	**Manufactur. Industries & Construction**	**Transport**	**Other Sectors**	**Other**	**FUGITIVE EMISSIONS FROM FUELS**	**Solid fuels**	**Oil and natural gas**
					Gg						
1990	192.41	181.43	181.43	17.78	44.31	82.29	36.96	0.08	IE	NA	IE
1991	202.65	191.77	191.77	17.20	45.41	93.16	35.91	0.09	IE	NA	IE
1992	191.89	181.32	181.32	14.71	41.98	88.98	35.57	0.08	IE	NA	IE
1993	186.24	178.50	178.50	12.10	42.05	89.28	34.98	0.09	IE	NA	IE
1994	180.70	172.61	172.61	11.09	42.29	84.45	34.68	0.09	IE	NA	IE
1995	181.40	173.72	173.72	12.70	40.11	85.85	34.99	0.08	IE	NA	IE
1996	203.81	196.48	196.48	11.04	39.55	107.69	38.11	0.09	IE	NA	IE
1997	193.03	185.57	185.57	11.93	42.21	91.91	39.44	0.09	IE	NA	IE
1998	208.09	200.67	200.67	10.83	40.64	110.65	38.46	0.10	IE	NA	IE
1999	198.89	191.64	191.64	10.89	38.72	102.82	39.12	0.09	IE	NA	IE
2000	205.35	198.16	198.16	11.00	37.57	113.60	35.90	0.10	IE	NA	IE
2001	215.03	207.84	207.84	12.61	36.26	121.04	37.84	0.09	IE	NA	IE
2002	224.58	217.39	217.39	12.87	36.67	130.62	37.15	0.09	IE	NA	IE
2003	235.54	228.75	228.75	14.27	35.78	141.02	37.51	0.16	IE	NA	IE
2004	233.29	226.71	226.71	15.14	34.36	141.23	35.80	0.18	IE	NA	IE
2005	236.97	229.95	229.95	14.53	34.52	145.78	34.92	0.20	IE	NA	IE
2006	225.16	218.27	218.27	15.37	35.37	133.71	33.62	0.21	IE	NA	IE
Trend											
1990–2006	*17.0%*	*20.3%*	*20.3%*	*-13.5%*	*-20.2%*	*62.5%*	*-9.0%*	*154.7%*			
2005–2006	*-5.0%*	*-5.1%*	*-5.1%*	*5.8%*	*2.5%*	*-8.3%*	*-3.7%*	*3.3%*			
Share in National Total											
1990		*94.3%*	*94.3%*	*9.2%*	*23.0%*	*42.8%*	*19.2%*	*0.0%*			
2006		*96.9%*	*96.9%*	*6.8%*	*15.7%*	*59.4%*	*14.9%*	*0.1%*			

Table 39: NMVOC emissions and trends from Sector 1 Energy Industries and source categories 1990–2006.

Year	0	1	1 A	1 A 1	1 A 2	1 A 3	1 A 4	1 A 5	1 B	1 B 1	1 B 2
	TOTAL	**ENERGY**	**FUEL COMBUSTION ACTIVITIES**	**Energy Industries**	**Manufactur. Industries & Construction**	**Transport**	**Other Sectors**	**Other**	**FUGITIVE EMISSIONS FROM FUELS**	**Solid fuels**	**Oil and natural gas**
					Gg						
1990	283.18	153.12	140.91	0.42	4.09	69.28	67.11	0.02	12.22	NA	12.22
1991	275.20	160.54	147.38	0.49	4.23	72.58	70.05	0.02	13.16	NA	13.16
1992	250.43	152.39	139.26	0.41	4.20	70.05	64.59	0.02	13.12	NA	13.12
1993	249.27	149.88	137.03	0.42	4.07	67.94	64.58	0.02	12.86	NA	12.86
1994	231.16	138.58	128.32	0.39	3.98	63.42	60.51	0.02	10.26	NA	10.26
1995	229.35	133.70	124.88	0.39	3.86	58.67	61.95	0.01	8.83	NA	8.83
1996	221.54	131.19	123.28	0.42	3.73	53.68	65.44	0.02	7.90	NA	7.90
1997	206.62	112.62	105.26	0.41	3.74	47.61	53.48	0.02	7.37	NA	7.37
1998	191.80	106.59	100.74	0.43	3.55	45.38	51.36	0.02	5.85	NA	5.85
1999	178.44	100.46	95.32	0.38	3.30	39.74	51.89	0.02	5.13	NA	5.13
2000	177.11	92.52	87.36	0.38	3.15	35.96	47.86	0.02	5.16	NA	5.16
2001	188.25	89.55	86.23	0.50	3.10	33.26	49.35	0.02	3.31	NA	3.31
2002	188.79	85.37	81.89	0.48	2.99	31.70	46.71	0.02	3.47	NA	3.47
2003	183.01	83.37	79.93	0.55	3.00	29.85	46.50	0.03	3.44	NA	3.44
2004	176.02	77.73	74.46	0.54	3.02	27.24	43.62	0.04	3.27	NA	3.27
2005	163.65	75.19	72.10	0.51	3.06	25.04	43.44	0.04	3.09	NA	3.09
2006	171.63	70.12	66.99	0.71	3.06	22.32	40.86	0.05	3.12	NA	3.12
Trend											
1990–2006	*-39.4%*	*-54.2%*	*-52.5%*	*68.1%*	*-25.1%*	*-67.8%*	*-39.1%*	*183.1%*	*-74.4%*		*-74.4%*
2005–2006	*4.9%*	*-6.8%*	*-7.1%*	*37.9%*	*0.1%*	*-10.9%*	*-5.9%*	*3.9%*	*0.9%*		*0.9%*
Share in National Total											
1990		*54.1%*	*49.8%*	*0.1%*	*1.4%*	*24.5%*	*23.7%*	*0.0%*	*4.3%*		*4.3%*
2006		*40.9%*	*39.0%*	*0.4%*	*1.8%*	*13.0%*	*23.8%*	*0.0%*	*1.8%*		*1.8%*

Table 40: NH_3 emissions and trends from Sector 1 Energy Industries and source categories 1990–2006.

Year	0	1	1 A	1 A 1	1 A 2	1 A 3	1 A 4	1 A 5	1 B	1 B 1	1 B 2
	TOTAL	**ENERGY**	**FUEL COMBUSTION ACTIVITIES**	**Energy Industries**	**Manufactur. Industries & Construction**	**Transport**	**Other Sectors**	**Other**	**FUGITIVE EMISSIONS FROM FUELS**	**Solid fuels**	**Oil and natural gas**
					Gg						
1990	71.05	4.28	4.28	0.20	0.22	3.22	0.63	0.00	IE	NA	IE
1991	73.62	5.85	5.85	0.21	0.24	4.70	0.69	0.00	IE	NA	IE
1992	72.06	6.67	6.67	0.21	0.22	5.58	0.66	0.00	IE	NA	IE
1993	72.80	7.45	7.45	0.24	0.25	6.29	0.67	0.00	IE	NA	IE
1994	73.99	7.66	7.66	0.24	0.26	6.53	0.62	0.00	IE	NA	IE
1995	75.35	7.49	7.49	0.23	0.25	6.33	0.68	0.00	IE	NA	IE
1996	73.11	7.01	7.01	0.26	0.25	5.76	0.75	0.00	IE	NA	IE
1997	72.87	6.52	6.52	0.26	0.28	5.28	0.70	0.00	IE	NA	IE
1998	72.98	6.55	6.55	0.28	0.25	5.33	0.69	0.00	IE	NA	IE
1999	71.13	5.92	5.92	0.25	0.29	4.66	0.72	0.00	IE	NA	IE
2000	69.14	5.42	5.42	0.23	0.26	4.27	0.66	0.00	IE	NA	IE
2001	68.77	5.28	5.28	0.25	0.27	4.03	0.72	0.00	IE	NA	IE
2002	67.62	5.23	5.23	0.26	0.25	4.01	0.70	0.00	IE	NA	IE
2003	67.27	5.05	5.05	0.28	0.26	3.75	0.76	0.00	IE	NA	IE
2004	66.46	4.55	4.55	0.31	0.25	3.29	0.70	0.00	IE	NA	IE
2005	65.95	4.17	4.17	0.33	0.26	2.84	0.73	0.00	IE	NA	IE
2006	65.81	3.76	3.76	0.37	0.29	2.39	0.71	0.00	IE	NA	IE
Trend											
1990–2006	*-7.4%*	*-12.1%*	*-12.1%*	*82.7%*	*27.4%*	*-25.7%*	*12.4%*	*227.5%*			
2005–2006	*-0.2%*	*-9.8%*	*-9.8%*	*12.5%*	*9.1%*	*-16.0%*	*-2.7%*	*4.6%*			
Share in National Total											
1990		*6.0%*	*6.0%*	*0.3%*	*0.3%*	*4.5%*	*0.9%*	*0.0%*			
2006		*5.7%*	*5.7%*	*0.6%*	*0.4%*	*3.6%*	*1.1%*	*0.0%*			

Table 41: CO emissions and trends from Sector 1 Energy Industries and source categories 1990–2006.

Year	0	1	1 A	1 A 1	1 A 2	1 A 3	1 A 4	1 A 5	1 B	1 B 1	1 B 2
	TOTAL	ENERGY	FUEL COMBUSTION ACTIVITIES	Energy Industries	Manufactur. Industries & Construction	Transport	Other Sectors	Other	FUGITIVE EMISSIONS FROM FUELS	Solid fuels	Oil and natural gas
					Gg						
1990	1444.11	1385.17	1385.17	6.10	235.59	649.01	494.26	0.21	IE	NA	IE
1991	1513.92	1459.72	1459.72	2.54	211.66	711.19	534.09	0.22	IE	NA	IE
1992	1481.31	1424.19	1424.19	1.88	252.95	679.09	490.07	0.20	IE	NA	IE
1993	1448.57	1389.45	1389.45	1.52	262.45	657.10	468.13	0.24	IE	NA	IE
1994	1379.37	1319.28	1319.28	1.72	275.01	610.22	432.09	0.25	IE	NA	IE
1995	1267.33	1211.36	1211.36	2.37	203.44	562.36	442.99	0.19	IE	NA	IE
1996	1246.13	1196.34	1196.34	2.27	227.98	502.47	463.40	0.23	IE	NA	IE
1997	1154.95	1106.65	1106.65	2.47	232.32	452.21	419.43	0.22	IE	NA	IE
1998	1109.26	1064.77	1064.77	1.91	217.43	444.08	401.10	0.25	IE	NA	IE
1999	1034.38	994.48	994.48	2.51	196.38	391.87	403.47	0.25	IE	NA	IE
2000	959.09	922.83	922.83	2.66	183.20	361.16	375.54	0.27	IE	NA	IE
2001	930.36	897.49	897.49	2.95	159.69	342.22	392.37	0.26	IE	NA	IE
2002	898.57	866.16	866.16	3.35	152.33	341.00	369.23	0.25	IE	NA	IE
2003	900.10	868.00	868.00	3.94	166.19	327.99	369.34	0.53	IE	NA	IE
2004	857.50	825.04	825.04	3.74	172.21	301.21	347.24	0.64	IE	NA	IE
2005	823.41	791.69	791.69	3.43	156.90	274.38	356.26	0.72	IE	NA	IE
2006	785.35	754.06	754.06	4.67	168.71	241.93	338.00	0.75	IE	NA	IE
Trend											
1990–2006	*-45.6%*	*-45.6%*	*-45.6%*	*-23.4%*	*-28.4%*	*-62.7%*	*-31.6%*	*257.9%*			
2005–2006	*-4.6%*	*-4.8%*	*-4.8%*	*36.3%*	*7.5%*	*-11.8%*	*-5.1%*	*4.5%*			
Share in National Total											
1990		*95.9%*	*95.9%*	*0.4%*	*16.3%*	*44.9%*	*34.2%*	*0.0%*			
2006		*96.0%*	*96.0%*	*0.6%*	*21.5%*	*30.8%*	*43.0%*	*0.1%*			

Table 42: Cd emissions and trends from Sector 1 Energy Industries and source categories 1990–2006.

Year	**0**	**1**	**1 A**	**1 A 1**	**1 A 2**	**1 A 3**	**1 A 4**	**1 A 5**	**1 B**	**1 B 1**	**1 B 2**
	TOTAL	**ENERGY**	**FUEL COMBUSTION ACTIVITIES**	**Energy Industries**	**Manufactur. Industries & Construction**	**Transport**	**Other Sectors**	**Other**	**FUGITIVE EMISSIONS FROM FUELS**	**Solid fuels**	**Oil and natural gas**
					Mg						
1990	1.58	1.06	1.06	0.20	0.38	0.06	0.42	0.00	NA	NA	IE
1991	1.53	1.09	1.09	0.22	0.37	0.06	0.45	0.00	NA	NA	IE
1992	1.25	0.97	0.97	0.18	0.32	0.07	0.41	0.00	NA	NA	IE
1993	1.16	0.94	0.94	0.20	0.30	0.07	0.38	0.00	NA	NA	IE
1994	1.06	0.88	0.88	0.19	0.28	0.07	0.34	0.00	NA	NA	IE
1995	0.97	0.81	0.81	0.17	0.22	0.07	0.35	0.00	NA	NA	IE
1996	0.99	0.84	0.84	0.19	0.20	0.07	0.37	0.00	NA	NA	IE
1997	0.97	0.80	0.80	0.20	0.19	0.07	0.34	0.00	NA	NA	IE
1998	0.90	0.74	0.74	0.19	0.15	0.08	0.32	0.00	NA	NA	IE
1999	0.98	0.80	0.80	0.21	0.18	0.08	0.34	0.00	NA	NA	IE
2000	0.95	0.76	0.76	0.20	0.16	0.08	0.32	0.00	NA	NA	IE
2001	0.98	0.80	0.80	0.22	0.15	0.08	0.33	0.00	NA	NA	IE
2002	1.00	0.80	0.80	0.25	0.15	0.08	0.32	0.00	NA	NA	IE
2003	1.03	0.83	0.83	0.25	0.16	0.09	0.33	0.00	NA	NA	IE
2004	1.03	0.83	0.83	0.25	0.16	0.09	0.33	0.00	NA	NA	IE
2005	1.10	0.88	0.88	0.27	0.18	0.09	0.34	0.00	NA	NA	IE
2006	1.12	0.90	0.90	0.28	0.20	0.09	0.33	0.00	NA	NA	IE
Trend											
1990–2006	*-28.7%*	*-15.1%*	*-15.1%*	*40.2%*	*-48.7%*	*52.7%*	*-20.2%*	*256.5%*			
2005–2006	*1.8%*	*1.8%*	*1.8%*	*2.2%*	*11.0%*	*0.6%*	*-2.9%*	*4.5%*			
Share in National Total											
1990		*67.1%*	*67.1%*	*12.5%*	*24.2%*	*3.8%*	*26.6%*	*0.0%*			
2006		*79.9%*	*79.9%*	*24.6%*	*17.4%*	*8.2%*	*29.8%*	*0.0%*			

Table 43: Hg emissions and trends from Sector 1 Energy Industries and source categories 1990–2006.

Year	0	1	1 A	1 A 1	1 A 2	1 A 3	1 A 4	1 A 5	1 B	1 B 1	1 B 2
	TOTAL	**ENERGY**	**FUEL COMBUSTION ACTIVITIES**	**Energy Industries**	**Manufactur. Industries & Construction**	**Transport**	**Other Sectors**	**Other**	**FUGITIVE EMISSIONS FROM FUELS**	**Solid fuels**	**Oil and natural gas**
					Mg						
1990	2.14	1.56	1.56	0.33	0.80	0.00	0.43	0.00	NA	NA	IE
1991	2.04	1.50	1.50	0.35	0.68	0.00	0.47	0.00	NA	NA	IE
1992	1.64	1.18	1.18	0.23	0.53	0.00	0.42	0.00	NA	NA	IE
1993	1.39	0.96	0.96	0.20	0.39	0.00	0.37	0.00	NA	NA	IE
1994	1.18	0.76	0.76	0.18	0.24	0.00	0.33	0.00	NA	NA	IE
1995	1.20	0.71	0.71	0.20	0.19	0.00	0.33	0.00	NA	NA	IE
1996	1.16	0.71	0.71	0.19	0.18	0.00	0.33	0.00	NA	NA	IE
1997	1.13	0.68	0.68	0.20	0.20	0.00	0.29	0.00	NA	NA	IE
1998	0.95	0.60	0.60	0.16	0.18	0.00	0.26	0.00	NA	NA	IE
1999	0.94	0.65	0.65	0.18	0.20	0.00	0.26	0.00	NA	NA	IE
2000	0.89	0.64	0.64	0.20	0.20	0.00	0.24	0.00	NA	NA	IE
2001	0.95	0.70	0.70	0.22	0.23	0.00	0.25	0.00	NA	NA	IE
2002	0.94	0.66	0.66	0.21	0.23	0.00	0.22	0.00	NA	NA	IE
2003	0.98	0.70	0.70	0.23	0.25	0.00	0.22	0.00	NA	NA	IE
2004	0.94	0.65	0.65	0.22	0.23	0.00	0.20	0.00	NA	NA	IE
2005	1.00	0.67	0.67	0.21	0.24	0.00	0.21	0.00	NA	NA	IE
2006	1.02	0.69	0.69	0.21	0.27	0.00	0.21	0.00	NA	NA	IE
Trend											
1990–2006	*-52.1%*	*-55.6%*	*-55.6%*	*-36.2%*	*-66.3%*	*30.2%*	*-51.2%*	*256.5%*			
2005–2006	*2.9%*	*3.5%*	*3.5%*	*2.3%*	*9.8%*	*-1.7%*	*-2.6%*	*4.5%*			
Share in National Total											
1990		*72.8%*	*72.8%*	*15.6%*	*37.2%*	*0.1%*	*19.9%*	*0.0%*			
2006		*67.6%*	*67.6%*	*20.9%*	*26.2%*	*0.2%*	*20.3%*	*0.0%*			

Table 44: Pb emissions and trends from Sector 1 Energy Industries and source categories 1990–2006.

Year	0	1	1 A	1 A 1	1 A 2	1 A 3	1 A 4	1 A 5	1 B	1 B 1	1 B 2
	TOTAL	ENERGY	FUEL COMBUSTION ACTIVITIES	Energy Industries	Manufactur. Industries & Construction	Transport	Other Sectors	Other	FUGITIVE EMISSIONS FROM FUELS	Solid fuels	Oil and natural gas
					Mg						
1990	207.35	174.17	174.17	1.10	9.71	155.58	7.77	0.00	NA	NA	IE
1991	171.75	143.81	143.81	1.17	9.63	125.55	7.46	0.00	NA	NA	IE
1992	119.83	100.67	100.67	0.97	8.00	85.28	6.42	0.00	NA	NA	IE
1993	86.20	70.61	70.61	0.85	7.38	56.99	5.39	0.00	NA	NA	IE
1994	59.66	47.31	47.31	0.79	7.07	35.00	4.45	0.00	NA	NA	IE
1995	16.07	11.33	11.33	0.75	7.12	0.02	3.45	0.00	NA	NA	IE
1996	15.50	11.18	11.18	0.91	6.67	0.02	3.58	0.00	NA	NA	IE
1997	14.49	9.64	9.64	0.97	5.53	0.01	3.13	0.00	NA	NA	IE
1998	12.99	8.23	8.23	0.89	4.43	0.01	2.89	0.00	NA	NA	IE
1999	12.50	7.53	7.53	0.86	3.70	0.01	2.96	0.00	NA	NA	IE
2000	11.96	6.42	6.42	1.05	2.62	0.01	2.74	0.00	NA	NA	IE
2001	12.10	6.70	6.70	1.17	2.69	0.01	2.82	0.00	NA	NA	IE
2002	12.46	6.76	6.76	1.39	2.68	0.01	2.67	0.00	NA	NA	IE
2003	12.68	6.95	6.95	1.53	2.70	0.02	2.70	0.00	NA	NA	IE
2004	13.07	7.12	7.12	1.66	2.86	0.02	2.58	0.00	NA	NA	IE
2005	13.71	7.16	7.16	1.51	2.92	0.02	2.72	0.00	NA	NA	IE
2006	14.12	7.49	7.49	1.74	3.09	0.02	2.64	0.00	NA	NA	IE
Trend											
1990–2006	*-93.2%*	*-95.7%*	*-95.7%*	*57.8%*	*-68.2%*	*-100.0%*	*-66.0%*	*256.5%*			
2005–2006	*3.0%*	*4.5%*	*4.5%*	*15.4%*	*6.0%*	*-2.1%*	*-3.0%*	*4.5%*			
Share in National Total											
1990		*84.0%*	*84.0%*	*0.5%*	*4.7%*	*75.0%*	*3.7%*	*0.0%*			
2006		*53.0%*	*53.0%*	*12.3%*	*21.9%*	*0.1%*	*18.7%*	*0.0%*			

Table 45: PAH emissions and trends from Sector 1 Energy Industries and source categories 1990–2006.

Year	0	1	1 A	1 A 1	1 A 2	1 A 3	1 A 4	1 A 5	1 B	1 B 1	1 B 2
	TOTAL	**ENERGY**	**FUEL COMBUSTION ACTIVITIES**	**Energy Industries**	**Manufactur. Industries & Construction**	**Transport**	**Other Sectors**	**Other**	**FUGITIVE EMISSIONS FROM FUELS**	**Solid fuels**	**Oil and natural gas**
					Mg						
1990	17.30	9.47	9.47	0.01	0.13	0.78	8.55	0.00	NA	NA	IE
1991	17.89	10.32	10.32	0.01	0.14	0.84	9.33	0.00	NA	NA	IE
1992	13.33	9.40	9.40	0.01	0.14	0.81	8.44	0.00	NA	NA	IE
1993	10.12	9.28	9.28	0.01	0.13	0.81	8.33	0.00	NA	NA	IE
1994	9.28	8.40	8.40	0.01	0.13	0.80	7.46	0.00	NA	NA	IE
1995	9.62	8.85	8.85	0.01	0.13	0.82	7.89	0.00	NA	NA	IE
1996	10.72	9.57	9.57	0.01	0.13	0.98	8.45	0.00	NA	NA	IE
1997	9.29	8.58	8.58	0.01	0.13	0.89	7.55	0.00	NA	NA	IE
1998	8.94	8.30	8.30	0.01	0.13	1.04	7.12	0.00	NA	NA	IE
1999	8.80	8.32	8.32	0.01	0.16	1.00	7.14	0.00	NA	NA	IE
2000	8.21	7.78	7.78	0.01	0.16	1.10	6.51	0.00	NA	NA	IE
2001	8.89	8.47	8.47	0.01	0.16	1.20	7.11	0.00	NA	NA	IE
2002	8.71	8.29	8.29	0.01	0.16	1.33	6.79	0.00	NA	NA	IE
2003	9.04	8.62	8.62	0.01	0.16	1.47	6.98	0.00	NA	NA	IE
2004	8.99	8.50	8.50	0.01	0.17	1.52	6.79	0.00	NA	NA	IE
2005	9.19	8.77	8.77	0.01	0.17	1.61	6.97	0.00	NA	NA	IE
2006	8.73	8.31	8.31	0.02	0.19	1.59	6.52	0.00	NA	NA	IE
Trend											
1990–2006	*-49.6%*	*-12.3%*	*-12.3%*	*196.3%*	*43.5%*	*102.5%*	*-23.8%*	*-7.6%*			
2005–2006	*-5.0%*	*-5.2%*	*-5.2%*	*13.2%*	*10.9%*	*-1.5%*	*-6.5%*	*-0.5%*			
Share in National Total											
1990		*54.7%*	*54.7%*	*0.0%*	*0.8%*	*4.5%*	*49.4%*	*0.0%*			
2006		*95.2%*	*95.2%*	*0.2%*	*2.1%*	*18.2%*	*74.7%*	*0.0%*			

Table 46: Dioxin emissions and trends from Sector 1 Energy Industries and source categories 1990–2006.

Year	0	1	1 A	1 A 1	1 A 2	1 A 3	1 A 4	1 A 5	1 B	1 B 1	1 B 2
	TOTAL	**ENERGY**	**FUEL COMBUSTION ACTIVITIES**	**Energy Industries**	**Manufactur. Industries & Construction**	**Transport**	**Other Sectors**	**Other**	**FUGITIVE EMISSIONS FROM FUELS**	**Solid fuels**	**Oil and natural gas**
					g						
1990	160.27	101.84	101.84	0.82	52.03	3.55	45.44	0.00	NA	NA	IE
1991	134.99	80.87	80.87	0.85	26.78	3.46	49.77	0.00	NA	NA	IE
1992	76.47	53.86	53.86	1.04	4.56	2.94	45.31	0.00	NA	NA	IE
1993	66.77	49.34	49.34	0.27	3.82	2.58	42.67	0.00	NA	NA	IE
1994	56.06	44.54	44.54	0.29	3.91	2.24	38.11	0.00	NA	NA	IE
1995	58.27	45.79	45.79	0.33	3.86	1.96	39.64	0.00	NA	NA	IE
1996	59.64	48.22	48.22	0.37	4.13	1.82	41.90	0.00	NA	NA	IE
1997	59.33	46.92	46.92	0.39	8.05	1.53	36.95	0.00	NA	NA	IE
1998	56.15	44.45	44.45	0.40	7.97	1.51	34.56	0.00	NA	NA	IE
1999	53.59	40.74	40.74	0.44	4.36	1.30	34.64	0.00	NA	NA	IE
2000	51.99	37.69	37.69	0.51	4.19	1.25	31.74	0.00	NA	NA	IE
2001	54.35	40.55	40.55	0.51	4.56	1.22	34.25	0.00	NA	NA	IE
2002	42.57	39.08	39.08	0.64	4.63	1.24	32.57	0.00	NA	NA	IE
2003	43.31	40.04	40.04	0.68	4.68	1.27	33.41	0.00	NA	NA	IE
2004	42.75	39.08	39.08	0.71	4.83	1.23	32.31	0.00	NA	NA	IE
2005	44.65	40.31	40.31	0.74	4.75	1.24	33.58	0.00	NA	NA	IE
2006	43.69	38.62	38.62	0.81	5.18	1.16	31.47	0.00	NA	NA	IE
Trend											
1990–2006	*-72.7%*	*-62.1%*	*-62.1%*	*-1.1%*	*-90.0%*	*-67.5%*	*-30.7%*	*-7.6%*			
2005–2006	*-2.1%*	*-4.2%*	*-4.2%*	*9.7%*	*9.1%*	*-6.9%*	*-6.3%*	*-0.5%*			
Share in National Total											
1990		*63.5%*	*63.5%*	*0.5%*	*32.5%*	*2.2%*	*28.4%*	*0.0%*			
2006		*88.4%*	*88.4%*	*1.9%*	*11.9%*	*2.6%*	*72.0%*	*0.0%*			

Table 47: HCB emissions and trends from Sector 1 Energy Industries and source categories 1990–2006.

Year	0	1	1 A	1 A 1	1 A 2	1 A 3	1 A 4	1 A 5	1 B	1 B 1	1 B 2
	TOTAL	ENERGY	FUEL COMBUSTION ACTIVITIES	Energy Industries	Manufactur. Industries & Construction	Transport	Other Sectors	Other	FUGITIVE EMISSIONS FROM FUELS	Solid fuels	Oil and natural gas
					kg						
1990	91.77	72.57	72.57	0.21	17.45	0.71	54.21	0.00	NA	NA	IE
1991	84.44	69.71	69.71	0.23	9.00	0.69	59.78	0.00	NA	NA	IE
1992	69.51	56.94	56.94	0.25	1.61	0.59	54.50	0.00	NA	NA	IE
1993	63.84	53.58	53.58	0.18	1.28	0.52	51.61	0.00	NA	NA	IE
1994	51.79	48.04	48.04	0.19	1.30	0.45	46.09	0.00	NA	NA	IE
1995	52.93	50.20	50.20	0.20	1.29	0.39	48.31	0.00	NA	NA	IE
1996	55.64	53.15	53.15	0.21	1.33	0.36	51.24	0.00	NA	NA	IE
1997	51.78	49.07	49.07	0.22	3.28	0.31	45.26	0.00	NA	NA	IE
1998	49.01	46.45	46.45	0.21	3.27	0.30	42.67	0.00	NA	NA	IE
1999	47.56	44.75	44.75	0.26	1.20	0.26	43.03	0.00	NA	NA	IE
2000	44.15	41.02	41.02	0.26	1.17	0.25	39.34	0.00	NA	NA	IE
2001	47.35	44.32	44.32	0.25	1.40	0.24	42.42	0.00	NA	NA	IE
2002	45.02	41.80	41.80	0.28	1.41	0.25	39.86	0.00	NA	NA	IE
2003	45.60	42.36	42.36	0.28	1.42	0.25	40.41	0.00	NA	NA	IE
2004	43.86	40.48	40.48	0.33	1.44	0.25	38.46	0.00	NA	NA	IE
2005	45.58	41.82	41.82	0.33	1.43	0.25	39.82	0.00	NA	NA	IE
2006	43.10	39.27	39.27	0.35	1.50	0.23	37.20	0.00	NA	NA	IE
Trend											
1990–2006	*-53.0%*	*-45.9%*	*-45.9%*	*68.0%*	*-91.4%*	*-67.5%*	*-31.4%*	*-7.6%*			
2005–2006	*-5.5%*	*-6.1%*	*-6.1%*	*4.6%*	*4.8%*	*-6.9%*	*-6.6%*	*-0.5%*			
Share in National Total											
1990		*79.1%*	*79.1%*	*0.2%*	*19.0%*	*0.8%*	*59.1%*	*0.0%*			
2006		*91.1%*	*91.1%*	*0.8%*	*3.5%*	*0.5%*	*86.3%*	*0.0%*			

Table 48: TSP emissions and trends from Sector 1 Energy Industries and source categories 1990–2006.

Year	0	1	1 A	1 A 1	1 A 2	1 A 3	1 A 4	1 A 5	1 B	1 B 1	1 B 2
	TOTAL	**ENERGY**	**FUEL COMBUSTION ACTIVITIES**	**Energy Industries**	**Manufactur. Industries & Construction**	**Transport**	**Other Sectors**	**Other**	**FUGITIVE EMISSIONS FROM FUELS**	**Solid fuels**	**Oil and natural gas**
					Mg						
1990	68586.59	31811.93	31164.90	1053.64	4341.64	10981.47	14771.80	16.35	647.03	647.03	IE
1991	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
1992	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
1993	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
1994	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
1995	71568.09	32200.20	31655.16	901.96	3697.12	13442.04	13598.75	15.30	545.04	545.04	IE
1996	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
1997	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
1998	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
1999	70239.98	32714.34	32214.70	702.48	3725.74	14646.09	13122.59	17.79	499.64	499.64	IE
2000	74054.61	32097.98	31539.83	713.18	3600.58	15015.72	12191.61	18.74	558.15	558.15	IE
2001	73946.03	32928.52	32343.35	859.14	3351.13	15289.02	12826.13	17.92	585.17	585.17	IE
2002	73626.21	33010.37	32411.64	877.65	3325.15	15734.74	12456.87	17.24	598.73	598.73	IE
2003	73874.86	33725.61	33083.57	1051.60	3184.42	16203.92	12610.35	33.27	642.04	642.04	IE
2004	74355.32	33401.68	32796.86	1166.55	3114.24	16334.17	12142.91	38.99	604.82	604.82	IE
2005	73195.56	33535.63	32923.65	1069.27	3038.12	16512.64	12260.17	43.46	611.97	611.97	IE
2006	75000.51	33224.22	32635.35	1317.33	3198.97	16163.74	11910.17	45.14	588.88	588.88	IE
Trend											
1990–2006	*9.4%*	*4.4%*	*4.7%*	*25.0%*	*-26.3%*	*47.2%*	*-19.4%*	*176.1%*	*-9.0%*	*-9.0%*	
2005–2006	*2.5%*	*-0.9%*	*-0.9%*	*23.2%*	*5.3%*	*-2.1%*	*-2.9%*	*3.9%*	*-3.8%*	*-3.8%*	
Share in National Total											
1990		*46.4%*	*45.4%*	*1.5%*	*6.3%*	*16.0%*	*21.5%*	*0.0%*	*0.9%*	*0.9%*	
2006		*44.3%*	*43.5%*	*1.8%*	*4.3%*	*21.6%*	*15.9%*	*0.1%*	*0.8%*	*0.8%*	

Table 49: PM10 emissions and trends from Sector 1 Energy Industries and source categories 1990–2006.

Year	0	1	1 A	1 A 1	1 A 2	1 A 3	1 A 4	1 A 5	1 B	1 B 1	1 B 2
	TOTAL	**ENERGY**	**FUEL COMBUSTION ACTIVITIES**	**Energy Industries**	**Manufactur. Industries & Construction**	**Transport**	**Other Sectors**	**Other**	**FUGITIVE EMISSIONS FROM FUELS**	**Solid fuels**	**Oil and natural gas**
					Mg						
1990	42962.93	23962.50	23657.79	997.35	3790.55	5364.41	13489.88	15.60	304.71	304.71	IE
1991	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
1992	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
1993	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
1994	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
1995	43429.77	23717.21	23460.30	841.22	3198.95	6981.37	12424.22	14.55	256.91	256.91	IE
1996	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
1997	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
1998	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
1999	42580.91	23798.23	23562.70	660.21	3188.42	7698.70	11998.32	17.05	235.54	235.54	IE
2000	43918.28	23104.92	22841.63	666.21	3061.08	7945.84	11150.49	18.01	263.30	263.30	IE
2001	44135.61	23771.24	23495.32	801.33	2823.74	8131.16	11721.90	17.19	275.91	275.91	IE
2002	43538.95	23716.91	23434.51	819.37	2791.97	8434.76	11371.88	16.52	282.40	282.40	IE
2003	43796.85	24200.40	23897.60	985.86	2650.37	8751.33	11477.47	32.56	302.80	302.80	IE
2004	43689.52	23744.38	23458.94	1082.91	2557.32	8727.88	11052.55	38.28	285.44	285.44	IE
2005	43041.57	23747.95	23459.14	993.20	2476.75	8792.48	11153.95	42.76	288.82	288.82	IE
2006	43450.49	23340.23	23062.06	1218.71	2609.64	8361.63	10827.64	44.45	278.17	278.17	IE
Trend											
1990–2006	*1.1%*	*-2.6%*	*-2.5%*	*22.2%*	*-31.2%*	*55.9%*	*-19.7%*	*185%*	*-8.7%*	*-8.7%*	
2005–2006	*1.0%*	*-1.7%*	*-1.7%*	*22.7%*	*5.4%*	*-4.9%*	*-2.9%*	*4%*	*-3.7%*	*-3.7%*	
Share in National Total											
1990		*55.8%*	*55.1%*	*2.3%*	*8.8%*	*12.5%*	*31.4%*	*0%*	*0.7%*	*0.7%*	
2006		*53.7%*	*53.1%*	*2.8%*	*6.0%*	*19.2%*	*24.9%*	*0%*	*0.6%*	*0.6%*	

Table 50: PM2.5 emissions and trends from Sector 1 Energy Industries and source categories 1990–2006.

Year	0	1	1 A	1 A 1	1 A 2	1 A 3	1 A 4	1 A 5	1 B	1 B 1	1 B 2
	TOTAL	ENERGY	FUEL COMBUSTION ACTIVITIES	Energy Industries	Manufactur. Industries & Construction	Transport	Other Sectors	Other	FUGITIVE EMISSIONS FROM FUELS	Solid fuels	Oil and natural gas
					Mg						
1990	25122.04	19941.51	19846.55	850.22	3290.81	3398.21	12292.16	15.14	94.96	94.96	IE
1991	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
1992	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
1993	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
1994	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
1995	24354.01	19661.80	19581.53	723.91	2792.63	4719.90	11331.00	14.09	80.27	80.27	IE
1996	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
1997	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
1998	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
1999	23863.53	19617.63	19544.01	567.45	2729.27	5266.66	10964.02	16.61	73.61	73.61	IE
2000	23527.67	18941.75	18859.29	571.85	2604.64	5470.83	10194.41	17.57	82.46	82.46	IE
2001	24030.04	19510.76	19424.45	687.71	2389.13	5625.44	10705.43	16.75	86.30	86.30	IE
2002	23539.85	19417.76	19329.36	700.70	2350.98	5879.49	10382.10	16.09	88.41	88.41	IE
2003	23865.28	19770.00	19675.21	839.21	2210.94	6142.54	10450.39	32.13	94.79	94.79	IE
2004	23387.24	19281.92	19192.40	920.65	2101.31	6065.22	10067.36	37.86	89.53	89.53	IE
2005	23226.93	19236.67	19146.09	846.98	2021.48	6089.86	10145.44	42.34	90.58	90.58	IE
2006	22666.55	18763.85	18676.37	1036.70	2121.56	5630.42	9843.67	44.03	87.48	87.48	IE
Trend											
1990–2006	*-9.8%*	*-5.9%*	*-5.9%*	*21.9%*	*-35.5%*	*65.7%*	*-19.9%*	*190.7%*	*-7.9%*	*-7.9%*	
2005–2006	*-2.4%*	*-2.5%*	*-2.5%*	*22.4%*	*5.0%*	*-7.5%*	*-3.0%*	*4.0%*	*-3.4%*	*-3.4%*	
Share in National Total											
1990		*79.4%*	*79.0%*	*3.4%*	*13.1%*	*13.5%*	*48.9%*	*0.1%*	*0.4%*	*0.4%*	
2006		*82.8%*	*82.4%*	*4.6%*	*9.4%*	*24.8%*	*43.4%*	*0.2%*	*0.4%*	*0.4%*	

4.2 NFR 1 A Stationary Fuel Combustion Activities

Key source: NO_x, SO_2, NMVOC, CO, Cd, Pb, Hg, PAH, DIOX, HCB, TSP, PM10, PM2.5

4.2.1 Gerneral discription

This chapter gives an overview of category *1 A Stationary Fuel Combustion Activities*. It includes information on completeness, methodologies, activity data, emission factors, QA/QC and planned improvements.

Information is also provided in the Austrian National Inventory Report 2008 (UMWELTBUNDESAMT 2008a) which is part of the submission under the UNFCCC.

- Additionally to information provided in this document, Annex 2 of (UMWELTBUNDESAMT 2008a) includes further information on the underlying activity data used for emissions estimation. It describes the national energy balance (fuels and fuel categories, net calorific values) and the methodology of how activity data are extracted from the energy balance (correspondence of energy balance to SNAP and IPCC categories).
- National energy balance data are presented in Annex 4 of (UMWELTBUNDESAMT 2008a).

Completeness

Table 51 provides information on the status of emission estimates of all sub categories. A "✓" indicates that emissions from this sub category have been estimated.

Table 51: Completeness of "1 A Stationary Fuel Combustion Activities".

NFR Category	NO_x	CO	NMVOC	SO_x	NH_3	TSP	PM10	PM2.5	Pb	Cd	Hg	DIOX	PAH	HCB
1 A 1 a Public Electricity and Heat Production	✓	✓	✓	✓	✓ NE(3)	✓	✓	✓	✓	✓	✓	✓	✓	✓
1 A 1 b Petroleum refining	✓	✓	IE(1)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
1 A 1 c Manufacture of Solid fuels and Other Energy Industries	✓ IE(4)	✓ IE(4)	✓ IE(4)	✓ IE(4)	✓ IE(4)	✓ IE(4)	✓ IE(4)	✓ IE(4)	✓ IE(4)	✓ IE(4)	✓ IE(4)	✓ IE(4)	✓ IE(4)	✓ IE(4)
1 A 2 a Iron and Steel	✓	✓	✓	✓	✓	✓ IE(5)	✓ IE(5)	✓ IE(5)	✓ IE(5)	✓ IE(5)	✓ IE(5)	✓ IE(5)	✓ IE(5)	✓ IE(5)
1 A 2 b Non-ferrous Metals	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
1 A 2 c Chemicals	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
1 A 2 d Pulp, Paper and Print	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
1 A 2 e Food Processing, Beverages and Tobacco	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
1 A 2 f Other	✓	✓	✓	✓	✓	✓ (8)	✓ (8)	✓ (8)	✓	✓	✓	✓	✓	✓
1 A 3 e i Pipeline compressors	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	NE (6)	NA (7)	✓

NFR Category	NO_x	CO	NMVOC	SO_x	NH_3	TSP	PM10	PM2.5	Pb	Cd	Hg	DIOX	PAH	HCB
1 A 4 a Commercial/Institutional	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
1 A 4 b i Residential plants	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
1 A 4 c i Agriculture/ Forestry/Fishing, Stationary	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
1 A 5 a Other, Stationary (including Military)	IE(2)	IE(2)	IE(2)	IE(2)	IE(2)	IE(2)	IE(2)	IE(2)	IE(2)	IE(2)	IE(2)	IE(2)	IE(2)	IE(2)

(1) *NMVOC emissions from Petroleum Refining are included in 1 B.*

(2) *Emissions from military facilities are included in 1 A 4 a.*

(3) *NH_3 slip emissions from NO_x control are not estimated.*

(4) *Emissions from coke ovens are included in 1 A 2 a or 2 C 1. Emissions from final energy use of coal mines are included in 1 A 2 f.*

(5) *Heavy metals, POPs and PM emissions from integrated iron and steel plants are included in 2 C 1.*

(6) *Dioxin emissions from natural gas compressors are not estimated but assumed to be negligible (at level of detection limit).*

(7) *PAH emissions from natural gas compressors are assumed to be negligible (below detection limit).*

(8) *PM emissions from cement and lime kilns are inluded in 2 A 1 and 2 A 3.*

Table 52 shows the correspondence of NFR and SNAP categories.

Table 52: NFR and SNAP categories of "1 A Stationary Fuel Combustion Activities".

NFR Category		SNAP
1 A 1 a Public Electricity and Heat Production	0101 0102	Public power District heating plants
1 A 1 b Petroleum refining	0103	Petroleum refining plants
1 A 1 c Manufacture of Solid fuels and Other Energy Industries	0104 010503 010504	Solid fuel transformation plants Oil/Gas Extraction plants Gas Turbines
1 A 2 a Iron and Steel	0301 030302 030326	Comb. In boilers, gas turbines and stationary engines (Iron and Steel Industry) Reheating furnaces steel and iron Processes with Contact-Other(Iron and Steel Industry)
1 A 2 b Non-ferrous Metals	0301 030307 030309 030310 030324	Comb. In boilers, gas turbines and stationary engines (Non-ferrous Metals Industry) Secondary lead production Secondary copper production Secondary aluminium production Nickel production (thermal process)
1 A 2 c Chemicals	0301	Comb. in boilers, gas turbines and stationary engines (Chemicals Industry)
1 A 2 d Pulp, Paper and Print	0301	Comb. in boilers, gas turbines and stationary engines (Pulp, Paper and Print Industry)
1 A 2 e Food Processing, Beverages and Tobacco	0301	Comb. in boilers, gas turbines and stationary engines (Food Processing, Beverages and Tobacco Industry)

NFR Category			SNAP
1 A 2 f ii	Other Stationary in Industry	0301 030311 030317 030312 030319 030323	Comb. in boilers, gas turbines and stationary engines (Industry not included in 1 A 2 a to 1 A 2 e) Cement Glass Lime Bricks and Tiles Magnesium production (dolomite treatment)
1 A 3 e i	Pipeline compressors	010506	Pipeline Compressors
1 A 4 a	Commercial/Institutional	0201	Commercial and institutional plants Open Firepits and Bonfires
1 A 4 b I	Residential plants	0202	Residential plants Barbecue
1 A 4 c ii	Agriculture/Forestry/ Fisheries –Stationary	0203	Plants in agriculture, forestry and aquaculture

4.2.2 Methodological issues

General Methodology for stationary sources of NFR categories 1 A 1 to 1 A 5

For large point sources in categories 1 A 1 a, 1 A 1 b, 1 A 2 a, 1 A 2 d and 1 A 2 f (cement industry) emission measurements of NO_x, SO_2 ,NMVOC, CO and TSP are the basis for the reported emissions.

The remaining sources (area sources), where measured (plant-specific) emission data and plant specific activity data is not available, were estimated using the simple CORINAIR methodology by multiplying the fuel consumption of each sub category taken from the national energy balance with a fuel and technology dependent emission factor. Fuel specific emission factors are mainly country specific and taken from national studies.

Emission factors

Emission factors are expressed as: kg released pollutant per TJ of burned fuel [kg/TJ].

Emission factors may vary over time for the following reasons:

- The chemical characteristics of a fuel category varies, e.g. sulphur content in residual oil.
- The mix of fuels of a fuel category changes over time. If the different fuels of a fuel category have different calorific values and their share in the fuel category changes, the calorific value of the fuel category might change over time. If emission factors are in the unit kg/t the transformation to kg/TJ induces a different emission factor due to varying net calorific values.
- The (abatement-) technology of a facility – or of facilities – changes over time.

Sources of NO_x, SO_2, VOC, CO, and TSP emission factors are periodically published reports (BMWA 1990), (BMWA 1996), (UMWELTBUNDESAMT 2001a), (UMWELTBUNDESAMT 2004b). In these studies emission factors are provided for the years 1987, 1995 and 1996. Emission factors are mainly based on country specific measurements. NH_3 emission factors are taken from a national study (UMWELTBUNDESAMT 1993) and (EMEP/CORINAIR 2005, chapter B112). Details are included in the relevant chapters.

NH_3

Emission factors are constant for the whole time series.

SO_2, NO_x, NMVOC, CO

For the years 1990 to 1994 emission factors are linearly interpolated by using the emission factors from 1987 and 1995 taken from the studies mentioned above. From 1997 onwards mainly the emission factors of 1996 are used.

In several national studies only emission factors for VOC are cited. NMVOC emissions are calculated by subtracting a certain share of CH_4 emissions from VOC emissions.

Characteristic of oil products

According to a national standard residual fuel oil is classified into 3 groups with different sulphur content (heavy, medium, light). Consumption of special residual fuel oil with a sulphur content higher than 1% is limited to special power plants ≥ 50 MW and the oil refinery. Heating fuel oil is mainly used for space heating in small combustion plants. The following Table shows the sulphur contents of oil products which decreased strongly since 1980 due to legal measures. The years presented in the table are the years where leagal measures came into force.

Table 53: Limited sulphur content of oil product classes according to the Austrian standard „ÖNORM".

Year	Residual fuel oil "Heavy"	Residual fuel oil "Medium"	Residual fuel oil "Light"	Heating fuel oil
1980	3.5%	2.5%	1.50%	0.8%
1981				0.5%
1982		1.5%	0.75%	
1983	3.0%			0.3%
1984	2.5%; 2.0%	1.0%	0.50%	
1985				
1987		0.6%		
1989			0.30%	0.2%
1990			0.20%	0.1%
1992	1.0%			
1994		0.4%		

Activity data

A description of methodology and activity data is provided in (UMWELTBUNDESAMT 2007a). If the energy balance reports fuel quantities by mass or volume units the fuel quantities must be converted into energy units [TJ] by means of net calorific values (NCV) which are provided by Statistik Austria along with the energy balance.

Not all categories of the gross inland fuel consumption are combusted or relevant for the inventory:

- Emissions from international bunker fuels are not included in the National Total but reported separately as *Memo Item*.
- Avoiding of activity data double counting: transformation and distribution losses and transformations of fuels to other fuels (like hard coal to coke oven coke or internal refinery processes which have been added to the transformation sector of the energy balance) is not considered as activity data.
- Non energy use is also not considered for calculation of emissions in Sector *1 A Energy*. However, from these fuels fugitive emissions might occur which are considered in Sector 3 *Solvents*. Emissions from fuel used as a feedstock are considered in Sector 2 *Industrial Processes*.

Measured emissions

In case that measured emissions are used for inventory preparation it is essential that the correspondent activity data is additionally reported to avoid double counting of emissions within the inventory. Plant or industrial branch specific emissions are mostly broken down to fuel specific emissions per NFR source category. In case that complete time series of measured emission data are not available implied emission factors are used for emission calculation. Implied emission factors may also be used for validation of measured emissions.

4.2.3 NFR 1 A 1 Energy Industries

NFR Category *1 A 1* comprises emissions from fuel combustion for *public electricity and heat production* (NFR 1 A 1 a), in *petroleum refining* (NFR 1 A 1 b), and in manufacture of solid fuels and other energy industries (NFR 1 A 1 c).

Emission Trend

While total fuel consumption increased by 35% from 188 783 TJ in 1990 to 255 346 TJ in 2006,

- a decrease in emission due to fuel switches and the implementation of abatement techniques could be noted for
  - SO_2 emissions (-44%); between 2000 to 2006 SO_2 emissions increased due to rising coal consumption of public power plants.
  - NO_x emissions (-13%)
  - CO emissions (-23%)
  - Hg emissions (-36%)
  - dioxin/furan emissions (-1%).
- an increase in emissions mainly driven by the increase of coal, biomass and natural gas consumption could be noted for
  - NMVOC emissions (+68%)
  - NH_3 emissions (+83%)
  - TSP, PM10, PM2.5 emissions (+25%, +22%, +22%)
  - Cd and Pb emissions (+40% and +58%)
  - PAH and HCB emissions (+196% and +68%).

In the following tables the emission trends per sub category are presented.

Table 54: SO_2 and NO_x emissions and trends from Sector 1 A 1 Energy Industries and source categories 1990–2006.

Year	SO_2 [Gg]	1	1 A	1 A 1	1 A 1 a	1 A 1 b	1 A 1 c	NO_x [Gg]	1	1 A	1 A 1	1 A 1 a	1 A 1 b	1 A 1 c
1990		72.03	70.03	14.04	11.79	2.25	0.00		181.43	17.78	12.09	4.32	1.37	181.43
1991		69.46	68.16	15.42	13.31	2.11	0.00		191.77	17.20	11.40	4.32	1.48	191.77
1992		53.32	51.32	8.58	5.74	2.85	0.00		181.32	14.71	9.10	4.19	1.41	181.32
1993		51.92	49.82	10.06	6.64	3.42	0.00		178.50	12.10	7.55	3.40	1.15	178.50
1994		46.14	44.86	7.72	4.69	3.03	0.00		172.61	11.09	6.45	3.41	1.23	172.61
1995		45.43	43.90	8.92	5.93	2.98	0.00		173.72	12.70	7.66	3.38	1.65	173.72
1996		43.27	42.07	7.80	4.31	3.49	NA		196.48	11.04	6.86	3.48	0.71	196.48
1997		38.84	38.78	9.09	5.43	3.66	NA		185.57	11.93	7.71	3.47	0.75	185.57
1998		34.33	34.29	7.33	3.53	3.80	NA		200.67	10.83	6.54	3.36	0.93	200.67
1999		32.62	32.47	7.24	3.69	3.55	NA		191.64	10.89	6.57	3.25	1.07	191.64
2000		30.47	30.33	7.11	3.67	3.44	NA		198.16	11.00	7.03	3.07	0.89	198.16
2001		31.43	31.27	7.96	4.35	3.62	NA		207.84	12.61	8.39	3.30	0.92	207.84
2002		30.37	30.24	7.69	4.00	3.69	NA		217.39	12.87	8.03	3.44	1.41	217.39
2003		31.17	31.02	7.92	4.24	3.68	NA		228.75	14.27	9.76	3.34	1.16	228.75
2004		25.66	25.51	7.30	3.47	3.84	NA		226.71	15.14	10.14	3.44	1.55	226.71
2005		25.37	25.24	6.80	3.45	3.35	NA		229.95	14.53	10.05	3.05	1.42	229.95
2006		27.18	27.01	7.85	4.16	3.69	NA		218.27	15.37	10.50	3.39	1.48	218.27
Trend														
1990–2006		*-62.3%*	*-61.4%*	*-44.1%*	*-64.7%*	*63.9%*	*-100%*		*20.3%*	*-13.5%*	*-13.1%*	*-21.5%*	*8.0%*	*20.3%*
2005–2006		*7.1%*	*7.0%*	*15.5%*	*20.6%*	*10.2%*	*–*		*-5.1%*	*5.8%*	*4.4%*	*11.1%*	*4.3%*	*-5.1%*
Share in Sector 1 A 1 Energy Industries														
1990				*100.0%*	*84.0%*	*16.0%*	*0.0%*			*100.0%*	*68.0%*	*24.3%*	*7.7%*	*100.0%*
2006				*100.0%*	*53.0%*	*47.0%*	*–*			*100.0%*	*68.3%*	*22.0%*	*9.6%*	*100.0%*
Share in National Total														
1990		*96.9%*	*94.2%*	*18.9%*	*15.9%*	*3.0%*	*0.0%*		*9.2%*	*6.3%*	*2.2%*	*0.7%*	*9.2%*	*6.3%*
2006		*95.5%*	*94.9%*	*27.6%*	*14.6%*	*13.0%*	*–*		*6.8%*	*4.7%*	*1.5%*	*0.7%*	*6.8%*	*4.7%*

Table 55: NMVOC and CO emissions and trends from Sector 1 A 1 Energy Industries and source categories 1990–2006.

Year	NMVOC [Gg]	1	1 A	1 A 1	1 A 1 a	1 A 1 b	1 A 1 c	CO [Gg]	1	1 A	1 A 1	1 A 1 a	1 A 1 b	1 A 1 c
1990		153.12	140.91	0.42	0.42	IE	0.00		1 385.17	1385.17	6.10	1.36	4.65	0.09
1991		160.54	147.38	0.49	0.49	IE	0.00		1 459.72	1459.72	2.54	1.64	0.80	0.10
1992		152.39	139.26	0.41	0.40	IE	0.00		1 424.19	1424.19	1.88	1.34	0.45	0.09
1993		149.88	137.03	0.42	0.42	IE	0.00		1 389.45	1389.45	1.52	0.99	0.46	0.08
1994		138.58	128.32	0.39	0.39	IE	0.00		1 319.28	1319.28	1.72	1.12	0.52	0.08
1995		133.70	124.88	0.39	0.39	IE	0.01		1 211.36	1211.36	2.37	1.71	0.55	0.11
1996		131.19	123.28	0.42	0.41	IE	0.00		1 196.34	1196.34	2.27	1.79	0.44	0.05
1997		112.62	105.26	0.41	0.41	IE	0.00		1 106.65	1106.65	2.47	1.68	0.74	0.05
1998		106.59	100.74	0.43	0.43	IE	0.00		1 064.77	1064.77	1.91	1.50	0.35	0.06
1999		100.46	95.32	0.38	0.38	IE	0.00		994.48	994.48	2.51	1.98	0.46	0.07
2000		92.52	87.36	0.38	0.37	IE	0.00		922.83	922.83	2.66	2.02	0.58	0.06
2001		89.55	86.23	0.50	0.50	IE	0.00		897.49	897.49	2.95	2.40	0.49	0.06
2002		85.37	81.89	0.48	0.47	IE	0.00		866.16	866.16	3.35	2.53	0.72	0.09
2003		83.37	79.93	0.55	0.55	IE	0.00		868.00	868.00	3.94	2.99	0.87	0.08
2004		77.73	74.46	0.54	0.53	IE	0.01		825.04	825.04	3.74	2.77	0.87	0.10
2005		75.19	72.10	0.51	0.51	IE	0.00		791.69	791.69	3.43	2.91	0.42	0.09
2006		70.12	66.99	0.71	0.70	IE	0.00		754.06	754.06	4.67	4.11	0.46	0.10
Trend														
1990–2006		*-54.2%*	*-52.5%*	*68.1%*	*68.8%*		*7.4%*		*-45.6%*	*-45.6%*	*-23.4%*	*203.2%*	*-90.1%*	*7.4%*
2005–2006		*-6.8%*	*-7.1%*	*37.9%*	*38.2%*		*4.3%*		*-4.8%*	*-4.8%*	*36.3%*	*41.3%*	*9.2%*	*4.3%*
Share in Sector 1 A 1 Energy Industries														
1990				*100.0%*	*98.9%*		*1.1%*				*100.0%*	*22.2%*	*76.3%*	*1.5%*
2006				*100.0%*	*99.3%*		*0.7%*				*100.0%*	*88.0%*	*9.9%*	*2.1%*
Share in National Total														
1990		*54.1%*	*49.8%*	*0.1%*	*0.1%*		*0.0%*		*95.9%*	*95.9%*	*0.4%*	*0.1%*	*0.3%*	*0.0%*
2006		*40.9%*	*39.0%*	*0.4%*	*0.4%*		*0.0%*		*96.0%*	*96.0%*	*0.6%*	*0.5%*	*0.1%*	*0.0%*

Table 56: NH_3 and PM2.5 emissions and trends from Sector 1 A 1 Energy Industries and source categories 1990–2006.

Year	NH_3 [Gg]	1	1 A	1 A 1	1 A 1 a	1 A 1 b	1 A 1 c	PM2.5 [Mg]	1	1 A	1 A 1	1 A 1 a	1 A 1 b	1 A 1 c
1990		4.28	4.28	0.20	0.11	0.08	0.01		19 941.51	19 846.55	850.22	656.96	120.46	72.80
1991		5.85	5.85	0.21	0.12	0.08	0.01		NR	NR	NR	NR	NR	NR
1992		6.67	6.67	0.21	0.12	0.08	0.01		NR	NR	NR	NR	NR	NR
1993		7.45	7.45	0.24	0.14	0.09	0.01		NR	NR	NR	NR	NR	NR
1994		7.66	7.66	0.24	0.14	0.10	0.01		NR	NR	NR	NR	NR	NR
1995		7.49	7.49	0.23	0.13	0.09	0.01		19 661.80	19 581.53	723.91	573.43	77.00	73.48
1996		7.01	7.01	0.26	0.16	0.09	0.00		NR	NR	NR	NR	NR	NR
1997		6.52	6.52	0.26	0.16	0.09	0.01		NR	NR	NR	NR	NR	NR
1998		6.55	6.55	0.28	0.18	0.09	0.01		NR	NR	NR	NR	NR	NR
1999		5.92	5.92	0.25	0.17	0.08	0.01		19 617.63	19 544.01	567.45	399.08	96.34	72.03
2000		5.42	5.42	0.23	0.14	0.08	0.01		18 941.75	18 859.29	571.85	413.25	87.02	71.58
2001		5.28	5.28	0.25	0.16	0.08	0.01		19 510.76	19 424.45	687.71	520.69	95.37	71.65
2002		5.23	5.23	0.26	0.16	0.09	0.01		19 417.76	19 329.36	700.70	537.64	90.20	72.86
2003		5.05	5.05	0.28	0.19	0.08	0.01		19 770.00	19 675.21	839.21	683.16	83.80	72.25
2004		4.55	4.55	0.31	0.21	0.09	0.01		19 281.92	19 192.40	920.65	756.51	90.90	73.23
2005		4.17	4.17	0.33	0.24	0.09	0.01		19 236.67	19 146.09	846.98	695.14	78.94	72.90
2006		3.76	3.76	0.37	0.26	0.10	0.01		18 763.85	18 676.37	1 036.70	884.71	78.94	73.05
Trend														
1990–2006		*-12.1%*	*-12.1%*	*82.7%*	*138.8%*	*17.5%*	*6.2%*		*-5.9%*	*-5.9%*	*21.9%*	*34.7%*	*-34.5%*	*0.3%*
2005–2006		*-9.8%*	*-9.8%*	*12.5%*	*12.1%*	*14.5%*	*4.3%*		*-2.5%*	*-2.5%*	*22.4%*	*27.3%*	*0.0%*	*0.2%*
Share in Sector 1 A 1 Energy Industries														
1990				*100.0%*	*54.2%*	*41.3%*	*4.5%*				*100.0%*	*77.3%*	*14.2%*	*8.6%*
2006				*100.0%*	*70.8%*	*26.5%*	*2.6%*				*100.0%*	*85.3%*	*7.6%*	*7.0%*
Share in National Total														
1990		*6.0%*	*6.0%*	*0.3%*	*0.2%*	*0.1%*	*0.0%*		*79.4%*	*79.0%*	*3.4%*	*2.6%*	*0.5%*	*0.3%*
2006		*5.7%*	*5.7%*	*0.6%*	*0.4%*	*0.2%*	*0.0%*		*82.8%*	*82.4%*	*4.6%*	*3.9%*	*0.3%*	*0.3%*

Table 57: TSP and PM10 emissions and trends from Sector 1 A 1 Energy Industries and source categories 1990–2006.

Year	TSP [Mg]	1	1 A	1 A 1	1 A 1 a	1 A 1 b	1 A 1 c	PM10 [Mg]	1	1 A	1 A 1	1 A 1 a	1 A 1 b	1 A 1 c
1990		31 811.93	31 164.90	1 053.64	829.11	150.58	73.95		23 962.50	23 657.79	997.35	780.81	143.05	73.49
1991		NR	NR	NR	NR	NR	NR		NR	NR	NR	NR	NR	NR
1992		NR	NR	NR	NR	NR	NR		NR	NR	NR	NR	NR	NR
1993		NR	NR	NR	NR	NR	NR		NR	NR	NR	NR	NR	NR
1994		NR	NR	NR	NR	NR	NR		NR	NR	NR	NR	NR	NR
1995		32 200.20	31 655.16	901.96	730.84	96.25	74.86		23 717.21	23 460.30	841.22	675.47	91.44	74.31
1996		NR	NR	NR	NR	NR	NR		NR	NR	NR	NR	NR	NR
1997		NR	NR	NR	NR	NR	NR		NR	NR	NR	NR	NR	NR
1998		NR	NR	NR	NR	NR	NR		NR	NR	NR	NR	NR	NR
1999		32 714.34	32 214.70	702.48	509.14	120.42	72.92		23 798.23	23 562.70	660.21	473.25	114.40	72.56
2000		32 097.98	31 539.83	713.18	532.08	108.77	72.33		23 104.92	22 841.63	666.21	490.85	103.33	72.03
2001		32 928.52	32 343.35	859.14	667.51	119.21	72.42		23 771.24	23 495.32	801.33	615.97	113.25	72.11
2002		33 010.37	32 411.64	877.65	690.87	112.75	74.03		23 716.91	23 434.51	819.37	638.70	107.11	73.56
2003		33 725.61	33 083.57	1 051.60	873.63	104.75	73.21		24 200.40	23 897.60	985.86	813.52	99.52	72.83
2004		33 401.68	32 796.86	1 166.55	978.39	113.63	74.53		23 744.38	23 458.94	1 082.91	900.95	107.95	74.01
2005		33 535.63	32 923.65	1 069.27	896.51	98.67	74.09		23 747.95	23 459.14	993.20	825.85	93.74	73.61
2006		33 224.22	32 635.35	1 317.33	1 144.37	98.67	74.29		23 340.23	23 062.06	1 218.71	1 051.18	93.74	73.79
Trend														
1990–2006		*4.4%*	*4.7%*	*25.0%*	*38.0%*	*-34.5%*	*0.5%*		*-2.6%*	*-2.5%*	*22.2%*	*34.6%*	*-34.5%*	*0.4%*
2005–2006		*-0.9%*	*-0.9%*	*23.2%*	*27.6%*	*0.0%*	*0.3%*		*-1.7%*	*-1.7%*	*22.7%*	*27.3%*	*0.0%*	*0.2%*
Share in Sector 1 A 1 Energy Industries														
1990				*100.0%*	*78.7%*	*14.3%*	*7.0%*				*100.0%*	*78.3%*	*14.3%*	*7.4%*
2006				*100.0%*	*86.9%*	*7.5%*	*5.6%*				*100.0%*	*86.3%*	*7.7%*	*6.1%*
Share in National Total														
1990		*46.4%*	*45.4%*	*1.5%*	*1.2%*	*0.2%*	*0.1%*		*55.8%*	*55.1%*	*2.3%*	*1.8%*	*0.3%*	*0.2%*
2006		*44.3%*	*43.5%*	*1.8%*	*1.5%*	*0.1%*	*0.1%*		*53.7%*	*53.1%*	*2.8%*	*2.4%*	*0.2%*	*0.2%*

Table 58: Cd and Hg emissions and trends from Sector 1 A 1 Energy Industries and source categories 1990–2006.

Year	Cd [Mg]	1	1 A	1 A 1	1 A 1 a	1 A 1 b	1 A 1 c	Hg [Mg]	1	1 A	1 A 1	1 A 1 a	1 A 1 b	1 A 1 c
1990		1.06	1.06	0.20	0.11	0.09			1.56	1.56	0.33	0.33	0.01	
1991		1.09	1.09	0.22	0.11	0.10			1.50	1.50	0.35	0.34	0.01	
1992		0.97	0.97	0.18	0.08	0.10			1.18	1.18	0.23	0.23	0.01	
1993		0.94	0.94	0.20	0.07	0.12			0.96	0.96	0.20	0.19	0.01	
1994		0.88	0.88	0.19	0.06	0.13			0.76	0.76	0.18	0.17	0.01	
1995		0.81	0.81	0.17	0.06	0.11			0.71	0.71	0.20	0.19	0.01	
1996		0.84	0.84	0.19	0.06	0.13			0.71	0.71	0.19	0.18	0.01	
1997		0.80	0.80	0.20	0.06	0.14			0.68	0.68	0.20	0.18	0.01	
1998		0.74	0.74	0.19	0.05	0.13			0.60	0.60	0.16	0.15	0.01	
1999		0.80	0.80	0.21	0.06	0.14			0.65	0.65	0.18	0.17	0.01	
2000		0.76	0.76	0.20	0.06	0.14			0.64	0.64	0.20	0.19	0.01	
2001		0.80	0.80	0.22	0.07	0.15			0.70	0.70	0.22	0.21	0.01	
2002		0.80	0.80	0.25	0.08	0.17			0.66	0.66	0.21	0.20	0.01	
2003		0.83	0.83	0.25	0.09	0.17			0.70	0.70	0.23	0.22	0.01	
2004		0.83	0.83	0.25	0.08	0.17			0.65	0.65	0.22	0.20	0.01	
2005		0.88	0.88	0.27	0.09	0.18			0.67	0.67	0.21	0.20	0.01	
2006		0.90	0.90	0.28	0.10	0.17			0.69	0.69	0.21	0.20	0.01	
Trend														
1990–2006		*-15.1%*	*-15.1%*	*40.2%*	*-2.6%*	*90.5%*			*-55.6%*	*-55.6%*	*-36.2%*	*-38.2%*	*58.6%*	
2005–2006		*1.8%*	*1.8%*	*2.2%*	*14.0%*	*-3.8%*			*3.5%*	*3.5%*	*2.3%*	*1.6%*	*18.3%*	
Share in Sector 1 A 1 Energy Industries														
1990				*100.0%*	*54.0%*	*46.0%*					*100.0%*	*98.0%*	*2.0%*	
2006				*100.0%*	*37.5%*	*62.5%*					*100.0%*	*94.9%*	*5.1%*	
Share in National Total														
1990		*67.1%*	*67.1%*	*12.5%*	*6.7%*	*5.7%*			*72.8%*	*72.8%*	*15.6%*	*15.3%*	*0.3%*	
2006		*79.9%*	*79.9%*	*24.6%*	*9.2%*	*15.3%*			*67.6%*	*67.6%*	*20.9%*	*19.8%*	*1.1%*	

Table 59: Pb and PAH emissions and trends from Sector 1 A 1 Energy Industries and source categories 1990–2006.

Year	Pb [Mg]	1	1 A	1 A 1	1 A 1 a	1 A 1 b	1 A 1 c	PAH [Mg]	1	1 A	1 A 1	1 A 1 a	1 A 1 b	1 A 1 c
1990		174.17	174.17	1.10	0.93	0.18			9.47	9.47	0.006	0.004	0.002	0.000
1991		143.81	143.81	1.17	0.97	0.20			10.32	10.32	0.006	0.004	0.002	0.000
1992		100.67	100.67	0.97	0.78	0.19			9.40	9.40	0.007	0.005	0.002	0.000
1993		70.61	70.61	0.85	0.61	0.24			9.28	9.28	0.009	0.006	0.003	0.000
1994		47.31	47.31	0.79	0.54	0.25			8.40	8.40	0.009	0.006	0.003	0.000
1995		11.33	11.33	0.75	0.54	0.22			8.85	8.85	0.008	0.006	0.003	0.000
1996		11.18	11.18	0.91	0.64	0.26			9.57	9.57	0.009	0.006	0.002	–
1997		9.64	9.64	0.97	0.69	0.28			8.58	8.58	0.010	0.007	0.003	–
1998		8.23	8.23	0.89	0.63	0.27			8.30	8.30	0.011	0.008	0.003	–
1999		7.53	7.53	0.86	0.57	0.29			8.32	8.32	0.010	0.008	0.002	–
2000		6.42	6.42	1.05	0.78	0.27			7.78	7.78	0.010	0.008	0.002	–
2001		6.70	6.70	1.17	0.87	0.30			8.47	8.47	0.011	0.009	0.002	–
2002		6.76	6.76	1.39	1.04	0.35			8.29	8.29	0.013	0.010	0.003	–
2003		6.95	6.95	1.53	1.20	0.33			8.62	8.62	0.014	0.011	0.003	–
2004		7.12	7.12	1.66	1.27	0.39			8.50	8.50	0.015	0.012	0.003	–
2005		7.16	7.16	1.51	1.26	0.24			8.77	8.77	0.014	0.012	0.002	–
2006		7.49	7.49	1.74	1.45	0.29			8.31	8.31	0.016	0.014	0.002	–
Trend														
1990–2006		*-95.7%*	*-95.7%*	*57.8%*	*56.7%*	*63.6%*			*-12.3%*	*-12.3%*	*196.3%*	*291.3%*	*21.6%*	*-100%*
2005–2006		*4.5%*	*4.5%*	*15.4%*	*14.7%*	*19.1%*			*-5.2%*	*-5.2%*	*13.2%*	*13.6%*	*11.2%*	
Share in Sector 1 A 1 Energy Industries														
1990				*100.0%*	*84.0%*	*16.0%*					*100.0%*	*64.8%*	*35.2%*	*0.0%*
2006				*100.0%*	*83.4%*	*16.6%*					*100.0%*	*85.5%*	*14.5%*	
Share in National Total														
1990		*84.0%*	*84.0%*	*0.5%*	*0.4%*	*0.1%*			*54.7%*	*54.7%*	*< 0.1%*	*< 0.1%*	*< 0.1%*	*< 0.1%*
2006		*53.0%*	*53.0%*	*12.3%*	*10.3%*	*2.1%*			*95.2%*	*95.2%*	*0.2%*	*0.2%*	*< 0.1%*	

Table 60: Dioxin and HCB emissions and trends from Sector 1 A 1 Energy Industries and source categories 1990–2006.

Year	Dioxin [g]	1	1 A	1 A 1	1 A 1 a	1 A 1 b	1 A 1 c	HCB [kg]	1	1 A	1 A 1	1 A 1 a	1 A 1 b	1 A 1 c
1990		101.84	101.84	0.82	0.801	0.019	0.002		72.57	72.57	0.2070	0.2043	0.0023	0.0004
1991		80.87	80.87	0.85	0.832	0.019	0.002		69.71	69.71	0.2270	0.2241	0.0025	0.0004
1992		53.86	53.86	1.04	1.024	0.019	0.002		56.94	56.94	0.2465	0.2438	0.0024	0.0004
1993		49.34	49.34	0.27	0.246	0.020	0.002		53.58	53.58	0.1838	0.1807	0.0028	0.0003
1994		44.54	44.54	0.29	0.265	0.020	0.002		48.04	48.04	0.1939	0.1909	0.0027	0.0003
1995		45.79	45.79	0.33	0.306	0.019	0.002		50.20	50.20	0.2039	0.2009	0.0026	0.0004
1996		48.22	48.22	0.37	0.347	0.020	0.001		53.15	53.15	0.2114	0.2086	0.0026	0.0002
1997		46.92	46.92	0.39	0.369	0.020	0.001		49.07	49.07	0.2187	0.2159	0.0026	0.0002
1998		44.45	44.45	0.40	0.377	0.020	0.001		46.45	46.45	0.2147	0.2118	0.0026	0.0002
1999		40.74	40.74	0.44	0.418	0.018	0.001		44.75	44.75	0.2580	0.2553	0.0024	0.0003
2000		37.69	37.69	0.51	0.490	0.017	0.001		41.02	41.02	0.2612	0.2587	0.0023	0.0002
2001		40.55	40.55	0.51	0.487	0.018	0.001		44.32	44.32	0.2540	0.2513	0.0024	0.0002
2002		39.08	39.08	0.64	0.617	0.018	0.002		41.80	41.80	0.2815	0.2785	0.0026	0.0004
2003		40.04	40.04	0.68	0.663	0.017	0.002		42.36	42.36	0.2782	0.2754	0.0025	0.0003
2004		39.08	39.08	0.71	0.685	0.018	0.002		40.48	40.48	0.3318	0.3287	0.0026	0.0004
2005		40.31	40.31	0.74	0.719	0.020	0.002		41.82	41.82	0.3323	0.3291	0.0028	0.0004
2006		38.62	38.62	0.81	0.789	0.023	0.002		39.27	39.27	0.3477	0.3444	0.0029	0.0004
Trend														
1990–2006		*-62.1%*	*-62.1%*	*-1.1%*	*-1.6%*	*18.9%*	*2.3%*		*-45.9%*	*-45.9%*	*68.0%*	*68.6%*	*25.8%*	*5.7%*
2005–2006		*-4.2%*	*-4.2%*	*9.7%*	*9.7%*	*12.6%*	*4.3%*		*-6.1%*	*-6.1%*	*4.6%*	*4.6%*	*6.9%*	*4.3%*
Share in Sector 1 A 1 Energy Industries														
1990				*100.0%*	*97.5%*	*2.3%*	*0.2%*				*100.0%*	*98.7%*	*1.1%*	*0.2%*
2006				*100.0%*	*97.0%*	*2.8%*	*0.2%*				*100.0%*	*99.0%*	*0.8%*	*0.1%*
Share in National Total														
1990		*63.5%*	*63.5%*	*0.5%*	*0.5%*	*0.0%*	*0.0%*		*79.1%*	*79.1%*	*0.2%*	*0.2%*	*0.0%*	*0.0%*
2006		*88.4%*	*88.4%*	*1.9%*	*1.8%*	*0.1%*	*0.0%*		*91.1%*	*91.1%*	*0.8%*	*0.8%*	*0.0%*	*0.0%*

General Methodology

The following Table 61 gives an overview of methodologies and data sources of sub category *1 A 1 Energy Industries*.

Table 61: Overview of 1 A 1 methodologies for main pollutants.

	Activity data	Reported/measured emissions	Emission factors
1 A 1 a boilers ≥ 50 MW_{th}	Reporting Obligation: fuel consumption (monthly). 2005–2006: ETS data	Reporting Obligation: NO_x, SO_2, TSP, CO (monthly) (56 boilers)	NMVOC, NH_3: national studies
1 A 1 a boilers < 50 MW_{th}	Energy balance 2005–2006: ETS data for plants ≥ 20 MW_{th}	Used for deriving emission factors	All pollutants: national studies
1 A 1 b (1 plant)	Reported by plant operator (yearly) 2005–2006: ETS data	Reported by plant operator: SO_2, NO_x, CO, NMVOC (yearly)	NH_3: national study
1 A 1 c	Energy balance 2005–2006: ETS data		All pollutants: national studies

For 2005–2006 activity data from the emission trading system (ETS) has been considered. ETS data fully covers caegory *1 A 1 b*, covers about 75% of category *1 A 1 a* and 10% of category *1 A 1 c* activity data.

NFR 1 A 1 a Public Electricity

In this category large point sources are considered. The Umweltbundesamt operates a database called „Dampfkesseldatenbank" (DKDB) which stores plant specific monthly fuel consumption as well as measured CO, NO_x, SO_x and TSP emissions from boilers with a thermal capacity greater than 3 MW_{th} from 1990 on. These data are used to generate a sectoral split of the categories *Public Power* and *District Heating* into the two categories ≥ *300* MW_{th} and ≥ *50* MW_{th} *to 300* MW_{th}. Currently 56 boilers are considered in this approach. It turned out that this methodology is appropriate for most cases but overall fuel consumption has to be checked against the national energy balance or other available complete datasets/surveys (see section on QA/QC).

Total fuel consumption data is taken from the energy balance (STATISTIK AUSTRIA 2007). The remaining fuel consumption (= total consumption minus reported boiler consumption) is the activity data of plants < 50 MW_{th} used for emission calculation with the simple CORINAIR methodology using national emission factors.

As an example Table 62 shows measured and calculated emission data of category 1 A 1 a for the year 2004.

Table 62: NFR 1 A 1 a measured and calculated emission data for the year 2004.

	Fuel consumption [TJ]	NO_x [Gg]	CO [Gg]	SO_2 [Gg]	TSP [Gg]
≥ 50 MW_{th} Measured	137 145	7.10	1.14	2.78	0.41
< 50 MW_{th} Calculated	56 153	3.05	1.63	0.69	0.57
Total 1 A 1 a	**193 298**	**10.14**	**2.77**	**3.47**	**0.98**

Boilers and gas turbines ≥ 50 MW_{th}

This category considers steam boilers and gas turbines with heat recovery. Due to national regulations coal and residual fuel oil operated boilers are mostly eqipped with NO_x controls, flue gas desulphurisation and dust control units. A high share (regarding fuel consumption) of natural gas operated boilers and gas turbines are also equipped with NO_x controls. Emission data of boilers ≥ 300 MW_{th} is consistent with data used for the national report to the Large Combustion Plant Directive 2001/80/EG (UMWELTBUNDESAMT 2006) except in the case where gap filling was performed. An overview about installed SO_2 and NO_x controls and emission trends are presented in (UMWELTBUNDESAMT 2006).

Emissions by fuel type are essential for validation and review purposes. If boilers are operated with mixed fuels derivation of fuel specific emissions from measured emissions is not always appropriate. Fuel specific emissions were derived as following:

i) Add up fuel consumption and emissons of the boiler size classes ≥ *300 MW_{th}* and ≥ *50 MW_{th} < 300 MW_{th}*. Convert fuel consumption from mass or volume units to TJ by means of average heating values from the energy balance.

ii) Derive default emission factors for each fuel type of the "most representative" plants by means of actual flue gas concentration measurements and/or legal emission limits. This work is done by the Umweltbundesamt. The national "default" emission factors are periodically published in reports like (UMWELTBUNDESAMT 2004b).

iii) Calculate "default" emissions by fuel consumption and national "default" emission factors.

iv) Calculate emission ratio of calculated emissions and measured emissions by boiler size class.

v) Calculate emissions by fuel type and boiler size class by multiplying default emissions with emission ratio. Implied emission factors by fuel type may be calculated.

In the approach above different coal types and residuel fuel classifications are considered. Table 63 shows some selected aggregated results for 2005. The ratios of measured to calculated emissions show that the application of a simple Tier 2 approach would introduce a high uncertainty for CO and SO_2. The ratio of 1.13 for NO_x leads to the conclusion that NO_x emission factors are representing legal limits which are not under-run due to high DeNOX operating costs.

Table 63: NFR 1 A 1 a ≥ 50 MW_{th} selected aggregated emission factors, fuel consumption and emissions ratios for the year 2005.

	Fuel consumption [TJ]	NO_x [kg/TJ]		CO [kg/TJ]		SO_2 [kg/TJ]	
		Default	Derived	Default	Derived	Default	Derived
NFR 1 A 1 a ≥ 50 MW_{th}		1.13(1)		0.71(1)		0.51(1)	
SNAP 010101		1.03(1)		2.23(1)		0.56(1)	
Coal	57 777	54.7	56.2	2.1	4.6	62.6	35.3
Oil	6 380	26.0	26.7	3.0	6.7	50.0	28.2
Natural gas	75 134	30.0	30.8	4.0	8.9	NA	NA
Sewage sludge	21	100.0	102.7	200.0	445.9	130.0	73.3
Biomass	106	94.0	96.5	72.0	160.5	11.0	6.2
SNAP 010102		4.28(1)		5.59(1)		0.38(1)	
Coal	3 844	50.0	213.8	1.0	5.6	57.0	21.5
Oil	113	26.0	111.2	3.0	16.8	50.0	18.8
Natural gas	2 022	30.0	128.3	4.0	22.4	NA	NA
Biomass	182	94.0	402.0	72.0	402.4	11.0	4.1

	Fuel consumption [TJ]	NO_x [kg/TJ]		CO [kg/TJ]		SO_2 [kg/TJ]	
SNAP 010201		0.59(1)		0.09(1)		1.50(1)	
Oil	60	95.0	56.0	4.6	0.4	117.2	175.9
Natural gas	661	25.0	14.7	4.0	0.3	NA	NA
SNAP 010202		0.81(1)		0.09(1)		0.39(1)	
Coal	3 589	83.9	68.2	4.0	0.4	170.5	66.6
Oil	7 007	25.0	20.3	4.0	0.4	NA	NA
Natural gas	5 756	46.3	37.6	200.0	18.3	130.0	50.8
Waste	708	100.0	81.3	200.0	18.3	130.0	50.8
Sewage Sludge	3 589	83.9	68.2	4.0	0.4	170.5	66.6

(1) *Emission ratio of measured emissions divided by calculated emissions .*

Boilers and gas turbines < 50 MWth

Table 64 shows main pollutant emission factors used for calculation of emissions from boilers < 50 MW_{th} for the year 2005. Inceasing biomass consumption of smaller plants is a main source of NO_x emissions from this category in 2005.

Table 64: NFR 1 A 1 a < 50 MW_{th} main pollutant emission factors and fuel consumption for the year 2006.

Fuel	Activity [TJ]	NO_x [kg/TJ]	CO [kg/TJ]	NMVOC [kg/TJ]	SO_2 [kg/TJ]	NH_3 [kg/TJ]
Light Fuel Oil	111	159.4	10/45(1)	0.8	92	2.7
Medium Fuel Oil	0	159.4	15	8.0	196	2.7
Heavy Fuel Oil	4 631	317.4	3/15(1)	8.0	398	2.7
Gasoil	178	65	10	4.8	45	2.7
Diesel oil	0	700	15	0.8	18.8	2.7
Liquified Petroleum Gas	17	150	5	0.5	6	1
Natural Gas/power and CHP	10 484	30	4	0.5	NA	1
Natural Gas/district heating	2 556	41	5	0.5	NA	1
Wood Waste	26 006	94	72	5.0	11	5
Biogas, Sewage Sludge Gas, Landfill Gas	650	150	4	0.5	NA	1
Municipal Solid $Waste_{wet}$	3 646	30	200	38.0	130	0.02
Industrial Waste	2	100	200	38.0	130	0.02

(1) *Different values for: Electricity & CHP/District heating.*

Sources of emission factors

Sources of NO_x, SO_2, VOC, CO, and TSP emission factors are periodically published reports (BMWA 1990), (BMWA 1996), (BMWA 2003), (UMWELTBUNDESAMT 2004b). These reports provide information about the methodology of emission factor derivation and are structured by SNAP nomenclature. Emisson factors for electricity and heat plants are based on expert judgment by Umweltbundesamt and experts from industry.

The NO_x emission factor for biomass boilers ≤ 50 MW_{th} and municipal solid waste is taken from a national unpublished study (UMWELTBUNDESAMT 2006). Biomass NO_x EF are derived by means of measurements of 71 boilers which where taken as a representative sample from the approximately 1000 existing biomass boilers in 2005. Municipal waste NO_x EF are derived from plant specific data taken from (BMLFUW 2002).

NH_3 emission factors for coal, oil and gas are taken from (UMWELTBUNDESAMT 1993). For waste the emission factor of coal is selected. NH_3 emission factors for biomass are taken from (EMEP/CORINAIR 2005, chapter B112) and a value of 5 kg/TJ was selected.

VOC emission factors are divided into NMVOC and CH_4 emission factors as shown in Table 65. The split follows closely (STANZEL et al. 1995).

Table 65: Share of NMVOC emissions in VOC emissions for 1 A 1 a.

	Solid Fossile	Liquid Fossile	Natural Gas	Biomass
Electricity plants	90%	80%	25%	75%
District Heating plants	Hard coal 70% Brown Coal 80%	80%	30%	75%

NFR 1 A 1 b Petroleum Refining

In this category emissions from fuel combustion of a single petroleum refining plant are considered. The plant does not have any secondary DeNOX equipment but a certain amount of primary NO_x control has been achieved since 1990 by switching to low NO_x burners (UMWELTBUNDESAMT 2006). SO_2 reduction is achieved by a regenerative Wellman-Lord process facility (WINDSPERGER & HINTERMEIER 2003). Particulates control is achieved by two electrostatic precipitator (ESP) units. CO emissions were significantly reduced between 1990 and 1991 due to reconstruction of a FCC facility (UMWELTBUNDESAMT 2001).

The Austrian association of mineral oil industry (*Fachverband der Mineralölindustrie*) communicates yearly fuel consumption, SO_2, NO_x, CO, VOC and TSP emissions to the Umweltbundesamt. NMVOC emissions from fuel combustion are reported together with fugitive emissions under category 1 B 2 a. NH_3, heavy metals and POPs emissions are calculated with the simple CORINAIR methodology.

Sources of emission factors

NH_3 emission factors for petroleum products (2.7 kg/TJ) and natural gas (1 g/TJ) are taken from (UMWELTBUNDESAMT 1993).

Facility specific 1990 to 1998 emissions are presented in (UMWELTBUNDESAMT 2000a) and (UMWELTBUNDESAMT 2001).

NFR 1 A 1 c Manufacture of Solid fuels and Other Energy Industries

This category includes emissions from natural gas combustion in the oil and gas extraction sector, natural gas raffination, natural gas compressors for natural gas storage systems as well as own energy use of gas works which closed in 1995.

Furthermore PM emissions of charcoal kilns are included in this category.

Emissions from final energy consumption of coal mines are included in category 1 A 2 f. Emissions from coke ovens are included in category 1 A 2 a.

Fuel consumption is taken from the national energy balance. Emissions are calculated with the simple CORINAIR methodology.

Emission factors and activity data 2006

Table 66 summarizes the selected emission factors for main pollutants and activity data for the year 2006. It is assumed that emissions are uncontrolled.

Table 66: NFR 1 A 1 c main pollutant emission factors and fuel consumption for the year 2004.

Fuel	Source of NO_x, CO, NMVOC, SO_2 emission factors[(1)]	Activity [TJ]	NO_x [kg/TJ]	CO [kg/TJ]	NMVOC [kg/TJ]	SO_2 [kg/TJ]	NH_3 [kg/TJ]
Natural Gas/Oil gas extraction and Gasworks	(BMWA 1990)	9 879	150.0	10.0	0.5	NA	1.0
Residual fuel oil/ Gasworks	(BMWA 1996)	0[(2)]	235.0	15.0	8.0	398.0	2.7
Liquid petroleum gas/Gasworks	(BMWA 1990)	0[(2)]	40.0	10.0	0.5	6.0	1.0

(1) *Default emission factors for industry are selected*

(2) *Gasworks closed in 1995*

NH_3 emission factors are taken from (UMWELTBUNDESAMT 1993).

PM emissions from charcoal production

It is assumed (WINIWARTER et al. 2007) that charcoal is produced in traditionally kilns by approximately 20 producers. Assuming 10 charges per producer and year each of 50 m³ wood input , assuming an output of 200 kg of charcoal from 1 000 kg of wood input and assuming a density of 350 kg/m³ wood leads to an estimated activity of 1 000 t charcoal per year which is 31 TJ (net calorific value 31 MJ/kg charcoal). Applying an emission factor of 2.2 kg TSP/GJ charcoal which is similar to brown coal stoker fired furnaces this leads to an emission of approx. 70 t TSP per year. Furthermore it is assumed that 100% of particles are PM2.5.

Emission factors for heavy metals, POPs and PM used in NFR 1 A 1

In the following emission factors for heavy metals, POPs and PM which are used in NFR 1 A 1 are described and references are given.

Emission factors for heavy metals used in NFR 1 A 1

Coal

Values were taken from the CORINAIR Guidebook (1999), Page B111-58, Table 31:

For 1985, two thirds of the values for "DBB, Dust Control" were used (from the ranges given in the guidebook the mean value was used). For 1995, the value for "DBB, Dust Control + FGD" was used, as in these 10 years the existing dust controls were supplemented with flue gas desulphurisation. For the years in between the values were linearly interpolated.

The net calorific value used to convert values given in [g/Mg fuel] to [g/MJ fuel] was 28 MJ/kg for hard coal and 10.9 MJ/kg for brown coal.

Due to the legal framework most coal fired power plants were already equipped with dust control and flue gas desulphurisation in 1995, and no substantial further improvements were made since then. Thus the emission factor for 1995 was used for the years onwards.

The cadmium emission factor of brown coal is derived from a flue gas concentration of 6 µg/m³ (UMWELTBUNDESAMT 2003b).

Fuel oil

The emission factors base on the heavy metal content of oil products of the only Austrian refinery that were analysed in 2001 (see Table 67). It is assumed that imported oil products have a similar metal content.

Table 67: Heavy Metal Contents of Fuel Oils in Austria.

[mg/kg]	Cadmium	Mercury	Lead
Heating Oil	< 0.01	< 0.003	< 0.01
Light fuel oil	< 0.01	< 0.003	< 0.01
Heavy fuel oil (1%S)	0.04	< 0.003	< 0.01

Only for heavy fuel oil a value for the heavy metal content was quantifiable, for lighter oil products the heavy metal content was below the detection limit. As the heavy metal content depends on the share of residues in the oil product the emission factor of medium fuel oil was assumed to be half the value of heavy fuel oil. For light fuel oil and heating and other gas oil one fifth and one tenth respectively of the detection limit was used.

As legal measures ban the use of heavy fuel oil without dust abatement techniques and the emission limits were lower over the years it was assumed that the emission factor decreased from 1985–1995 by 50%, except for Mercury where dust abatement techniques do not effect emissions as efficiently as Mercury is mainly not dust-bound.

The emission factors for "other oil products" (which is only used in the refinery) are based on the following assumption: the share of Cd and Pb in crude oil is about 1% and 2%, respectively. The share of these HM in particulate emissions of the refinery was estimated to be a fifth of the share in crude oil, that results in a share of 0.2% and 0.4% of dust emissions from the refinery. Based on a TSP emission factor of about 5.7 g/GJ, the resulting emission factors for Cd and Pb are 10 mg/GJ and 20 mg/GJ.

For Mercury 10 times the EF for heavy fuel oil for category *1 A 1 a* was used.

For 1985 twice the value as for 1990 was used.

Other Fuels

For fuel wood the value from (OBERNBERGER 1995) for plants > 4 MW was used for 1985 and 1990. For 1995 and for wood waste for the whole time series the value taken from a personal information about emission factors for wood waste from the author was used.

For plants < 50 MW the emission factor for industrial waste is based on measurements of Austrian plants (FTU 2000).

The emission factors for the years 1985–1995 for municipal waste and sewage sludge base on regular measurements at Austrian facilities (MA22 1998). For industrial waste for plants > 50 MW emission factors were base on (EPA 1998, CORINAIR 1997, EPA 1997, EPA 1993, WINIWARTER 1993, ORTHOFER 1996); improvements in emission control have been considered.

The emission factors for waste (municipal and industrial waste and sewage sludge) for plants > 50 MW for 2004 were taken from (BMLFUW 2002):

Table 68: Cd emission factors for Sector 1 A 1 Energy Industries.

Cadmium EF [mg/GJ]	1985	1990	1995	2006
Coal				
102A Hard coal	0.1548	0.1140	0.073	0.073
105A Brown coal	2.13 (all years)			
Oil				
204A Heating and other gas oil 2050 Diesel	0.02 (all years)			
203B Light fuel oil	0.05 (all years)			
203C Medium fuel oil	0.5 (all years)			
203D Heavy fuel oil	1.0	0.75	0.5	0.5
110A Petrol coke 224A Other oil products	20	10	10	10
Other Fuels				
111A Fuel wood 116A Wood waste	6.1	6.1	2.5	2.5
115A Industrial waste (< 50MW)	7 (all years)			

The following table presents Cd emission factors of several waste categories. Emission factors 2006 are derived from actual measurements (UMWELTBUNDESAMT 2007).

Table 69: Cd emission factors for waste for Sector 1 A 1 Energy Industries.

Cadmium EF [mg/t Waste]	1985	1990	1995	2006
114B Municipal waste	2 580	71	12	11
115A Industrial waste (> 50 MW)	720	510	30	4.5
118A Sewage sludge	–	235	19	5.2

Table 70: Hg emission factors for Sector 1 A 1 Energy Industries.

Mercury EF [mg/GJ]	1985	1990	1995	2006
Coal				
102A Hard coal	2.98	2.38	1.8	1.8
105A Brown coal	7.65	6.12	4.6	4.6
Oil				
204A Heating and other gas oil 2050 Diesel	0.007 (all years)			
203B Light fuel oil	0.015 (all years)			
203C Medium fuel oil	0.04 (all years)			
203D Heavy fuel oil	0.075 (all years)			
110A Petrol coke 224A Other oil products	0.75 (all years)			
Other Fuels				
111A Fuel wood	1.9 (all years)			
116A Wood waste (> 50 MW)	1.9 (all years)			
115A Industrial waste (< 50 MW)	2.0 (all years)			

The following table presents Hg emission factors of several waste categories. Emission factors 2006 are derived from actual measurements (UMWELTBUNDESAMT 2007).

Table 71: Hg emission factors for waste for Sector 1 A 1 Energy Industries.

Mercury EF [mg/t Waste]	1985	1990	1995	2006
114B Municipal waste	1 800	299	120	25.2
115A Industrial waste (> 50 MW)	100	112	49	15.5
118A Sewage sludge	–	55	9	9

Table 72: Pb emission factors for Sector 1 A 1 Energy Industries.

Lead EF [mg/GJ]	1985	1990	1995	2006
Coal				
102A Hard coal	13.33	11.19	9.1	9.1
105A Brown coal	1.93	1.44	0.96	0.96
Oil				
204A Heating and other gas oil 2050 Diesel	0.02 (all years)			
203B Light fuel oil	0.05 (all years)			
203C Medium fuel oil	0.12 (all years)			
203D Heavy fuel oil	0.25	0.19	0.13	0.13
110A Petrol coke 224A Other oil products	20 (all years)			
Other Fuels				
111A Fuel wood	26.3	26.3	21.15	21.15
116A Wood waste: Public Power [0101]	21 (all years)			
116A Wood waste: District Heating [0102]	50 (all years)			
115A Industrial waste (< 50 MW)	50 (all years)			

The following table presents Hg emission factors of several waste categories. Emission factors 2006 are derived from actual measurements (UMWELTBUNDESAMT 2007).

Table 73: Pb emission factors for waste for Sector 1 A 1 Energy Industries.

Lead EF [mg/t Waste]	1985	1990	1995	2006
114B Municipal waste	30 000	1 170	150	36
115A Industrial waste (> 50 MW)	8 300	2 400	10	10
118A Sewage sludge	–	730	6	6

Emission factors for POPs used in NFR 1 A 1

Fossil fuels

The dioxin emission factor for coal and gas were taken from (WURST & HÜBNER 1997), for fuel oil the value given in the same study and new measurements were considered (FTU 2000).

The HCB emission factor for coal was taken from (BAILY 2001).

The PAK emission factors are based on results from (UBA BERLIN 1998), (BAAS et al. 1995), (ORTHOFER & VESSELY 1990) and measurements by FTU.

Other fuels

The dioxin emission factor for wood bases on measurements at Austrian plants > 1 MW (FTU 2000).

The PAK emission factors are based on results from (UBA BERLIN 1998) and (BAAS et al. 1995).

Gasworks

Default national emission factors of industrial boilers were selected. For *224A Other Oil Products* the emission factors of *303A LPG* were selected.

Table 74: POP emission factors for Sector 1 A 1 Energy Industries.

EF	Dioxin [µg/GJ]	HCB [µg/GJ]	PAK4 [mg/GJ]
Coal			
Coal (102A, 105A, 106A)	0.0015	0.46	0.0012
Fuel Oil			
Fuel Oil (203B, 203C, 203D, 204A) exc. Gasworks, 110A Petrol coke	0.0004	0.08	0.16
203D Heavy fuel oil in gasworks	0.009	0.12	0.24
224A Other oil products in gasworks	0.0017	0.14	0.011
308A Refinery gas	0.0006	0.04	NA
Gas			
301A, 303A Natural gas and LPG exc. SNAP 010202, 010301	0.0002	0.04	NA
301A, 303A Natural gas and LPG, SNAP 010202, 010301	0.0004	0.08	NA
Other Fuels			
115A Industrial waste/unspecified	0.024	14.48	0.174
Biomass			
111A Wood (> 1 MW) 116A Wood waste (> 1 MW)	0.01	2.0	0.2
111A Wood (< 1 MW) 116A Wood waste (< 1 MW)	0.14	28.0	2.4
116A Wood waste/Straw	0.12	24.0	3.7
309A, 309B, 310A Gaseous biofuels	0.0006	0.072	0.032

Waste emissions factors are expressed as per ton of dry substance and derived from plant specific measurements (UMWELTBUNDESAMT 2002, 2007). Comma separated values indicate plant specific emissions factors.

Table 75: POP emission factors for Sector 1 A 1 Energy Industries.

EF	Dioxin [µg/t]	HCB [µg/t]	PAK4 [mg/t]
114B Municipal Waste	0.09	247.0	0.7; 0.13
115A Industrial waste	0.21	126.0	0.16
118A Sewage Sludge	0.09	20.0	0.09

Emission factors for PM used in NFR 1 A 1

As already described in Chapter 1.3 the emission inventories of PM for different years were prepared by contractors and incorporated into the inventory system afterwards.

Large point sources (LPS)

In a first step large point sources (LPS) are considered. The UMWELTBUNDESAMT is operating a database to store plant specific data, called *„Dampfkesseldatenbank"* (DKDB) which includes data on fuel consumption, NO_x, SO_x, CO and PM emissions from boilers with a thermal capacity greater than 3 MW for all years from 1990 onwards. These data are used to generate a sectoral split of the categories *Public Power* and *District Heating*, with further distinction between the two categories ≥ *300 MW* and ≥ *50 MW to 300 MW* of thermal capacity. Currently 56 boilers are considered with this approach.

The fuel consumption of all considered point sources is subtracted from the total consumption of this category which is taken from the energy balance. The other combustion plants are considered as area source.

For point sources ≥ 50 MW plant specific emission and activity data from the DKDB were used. The 'implied emission factors', which are calculated by division of emissions by activity data, are given in Table 76.

Emission factors 2000 to 2006 for the fuel type **wood waste** were taken from (UMWELTBUNDESAMT 2006c).

The shares of PM10 and PM2.5 were taken from (WINIWARTER et al. 2001).

Table 76: PM implied emission factors (IEF) for LPS in NFR 1 A1 Energy Industries.

	TSP IEF [g/GJ]				%PM10	%PM2.5
	1990	1995	2000	2006	[%]	[%]
Public Power (0101)(1)	5.51	3.34	2.69	2.43	95	80
District Heating (0102) (1)	3.89	1.41	0.75	1.11	95	80
Petroleum Refining (010301)(2)	3,9	2,4	3.0	2.1	95	80
Wood waste (116A)	55	55	22	22	90	75

(1) *Used fuels are 102A, 105A, 111A, 115A, 118A, 203B, 203C, 203D, 301A*

(2) *Used fuels: Refinery gas (308A), FCC coke (110A), Residual Fuel Oil (203D), LPG (303A), Other oil products (224A) and Natural gas (301A)*

Area sources

In a second step the emissions of the **area source** are calculated. Emissions of plants < 50 MW are calculated by multiplying emission factors with the corresponding activity.

Coal and gas

The emission factors for **coal** and **gas** were taken from (WINIWARTER et al. 2001) and are valid for the whole time series.

Oil

The emission factor for **high-sulphur fuel** (203D) **medium-sulphur fuel** (203C) and **low-sulphur fuel** (203B) base on an analysis of Austrian combustion plants regarding limit values (TSP: 70 mg/Nm³, 60 mg/Nm³ and 50 mg/Nm³) (UMWELTBUNDESAMT 2006c), these values were used for all years.

The emission factor for **heating and other gas oil** (204A) was taken from (WINIWARTER et al. 2001) and used for all years.[88]

For diesel the emission factors for heavy duty vehicles and locomotives as described in Chapter 4.3 were used.

Other Fuels

Emission factors for **wood** and **wood waste** (111A and 116A)**, MSW renewable, MSW non-renewable** and **industrial waste** (114B and 115A) and **low-sulphur fuel** (203B) for the years 1990 and 1995 were taken from (WINIWARTER et al. 2001), for the years afterwards an updated value from (UMWELTBUNDESAMT 2006c) has been used.

The emission factor for **biogas, sewage sludge gas** and **landfill gas** (309B and 310A) were taken from (WINIWARTER et al. 2001) and used for all years.

The shares of PM10 and PM2.5 were taken from (WINIWARTER et al. 2001).

Table 77: PM emission factors for combustion plants (< 50 MW) in NFR 1 A 1.

	TSP Emission Factors [g/GJ]				PM10	PM2.5
	1990	1995	2000	2005	[%]	[%]
Gas						
301A and 303A	0.50				90	75
Coal						
102A	45.00				90	75
105A and 106 A	50.00				90	75
Oil						
203B	16.00				90	75
203D	22.00				90	80
204A	1.00				90	80
224A	0.50				90	75
2050	50				100	100
Other Fuels						
111A and 116A	55.00	55.00	22.00	22.00	90	75
114B and 115 A	9.00	9.00	1.00	1.00	95	80
309B and 310A	0.50				90	75

[88] a of central heating plants in houses (Hauszentralheizung – HZH)

4.2.4 NFR 1 A 2 Manufacturing Industry and Combustion

NFR Category *1 A 2 Manufacturing Industries and Construction* comprises emissions from fuel combustion in the sub categories

- iron and steel (NFR 1 A 2 a),
- non-ferrous metals (NFR 1 A 2 b),
- chemicals (NFR 1 A 2 c),
- pulp, paper and print (NFR 1 A 2 d),
- food processing, beverages and tobacco (NFR 1 A 2 e),
- other (NFR 1 A 2 f)
  - other-mobile in industry (NFR 1 A 2 f 1)[89]
  - other-stationary in industry (NFR 1 A 2 f 2).

While on the one hand total fuel consumption increased by 30% from 209.5 PJ in 1990 to 272.5 PJ in 2006, total output in industrial production increased over this period.

Since 1990 a decrease in emission due to fuel switches and the implementation of abatement techniques could be noted for

- SO_2 emissions (-44%)
- NO_x emissions (-20%)
- NMVOC emissions (-25%)
- CO emissions (-28%)
- TSP, PM10, PM2.5 emissions (-26%, -31%, -36%)
- Cd, Pb and Hg emissions (-49%, -66%, -68%)
- dioxin/furan emissions (-90%)
- HCB emissions (-91%).

An increase in emissions mainly driven by the increase of natural gas and biomass consumption, whereas consumption of liquid fossil fuels decreased, could be noted for

- NH_3 emissions (+27%)
- PAH emissions (+44%).

In the following Tables the emission trends per sub category are presented.

[89] methodologies for mobile sources are described in Chapter 4.3

Table 78: SO_2 emissions and trends from Sector 1 A 2 Manufacturing Industry and Combustion and source categories 1990–2006.

Year	SO_2 [Gg]	1	1 A	1 A 2	1 A 2 a	1 A 2 b	1 A 2 c	1 A 2 d	1 A 2 e	1 A 2 f	1 A 2 f 1	1 A 2 f 2
1990		72.03	70.03	18.49	6.73	0.15	0.76	4.30	1.65	4.91	0.82	4.09
1991		69.46	68.16	17.76	5.35	0.13	0.80	4.91	1.92	4.65	0.85	3.80
1992		53.32	51.32	11.19	3.48	0.06	0.57	2.60	0.90	3.58	0.86	2.72
1993		51.92	49.82	11.79	3.94	0.12	0.56	2.25	0.78	4.14	0.83	3.30
1994		46.14	44.86	11.43	4.24	0.12	0.61	2.21	0.89	3.37	0.73	2.64
1995		45.43	43.90	10.76	4.22	0.09	0.53	1.97	0.73	3.22	0.26	2.96
1996		43.27	42.07	12.19	4.76	0.13	0.65	1.96	0.52	4.17	0.25	3.91
1997		38.84	38.78	13.89	4.75	0.18	0.74	2.02	0.58	5.61	0.26	5.36
1998		34.33	34.29	11.84	4.70	0.16	0.66	1.71	0.48	4.13	0.26	3.87
1999		32.62	32.47	10.30	4.73	0.17	0.78	1.30	0.31	3.01	0.23	2.78
2000		30.47	30.33	9.84	4.46	0.16	0.72	1.22	0.54	2.73	0.23	2.49
2001		31.43	31.27	9.56	4.79	0.10	0.68	1.10	0.40	2.49	0.24	2.25
2002		30.37	30.24	9.80	4.90	0.16	0.70	1.31	0.56	2.16	0.24	1.92
2003		31.17	31.02	10.01	5.04	0.13	0.76	1.17	0.42	2.49	0.24	2.25
2004		25.66	25.51	9.11	4.71	0.11	0.73	1.17	0.29	2.10	0.04	2.06
2005		25.37	25.24	9.49	5.23	0.09	0.66	1.17	0.24	2.10	0.04	2.06
2006		27.18	27.01	10.29	5.76	0.10	0.44	1.17	0.24	2.58	0.04	2.55
Trend												
1990–2006		*-62.3%*	*-61.4%*	*-44.3%*	*-14.4%*	*-32.8%*	*-42.2%*	*-72.7%*	*-85.4%*	*-47.4%*	*-95.5%*	*-37.8%*
2005–2006		*7.1%*	*7.0%*	*8.5%*	*10.2%*	*5.2%*	*-33.7%*	*0.0%*	*2.0%*	*23.1%*	*1.1%*	*23.5%*
Share in Sector 1 A 2 Manufacturing Industry and Combustion												
1990				*100.0%*	*36.4%*	*0.8%*	*4.1%*	*23.3%*	*8.9%*	*26.6%*	*4.4%*	*22.1%*
2006				*100.0%*	*56.0%*	*1.0%*	*4.2%*	*11.4%*	*2.3%*	*25.1%*	*0.4%*	*24.7%*
Share in National Total												
1990		*96.9%*	*94.2%*	*24.9%*	*9.1%*	*0.2%*	*1.0%*	*5.8%*	*2.2%*	*6.6%*	*1.1%*	*5.5%*
2006		*95.5%*	*94.9%*	*36.2%*	*20.2%*	*0.3%*	*1.5%*	*4.1%*	*0.8%*	*9.1%*	*0.1%*	*8.9%*

Table 79: NO_x emissions and trends from Sector 1 A 2 Manufacturing Industry and Combustion and source categories 1990–2006.

Year	NO_x [Gg] 1	1 A	1 A 2	1 A 2 a	1 A 2 b	1 A 2 c	1 A 2 d	1 A 2 e	1 A 2 f	1 A 2 f 1	1 A 2 f 2
1990	181.43	181.43	44.31	5.41	0.25	1.69	7.00	1.74	28.22	14.59	13.63
1991	191.77	191.77	45.41	5.44	0.21	1.52	7.78	1.77	28.69	15.18	13.52
1992	181.32	181.32	41.98	4.51	0.19	1.45	6.33	1.46	28.05	15.33	12.71
1993	178.50	178.50	42.05	4.90	0.22	1.37	6.48	1.32	27.75	14.84	12.91
1994	172.61	172.61	42.29	4.57	0.29	1.16	6.90	1.27	28.11	15.72	12.38
1995	173.72	173.72	40.11	4.86	0.22	1.01	6.14	1.09	26.79	15.36	11.43
1996	196.48	196.48	39.55	4.75	0.18	1.17	5.50	0.93	27.02	15.08	11.94
1997	185.57	185.57	42.21	4.90	0.24	1.31	6.56	1.08	28.12	15.70	12.42
1998	200.67	200.67	40.64	4.95	0.22	1.17	5.82	0.95	27.52	16.18	11.34
1999	191.64	191.64	38.72	4.69	0.20	1.64	5.56	0.89	25.73	15.00	10.73
2000	198.16	198.16	37.57	4.66	0.20	1.54	5.01	1.07	25.09	14.47	10.62
2001	207.84	207.84	36.26	4.37	0.19	1.38	4.94	0.98	24.39	14.03	10.36
2002	217.39	217.39	36.67	4.65	0.21	1.39	4.98	1.19	24.25	13.61	10.64
2003	228.75	228.75	35.78	4.66	0.21	1.43	4.84	0.99	23.66	12.45	11.21
2004	226.71	226.71	34.36	4.30	0.20	1.42	4.72	0.88	22.83	11.63	11.20
2005	229.95	229.95	34.52	5.09	0.20	1.40	5.07	0.78	21.99	11.22	10.77
2006	218.27	218.27	35.37	5.23	0.21	1.20	5.12	0.78	22.83	10.74	12.09
Trend											
1990–2006	*20.3%*	*20.3%*	*-20.2%*	*-3.3%*	*-19.1%*	*-29.0%*	*-26.9%*	*-55.0%*	*-19.1%*	*-26.4%*	*-11.3%*
2005–2006	*-5.1%*	*-5.1%*	*2.5%*	*2.9%*	*5.0%*	*-14.4%*	*1.0%*	*0.1%*	*3.8%*	*-4.3%*	*12.3%*
Share in Sector 1 A 2 Manufacturing Industry and Combustion											
1990			*100.0%*	*12.2%*	*0.6%*	*3.8%*	*15.8%*	*3.9%*	*63.7%*	*32.9%*	*30.8%*
2006			*100.0%*	*14.8%*	*0.6%*	*3.4%*	*14.5%*	*2.2%*	*64.6%*	*30.4%*	*34.2%*
Share in National Total											
1990	*94.3%*	*94.3%*	*23.0%*	*2.8%*	*0.1%*	*0.9%*	*3.6%*	*0.9%*	*14.7%*	*7.6%*	*7.1%*
2006	*96.9%*	*96.9%*	*15.7%*	*2.3%*	*0.1%*	*0.5%*	*2.3%*	*0.3%*	*10.1%*	*4.8%*	*5.4%*

Table 80: NMVOC emissions and trends from Sector 1 A 2 Manufacturing Industry and Combustion and source categories 1990–2006.

Year NMVOC [Gg]	1	1 A	1 A 2	1 A 2 a	1 A 2 b	1 A 2 c	1 A 2 d	1 A 2 e	1 A 2 f	1 A 2 f 1	1 A 2 f 2
1990	153.12	140.91	4.087	0.075	0.003	0.099	0.741	0.021	3.147	2.872	0.276
1991	160.54	147.38	4.234	0.063	0.003	0.122	0.737	0.026	3.284	2.993	0.291
1992	152.39	139.26	4.199	0.053	0.002	0.143	0.650	0.020	3.331	3.035	0.296
1993	149.88	137.03	4.067	0.063	0.003	0.106	0.626	0.016	3.252	2.945	0.307
1994	138.58	128.32	3.983	0.074	0.004	0.107	0.595	0.020	3.184	2.911	0.273
1995	133.70	124.88	3.855	0.073	0.003	0.120	0.565	0.017	3.077	2.834	0.243
1996	131.19	123.28	3.731	0.073	0.003	0.148	0.481	0.014	3.013	2.723	0.291
1997	112.62	105.26	3.742	0.080	0.004	0.138	0.442	0.015	3.062	2.683	0.379
1998	106.59	100.74	3.553	0.077	0.004	0.121	0.368	0.014	2.970	2.663	0.307
1999	100.46	95.32	3.296	0.076	0.004	0.135	0.299	0.014	2.769	2.453	0.315
2000	92.52	87.36	3.146	0.101	0.004	0.150	0.221	0.019	2.650	2.344	0.307
2001	89.55	86.23	3.101	0.097	0.003	0.159	0.222	0.018	2.602	2.250	0.352
2002	85.37	81.89	2.988	0.097	0.005	0.178	0.228	0.024	2.457	2.160	0.297
2003	83.37	79.93	3.000	0.229	0.004	0.198	0.225	0.018	2.326	2.033	0.293
2004	77.73	74.46	3.024	0.260	0.003	0.253	0.231	0.014	2.262	1.964	0.298
2005	75.19	72.10	3.060	0.298	0.003	0.215	0.248	0.013	2.283	1.908	0.375
2006	70.12	66.99	3.062	0.327	0.003	0.163	0.253	0.013	2.302	1.845	0.457
Trend											
1990–2006	*-54.2%*	*-52.5%*	*-25.1%*	*335.7%*	*17.3%*	*64.1%*	*-65.9%*	*-38.2%*	*-26.8%*	*-35.7%*	*65.8%*
2005–2006	*-6.8%*	*-7.1%*	*0.1%*	*9.9%*	*7.3%*	*-24.2%*	*1.9%*	*-1.2%*	*0.9%*	*-3.3%*	*21.8%*
Share in Sector 1 A 2 Manufacturing Industry and Combustion											
1990			*100.0%*	*1.8%*	*0.1%*	*2.4%*	*18.1%*	*0.5%*	*77.0%*	*70.3%*	*6.7%*
2006			*100.0%*	*10.7%*	*0.1%*	*5.3%*	*8.3%*	*0.4%*	*75.2%*	*60.3%*	*14.9%*
Share in National Total											
1990	*54.1%*	*49.8%*	*1.4%*	*0.0%*	*0.0%*	*0.0%*	*0.3%*	*0.0%*	*1.1%*	*1.0%*	*0.1%*
2006	*40.9%*	*39.0%*	*1.8%*	*0.2%*	*0.0%*	*0.1%*	*0.1%*	*0.0%*	*1.3%*	*1.1%*	*0.3%*

Table 81: CO emissions and trends from Sector 1 A 2 Manufacturing Industry and Combustion and source categories 1990–2006.

Year	CO [Gg] 1	1 A	1 A 2	1 A 2 a	1 A 2 b	1 A 2 c	1 A 2 d	1 A 2 e	1 A 2 f	1 A 2 f 1	1 A 2 f 2
1990	1385.17	1385.17	235.59	210.72	0.05	0.80	4.08	0.20	19.74	8.78	10.96
1991	1459.72	1459.72	211.66	185.44	0.04	0.92	4.11	0.20	20.95	9.18	11.77
1992	1424.19	1424.19	252.95	226.94	0.03	1.08	3.73	0.16	21.01	9.36	11.65
1993	1389.45	1389.45	262.45	237.42	0.04	0.86	3.73	0.19	20.22	9.11	11.11
1994	1319.28	1319.28	275.01	250.64	0.05	0.80	3.58	0.17	19.78	8.86	10.92
1995	1211.36	1211.36	203.44	182.16	0.04	0.85	3.43	0.15	16.81	8.63	8.18
1996	1196.34	1196.34	227.98	206.70	0.04	1.07	2.96	0.12	17.09	8.26	8.83
1997	1106.65	1106.65	232.32	211.64	0.05	1.09	2.92	0.13	16.48	8.08	8.40
1998	1064.77	1064.77	217.43	197.84	0.04	0.96	2.39	0.12	16.08	7.98	8.10
1999	994.48	994.48	196.38	176.62	0.05	1.20	2.13	0.13	16.25	7.62	8.62
2000	922.83	922.83	183.20	164.53	0.05	1.19	1.62	0.20	15.61	7.43	8.18
2001	897.49	897.49	159.69	140.83	0.03	1.14	1.67	0.17	15.85	7.27	8.57
2002	866.16	866.16	152.33	134.42	0.04	1.23	1.75	0.19	14.69	7.12	7.58
2003	868.00	868.00	166.19	147.24	0.04	1.35	1.70	0.17	15.69	6.90	8.79
2004	825.04	825.04	172.21	153.17	0.04	1.63	1.74	0.15	15.48	6.89	8.59
2005	791.69	791.69	156.90	138.26	0.04	1.37	1.88	0.13	15.22	6.82	8.40
2006	754.06	754.06	168.71	148.00	0.04	1.29	2.01	0.13	17.24	6.73	10.50
Trend											
1990–2006	*-45.6%*	*-45.6%*	*-28.4%*	*-29.8%*	*-8.7%*	*62.6%*	*-50.8%*	*-35.1%*	*-12.7%*	*-23.4%*	*-4.2%*
2005–2006	*-4.8%*	*-4.8%*	*7.5%*	*7.0%*	*10.7%*	*-5.8%*	*6.7%*	*-2.1%*	*13.3%*	*-1.3%*	*25.1%*
Share in Sector 1 A 2 Manufacturing Industry and Combustion											
1990			*100.0%*	*89.4%*	*0.0%*	*0.3%*	*1.7%*	*0.1%*	*8.4%*	*3.7%*	*4.7%*
2006			*100.0%*	*87.7%*	*0.0%*	*0.8%*	*1.2%*	*0.1%*	*10.2%*	*4.0%*	*6.2%*
Share in National Total											
1990	*95.9%*	*95.9%*	*16.3%*	*14.6%*	*0.0%*	*0.1%*	*0.3%*	*0.0%*	*1.4%*	*0.6%*	*0.8%*
2006	*96.0%*	*96.0%*	*21.5%*	*18.8%*	*0.0%*	*0.2%*	*0.3%*	*0.0%*	*2.2%*	*0.9%*	*1.3%*

Table 82: NH_3 emissions and trends from Sector 1 A 2 Manufacturing Industry and Combustion and source categories 1990–2006.

Year	NH_3 [Gg] 1	1 A	1 A 2	1 A 2 a	1 A 2 b	1 A 2 c	1 A 2 d	1 A 2 e	1 A 2 f	1 A 2 f 1	1 A 2 f 2
1990	4.280	4.280	0.225	0.027	0.002	0.027	0.066	0.021	0.081	0.004	0.077
1991	5.848	5.848	0.241	0.028	0.002	0.026	0.078	0.023	0.085	0.004	0.080
1992	6.669	6.669	0.219	0.026	0.002	0.027	0.065	0.021	0.077	0.004	0.073
1993	7.451	7.451	0.247	0.027	0.003	0.024	0.081	0.022	0.089	0.004	0.085
1994	7.656	7.656	0.263	0.029	0.005	0.022	0.095	0.022	0.090	0.004	0.086
1995	7.490	7.490	0.253	0.033	0.005	0.022	0.084	0.023	0.086	0.004	0.082
1996	7.012	7.012	0.247	0.032	0.003	0.027	0.070	0.020	0.094	0.004	0.090
1997	6.519	6.519	0.280	0.037	0.005	0.030	0.094	0.024	0.091	0.004	0.087
1998	6.552	6.552	0.250	0.042	0.004	0.025	0.072	0.021	0.086	0.004	0.083
1999	5.919	5.919	0.287	0.041	0.004	0.041	0.079	0.021	0.103	0.004	0.099
2000	5.423	5.423	0.264	0.046	0.004	0.036	0.059	0.023	0.096	0.004	0.093
2001	5.276	5.276	0.266	0.048	0.004	0.027	0.067	0.023	0.097	0.004	0.094
2002	5.225	5.225	0.253	0.041	0.004	0.025	0.067	0.026	0.089	0.004	0.086
2003	5.046	5.046	0.255	0.038	0.004	0.026	0.069	0.022	0.096	0.003	0.092
2004	4.547	4.547	0.249	0.042	0.004	0.026	0.063	0.020	0.093	0.003	0.090
2005	4.170	4.170	0.263	0.049	0.004	0.028	0.066	0.019	0.098	0.003	0.094
2006	3.762	3.762	0.287	0.048	0.004	0.025	0.067	0.019	0.123	0.003	0.120
Trend											
1990–2006	*-12.1%*	*-12.1%*	*27.4%*	*76.0%*	*95.3%*	*-4.6%*	*1.8%*	*-12.0%*	*51.3%*	*-25.8%*	*55.5%*
2005–2006	*-9.8%*	*-9.8%*	*9.1%*	*-1.8%*	*2.9%*	*-8.9%*	*2.5%*	*1.6%*	*25.9%*	*-2.8%*	*26.9%*
Share in Sector 1 A 2 Manufacturing Industry and Combustion											
1990			*100.0%*	*12.1%*	*0.9%*	*11.9%*	*29.5%*	*9.5%*	*36.1%*	*1.9%*	*34.2%*
2006			*100.0%*	*16.7%*	*1.4%*	*8.9%*	*23.5%*	*6.6%*	*42.9%*	*1.1%*	*41.8%*
Share in National Total											
1990	*6.0%*	*6.0%*	*0.3%*	*0.0%*	*0.0%*	*0.0%*	*0.1%*	*0.0%*	*0.1%*	*0.0%*	*0.1%*
2006	*5.7%*	*5.7%*	*0.4%*	*0.1%*	*0.0%*	*0.0%*	*0.1%*	*0.0%*	*0.2%*	*0.0%*	*0.2%*

Table 83: Cd emissions and trends from Sector 1 A 2 Manufacturing Industry and Combustion and source categories 1990–2006.

Year	Cd [Mg] 1	1 A	1 A 2	1 A 2 a	1 A 2 b	1 A 2 c	1 A 2 d	1 A 2 e	1 A 2 f	1 A 2 f 1	1 A 2 f 2
1990	1.0591	1.0591	0.3824	0.0061	0.0842	0.0283	0.1438	0.0020	0.1180	0.0003	0.1178
1991	1.0909	1.0909	0.3660	0.0056	0.0672	0.0275	0.1305	0.0022	0.1330	0.0003	0.1327
1992	0.9746	0.9746	0.3215	0.0045	0.0443	0.0269	0.1146	0.0015	0.1297	0.0003	0.1294
1993	0.9392	0.9392	0.2997	0.0038	0.0322	0.0153	0.1134	0.0013	0.1338	0.0003	0.1335
1994	0.8792	0.8792	0.2827	0.0039	0.0291	0.0120	0.0987	0.0012	0.1378	0.0003	0.1375
1995	0.8104	0.8104	0.2226	0.0039	0.0294	0.0094	0.0784	0.0009	0.1005	0.0003	0.1003
1996	0.8437	0.8437	0.2046	0.0039	0.0251	0.0128	0.0703	0.0005	0.0921	0.0003	0.0918
1997	0.8039	0.8039	0.1910	0.0036	0.0229	0.0121	0.0776	0.0005	0.0743	0.0003	0.0741
1998	0.7353	0.7353	0.1522	0.0039	0.0207	0.0096	0.0714	0.0004	0.0462	0.0003	0.0459
1999	0.8035	0.8035	0.1793	0.0038	0.0185	0.0148	0.0795	0.0007	0.0619	0.0003	0.0617
2000	0.7591	0.7591	0.1626	0.0042	0.0163	0.0140	0.0716	0.0009	0.0557	0.0003	0.0554
2001	0.7951	0.7951	0.1547	0.0040	0.0163	0.0105	0.0741	0.0008	0.0489	0.0003	0.0486
2002	0.8042	0.8042	0.1478	0.0037	0.0164	0.0112	0.0728	0.0010	0.0427	0.0003	0.0424
2003	0.8313	0.8313	0.1590	0.0036	0.0163	0.0127	0.0735	0.0007	0.0523	0.0003	0.0520
2004	0.8287	0.8287	0.1638	0.0040	0.0163	0.0162	0.0755	0.0003	0.0514	0.0003	0.0511
2005	0.8829	0.8829	0.1766	0.0041	0.0163	0.0152	0.0825	0.0008	0.0576	0.0003	0.0573
2006	0.8990	0.8990	0.1961	0.0044	0.0163	0.0149	0.0859	0.0009	0.0736	0.0003	0.0733
Trend											
1990–2006	*-15.1%*	*-15.1%*	*-48.7%*	*-28.0%*	*-80.6%*	*-47.2%*	*-40.2%*	*-55.7%*	*-37.6%*	*16.9%*	*-37.8%*
2005–2006	*1.8%*	*1.8%*	*11.0%*	*6.3%*	*0.0%*	*-1.9%*	*4.1%*	*7.4%*	*27.9%*	*1.6%*	*28.0%*
Share in Sector 1 A 2 Manufacturing Industry and Combustion											
1990			*100.0%*	*1.6%*	*22.0%*	*7.4%*	*37.6%*	*0.5%*	*30.9%*	*0.1%*	*30.8%*
2006			*100.0%*	*2.2%*	*8.3%*	*7.6%*	*43.8%*	*0.5%*	*37.5%*	*0.2%*	*37.4%*
Share in National Total											
1990	*67.1%*	*67.1%*	*24.2%*	*0.4%*	*5.3%*	*1.8%*	*9.1%*	*0.1%*	*7.5%*	*0.0%*	*7.5%*
2006	*79.9%*	*79.9%*	*17.4%*	*0.4%*	*1.4%*	*1.3%*	*7.6%*	*0.1%*	*6.5%*	*0.0%*	*6.5%*

Table 84: Hg emissions and trends from Sector 1 A 2 Manufacturing Industry and Combustion and source categories 1990–2006.

Year	Hg [Mg]	1	1 A	1 A 2	1 A 2 a	1 A 2 b	1 A 2 c	1 A 2 d	1 A 2 e	1 A 2 f	1 A 2 f 1	1 A 2 f 2
1990		1.5600	1.5600	0.7962	0.0003	0.0073	0.0115	0.0663	0.0010	0.7098	0.0001	0.7097
1991		1.4994	1.4994	0.6791	0.0001	0.0067	0.0129	0.0688	0.0011	0.5895	0.0001	0.5894
1992		1.1802	1.1802	0.5278	0.0000	0.0060	0.0151	0.0641	0.0006	0.4419	0.0001	0.4418
1993		0.9554	0.9554	0.3899	0.0006	0.0058	0.0112	0.0705	0.0009	0.3008	0.0001	0.3007
1994		0.7580	0.7580	0.2427	0.0006	0.0063	0.0098	0.0707	0.0007	0.1546	0.0001	0.1545
1995		0.7129	0.7129	0.1855	0.0006	0.0062	0.0075	0.0659	0.0004	0.1048	0.0001	0.1047
1996		0.7082	0.7082	0.1773	0.0005	0.0081	0.0099	0.0583	0.0003	0.1001	0.0001	0.1000
1997		0.6828	0.6828	0.1998	0.0005	0.0082	0.0108	0.0619	0.0003	0.1181	0.0001	0.1180
1998		0.6004	0.6004	0.1796	0.0004	0.0082	0.0094	0.0593	0.0003	0.1021	0.0001	0.1020
1999		0.6480	0.6480	0.2041	0.0002	0.0082	0.0132	0.0637	0.0004	0.1184	0.0001	0.1183
2000		0.6432	0.6432	0.2011	0.0002	0.0082	0.0117	0.0611	0.0011	0.1188	0.0001	0.1187
2001		0.6994	0.6994	0.2277	0.0002	0.0080	0.0099	0.0609	0.0008	0.1479	0.0001	0.1478
2002		0.6640	0.6640	0.2263	0.0002	0.0082	0.0102	0.0612	0.0009	0.1457	0.0001	0.1456
2003		0.7000	0.7000	0.2453	0.0002	0.0081	0.0110	0.0607	0.0008	0.1644	0.0001	0.1643
2004		0.6518	0.6518	0.2252	0.0002	0.0081	0.0127	0.0634	0.0006	0.1402	0.0001	0.1401
2005		0.6700	0.6700	0.2446	0.0005	0.0081	0.0107	0.0685	0.0006	0.1563	0.0001	0.1562
2006		0.6934	0.6934	0.2687	0.0007	0.0081	0.0098	0.0696	0.0006	0.1799	0.0001	0.1798
Trend												
1990–2006		*-55.6%*	*-55.6%*	*-66.3%*	*150.3%*	*11.6%*	*-15.3%*	*4.9%*	*-38.4%*	*-74.7%*	*16.9%*	*-74.7%*
2005–2006		*3.5%*	*3.5%*	*9.8%*	*45.4%*	*0.5%*	*-8.4%*	*1.6%*	*-3.4%*	*15.1%*	*1.6%*	*15.1%*
Share in Sector 1 A 2 Manufacturing Industry and Combustion												
1990				*100.0%*	*0.0%*	*0.9%*	*1.4%*	*8.3%*	*0.1%*	*89.2%*	*0.0%*	*89.1%*
2006				*100.0%*	*0.2%*	*3.0%*	*3.6%*	*25.9%*	*0.2%*	*67.0%*	*0.0%*	*66.9%*
Share in National Total												
1990		*72.8%*	*72.8%*	*37.2%*	*0.0%*	*0.3%*	*0.5%*	*3.1%*	*0.0%*	*33.1%*	*0.0%*	*33.1%*
2006		*67.6%*	*67.6%*	*26.2%*	*0.1%*	*0.8%*	*1.0%*	*6.8%*	*0.1%*	*17.6%*	*0.0%*	*17.5%*

Table 85: Pb emissions and trends from Sector 1 A 2 Manufacturing Industry and Combustion and source categories 1990–2006.

Year	Pb [Mg]	1	1 A	1 A 2	1 A 2 a	1 A 2 b	1 A 2 c	1 A 2 d	1 A 2 e	1 A 2 f	1 A 2 f 1	1 A 2 f 2
1990		174.17	174.17	9.713	0.265	4.082	0.206	0.618	0.005	4.536	0.173	4.364
1991		143.81	143.81	9.633	0.243	3.788	0.238	0.611	0.005	4.748	0.151	4.597
1992		100.67	100.67	8.002	0.199	2.986	0.269	0.606	0.003	3.939	0.123	3.816
1993		70.61	70.61	7.380	0.158	2.801	0.180	0.670	0.005	3.566	0.090	3.475
1994		47.31	47.31	7.070	0.165	2.654	0.180	0.679	0.004	3.389	0.057	3.333
1995		11.33	11.33	7.116	0.167	3.111	0.202	0.692	0.003	2.941	0.000	2.941
1996		11.18	11.18	6.668	0.158	3.112	0.260	0.645	0.002	2.491	0.000	2.491
1997		9.64	9.64	5.530	0.161	2.614	0.228	0.674	0.002	1.851	0.000	1.851
1998		8.23	8.23	4.433	0.179	2.089	0.188	0.618	0.001	1.357	0.000	1.357
1999		7.53	7.53	3.699	0.171	1.564	0.229	0.700	0.005	1.030	0.000	1.030
2000		6.42	6.42	2.621	0.180	1.039	0.256	0.624	0.008	0.513	0.000	0.513
2001		6.70	6.70	2.689	0.181	1.052	0.245	0.653	0.007	0.552	0.000	0.551
2002		6.76	6.76	2.682	0.170	1.053	0.277	0.646	0.007	0.529	0.000	0.529
2003		6.95	6.95	2.701	0.165	1.053	0.319	0.651	0.006	0.508	0.000	0.508
2004		7.12	7.12	2.862	0.182	1.053	0.429	0.672	0.003	0.522	0.000	0.521
2005		7.16	7.16	2.919	0.185	1.053	0.378	0.734	0.008	0.562	0.000	0.561
2006		7.49	7.49	3.093	0.196	1.053	0.375	0.769	0.008	0.692	0.000	0.692
Trend												
1990–2006		*-95.7%*	*-95.7%*	*-68.2%*	*-26.0%*	*-74.2%*	*81.8%*	*24.4%*	*48.5%*	*-84.7%*	*-99.8%*	*-84.2%*
2005–2006		*4.5%*	*4.5%*	*6.0%*	*6.0%*	*0.0%*	*-0.8%*	*4.8%*	*3.4%*	*23.2%*	*1.6%*	*23.2%*
Share in Sector 1 A 2 Manufacturing Industry and Combustion												
1990				*100.0%*	*2.7%*	*42.0%*	*2.1%*	*6.4%*	*0.1%*	*46.7%*	*1.8%*	*44.9%*
2006				*100.0%*	*6.3%*	*34.0%*	*12.1%*	*24.9%*	*0.3%*	*22.4%*	*0.0%*	*22.4%*
Share in National Total												
1990		*84.0%*	*84.0%*	*4.7%*	*0.1%*	*2.0%*	*0.1%*	*0.3%*	*0.0%*	*2.2%*	*0.1%*	*2.1%*
2006		*53.0%*	*53.0%*	*21.9%*	*1.4%*	*7.5%*	*2.7%*	*5.4%*	*0.1%*	*4.9%*	*0.0%*	*4.9%*

Table 86: PAH emissions and trends from Sector 1 A 2 Manufacturing Industry and Combustion and source categories 1990–2006.

Year	PAH [Mg] 1	1 A	1 A 2	1 A 2 a	1 A 2 b	1 A 2 c	1 A 2 d	1 A 2 e	1 A 2 f	1 A 2 f 1	1 A 2 f 2
1990	9.4726	9.4726	0.1298	0.0005	0.0005	0.0175	0.0030	0.0017	0.1066	0.0891	0.0175
1991	10.3180	10.3180	0.1379	0.0003	0.0004	0.0197	0.0033	0.0019	0.1123	0.0927	0.0196
1992	9.3984	9.3984	0.1391	0.0002	0.0002	0.0228	0.0030	0.0015	0.1113	0.0937	0.0176
1993	9.2827	9.2827	0.1317	0.0008	0.0004	0.0167	0.0031	0.0020	0.1087	0.0908	0.0179
1994	8.3950	8.3950	0.1315	0.0008	0.0003	0.0153	0.0038	0.0017	0.1096	0.0932	0.0164
1995	8.8506	8.8506	0.1275	0.0009	0.0003	0.0162	0.0036	0.0014	0.1051	0.0912	0.0139
1996	9.5661	9.5661	0.1343	0.0009	0.0004	0.0216	0.0036	0.0011	0.1067	0.0887	0.0180
1997	8.5827	8.5827	0.1340	0.0008	0.0006	0.0221	0.0041	0.0013	0.1051	0.0901	0.0150
1998	8.2986	8.2986	0.1332	0.0006	0.0005	0.0185	0.0038	0.0010	0.1089	0.0915	0.0174
1999	8.3182	8.3182	0.1636	0.0004	0.0005	0.0268	0.0038	0.0013	0.1308	0.0922	0.0385
2000	7.7808	7.7808	0.1581	0.0005	0.0005	0.0246	0.0037	0.0021	0.1268	0.0934	0.0333
2001	8.4748	8.4748	0.1550	0.0004	0.0003	0.0197	0.0036	0.0019	0.1291	0.0947	0.0344
2002	8.2878	8.2878	0.1557	0.0004	0.0004	0.0205	0.0037	0.0019	0.1288	0.0952	0.0336
2003	8.6182	8.6182	0.1588	0.0003	0.0004	0.0227	0.0037	0.0017	0.1300	0.0956	0.0344
2004	8.4966	8.4966	0.1692	0.0004	0.0004	0.0275	0.0036	0.0012	0.1361	0.1007	0.0354
2005	8.7661	8.7661	0.1679	0.0008	0.0003	0.0243	0.0038	0.0016	0.1370	0.1024	0.0346
2006	8.3097	8.3097	0.1863	0.0010	0.0004	0.0231	0.0038	0.0017	0.1563	0.1040	0.0523
Trend											
1990–2006	*-12.3%*	*-12.3%*	*43.5%*	*105.8%*	*-19.4%*	*31.7%*	*29.0%*	*-4.5%*	*46.6%*	*16.8%*	*198.0%*
2005–2006	*-5.2%*	*-5.2%*	*10.9%*	*29.9%*	*14.1%*	*-5.1%*	*-0.2%*	*1.5%*	*14.1%*	*1.6%*	*51.1%*
Share in Sector 1 A 2 Manufacturing Industry and Combustion											
1990			*100.0%*	*0.4%*	*0.4%*	*13.5%*	*2.3%*	*1.3%*	*82.1%*	*68.6%*	*13.5%*
2006			*100.0%*	*0.5%*	*0.2%*	*12.4%*	*2.1%*	*0.9%*	*83.9%*	*55.9%*	*28.1%*
Share in National Total											
1990	*54.7%*	*54.7%*	*0.8%*	*0.0%*	*0.0%*	*0.1%*	*0.0%*	*0.0%*	*0.6%*	*0.5%*	*0.1%*
2006	*95.2%*	*95.2%*	*2.1%*	*0.0%*	*0.0%*	*0.3%*	*0.0%*	*0.0%*	*1.8%*	*1.2%*	*0.6%*

Table 87: Dioxin emissions and trends from Sector 1 A 2 Manufacturing Industry and Combustion and source categories 1990–2006.

Year	Dioxin [g] 1	1 A	1 A 2	1 A 2 a	1 A 2 b	1 A 2 c	1 A 2 d	1 A 2 e	1 A 2 f	1 A 2 f 1	1 A 2 f 2
1990	101.84	101.84	52.027	0.034	50.336	0.436	0.487	0.029	0.705	0.079	0.626
1991	80.87	80.87	26.778	0.028	24.922	0.485	0.544	0.031	0.768	0.082	0.686
1992	53.86	53.86	4.560	0.023	2.739	0.560	0.494	0.022	0.721	0.083	0.638
1993	49.34	49.34	3.819	0.033	2.126	0.408	0.509	0.033	0.712	0.081	0.632
1994	44.54	44.54	3.909	0.033	2.152	0.375	0.615	0.028	0.707	0.083	0.624
1995	45.79	45.79	3.858	0.035	2.163	0.396	0.590	0.022	0.651	0.081	0.570
1996	48.22	48.22	4.131	0.036	2.207	0.531	0.581	0.018	0.757	0.079	0.679
1997	46.92	46.92	8.049	0.037	6.109	0.535	0.674	0.020	0.674	0.080	0.594
1998	44.45	44.45	7.973	0.033	6.107	0.446	0.625	0.017	0.744	0.081	0.663
1999	40.74	40.74	4.364	0.026	1.740	0.657	0.625	0.032	1.284	0.082	1.202
2000	37.69	37.69	4.190	0.028	1.739	0.608	0.601	0.054	1.161	0.083	1.078
2001	40.55	40.55	4.560	0.026	2.217	0.483	0.591	0.045	1.197	0.084	1.113
2002	39.08	39.08	4.633	0.026	2.220	0.508	0.599	0.050	1.230	0.084	1.145
2003	40.04	40.04	4.681	0.025	2.220	0.560	0.613	0.042	1.221	0.085	1.136
2004	39.08	39.08	4.825	0.025	2.220	0.682	0.595	0.031	1.272	0.089	1.183
2005	40.31	40.31	4.749	0.036	2.219	0.609	0.630	0.041	1.214	0.091	1.123
2006	38.62	38.62	5.182	0.043	2.220	0.580	0.629	0.042	1.669	0.092	1.577
Trend											
1990–2006	*-62.1%*	*-62.1%*	*-90.0%*	*26.8%*	*-95.6%*	*33.0%*	*29.0%*	*41.3%*	*136.9%*	*16.7%*	*152.0%*
2005–2006	*-4.2%*	*-4.2%*	*9.1%*	*18.0%*	*0.1%*	*-4.9%*	*-0.2%*	*0.8%*	*37.5%*	*1.6%*	*40.4%*
Share in Sector 1 A 2 Manufacturing Industry and Combustion											
1990			*100.0%*	*0.1%*	*96.7%*	*0.8%*	*0.9%*	*0.1%*	*1.4%*	*0.2%*	*1.2%*
2006			*100.0%*	*0.8%*	*42.8%*	*11.2%*	*12.1%*	*0.8%*	*32.2%*	*1.8%*	*30.4%*
Share in National Total											
1990	*63.5%*	*63.5%*	*32.5%*	*0.0%*	*31.4%*	*0.3%*	*0.3%*	*0.0%*	*0.4%*	*0.0%*	*0.4%*
2006	*88.4%*	*88.4%*	*11.9%*	*0.1%*	*5.1%*	*1.3%*	*1.4%*	*0.1%*	*3.8%*	*0.2%*	*3.6%*

Table 88: HCB emissions and trends from Sector 1 A 2 Manufacturing Industry and Combustion and source categories 1990–2006.

Year	HCB [kg] 1	1 A	1 A 2	1 A 2 a	1 A 2 b	1 A 2 c	1 A 2 d	1 A 2 e	1 A 2 f	1 A 2 f 1	1 A 2 f 2
1990	72.57	72.57	17.446	0.006	17.151	0.066	0.097	0.004	0.122	0.016	0.106
1991	69.71	69.71	9.004	0.005	8.681	0.073	0.109	0.004	0.132	0.016	0.115
1992	56.94	56.94	1.605	0.004	1.290	0.083	0.099	0.003	0.125	0.017	0.109
1993	53.58	53.58	1.276	0.005	0.983	0.059	0.102	0.004	0.123	0.016	0.107
1994	48.04	48.04	1.302	0.005	0.992	0.055	0.123	0.004	0.123	0.017	0.107
1995	50.20	50.20	1.292	0.005	0.992	0.058	0.118	0.003	0.115	0.016	0.099
1996	53.15	53.15	1.328	0.006	0.992	0.079	0.117	0.002	0.133	0.016	0.117
1997	49.07	49.07	3.284	0.006	2.942	0.078	0.136	0.002	0.120	0.016	0.104
1998	46.45	46.45	3.270	0.005	2.942	0.064	0.126	0.002	0.131	0.016	0.115
1999	44.75	44.75	1.199	0.004	0.757	0.096	0.125	0.004	0.212	0.016	0.196
2000	41.02	41.02	1.174	0.005	0.757	0.089	0.120	0.007	0.196	0.017	0.179
2001	44.32	44.32	1.399	0.005	0.998	0.070	0.118	0.006	0.202	0.017	0.186
2002	41.80	41.80	1.410	0.005	0.998	0.073	0.120	0.007	0.208	0.017	0.191
2003	42.36	42.36	1.418	0.004	0.998	0.081	0.123	0.005	0.206	0.017	0.189
2004	40.48	40.48	1.441	0.004	0.998	0.101	0.119	0.004	0.215	0.018	0.197
2005	41.82	41.82	1.428	0.006	0.998	0.092	0.126	0.006	0.201	0.018	0.183
2006	39.27	39.27	1.497	0.007	0.998	0.088	0.126	0.006	0.272	0.018	0.254
Trend											
1990–2006	*-45.9%*	*-45.9%*	*-91.4%*	*5.0%*	*-94.2%*	*34.1%*	*29.0%*	*54.3%*	*124.0%*	*16.7%*	*140.0%*
2005–2006	*-6.1%*	*-6.1%*	*4.8%*	*14.1%*	*0.0%*	*-4.0%*	*-0.2%*	*2.0%*	*35.3%*	*1.6%*	*38.7%*
Share in Sector 1 A 2 Manufacturing Industry and Combustion											
1990			*100.0%*	*0.0%*	*98.3%*	*0.4%*	*0.6%*	*0.0%*	*0.7%*	*0.1%*	*0.6%*
2006			*100.0%*	*0.4%*	*66.7%*	*5.9%*	*8.4%*	*0.4%*	*18.2%*	*1.2%*	*17.0%*
Share in National Total											
1990	*79.1%*	*79.1%*	*19.0%*	*0.0%*	*18.7%*	*0.1%*	*0.1%*	*0.0%*	*0.1%*	*0.0%*	*0.1%*
2006	*91.1%*	*91.1%*	*3.5%*	*0.0%*	*2.3%*	*0.2%*	*0.3%*	*0.0%*	*0.6%*	*0.0%*	*0.6%*

Table 89: TSP emissions and trends from Sector 1 A 2 Manufacturing Industry and Combustion and source categories 1990–2006.

Year	TSP [Mg]	1	1 A	1 A 2	1 A 2 a	1 A 2 b	1 A 2 c	1 A 2 d	1 A 2 e	1 A 2 f	1 A 2 f 1	1 A 2 f 2
1990		31 811.93	31 164.90	4 341.64	57.13	12.53	324.59	1 056.00	120.45	2 770.94	1 764.30	354.73
1991		NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
1992		NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
1993		NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
1994		NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
1995		32 200.20	31 655.16	3 697.12	75.84	10.46	306.09	452.06	89.12	2763.55	1 711.69	385.29
1996		NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
1997		NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
1998		NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
1999		32 714.34	32 214.70	3 725.74	33.85	16.30	502.91	297.00	47.72	2 827.95	1 387.70	765.29
2000		32 097.98	31 539.83	3 600.58	65.14	17.14	458.33	341.01	74.26	2 644.70	1 282.23	678.65
2001		32 928.52	32 343.35	3 351.13	41.35	10.31	381.44	324.00	55.74	2 538.29	1 198.00	646.78
2002		33 010.37	32 411.64	3 325.15	30.00	19.49	400.19	350.00	89.78	2 435.69	1 129.75	608.97
2003		33 725.61	33 083.57	3 184.42	23.72	13.72	429.61	319.00	56.80	2 341.57	994.94	646.41
2004		33 401.68	32 796.86	3 114.24	31.20	9.97	497.75	331.00	30.94	2 213.38	862.79	613.31
2005		33 535.63	32 923.65	3 038.12	52.60	9.30	439.48	345.22	38.78	2 152.75	799.92	602.68
2006		33 224.22	32 635.35	3 198.97	62.90	10.23	410.71	274.14	40.91	2 400.08	734.47	903.64
Trend												
1990–2006		*4.4%*	*4.7%*	*-26.3%*	*10.1%*	*-18.4%*	*26.5%*	*-74.0%*	*-66.0%*	*-13.4%*	*-58.4%*	*154.7%*
2005–2006		*-0.9%*	*-0.9%*	*5.3%*	*19.6%*	*10.0%*	*-6.5%*	*-20.6%*	*5.5%*	*11.5%*	*-8.2%*	*49.9%*
Share in Sector 1 A 2 Manufacturing Industry and Combustion												
1990				*100.0%*	*1.3%*	*0.3%*	*7.5%*	*24.3%*	*2.8%*	*63.8%*	*40.6%*	*8.2%*
2006				*100.0%*	*2.0%*	*0.3%*	*12.8%*	*8.6%*	*1.3%*	*75.0%*	*23.0%*	*28.2%*
Share in National Total												
1990		*46.4%*	*45.4%*	*6.3%*	*0.1%*	*0.0%*	*0.5%*	*1.5%*	*0.2%*	*4.0%*	*2.6%*	*0.5%*
2006		*44.3%*	*43.5%*	*4.3%*	*0.1%*	*0.0%*	*0.5%*	*0.4%*	*0.1%*	*3.2%*	*1.0%*	*1.2%*

Table 90: PM10 emissions and trends from Sector 1 A 2 Manufacturing Industry and Combustion and source categories 1990–2006.

Year	PM10 [Mg] 1	1 A	1 A 2	1 A 2 a	1 A 2 b	1 A 2 c	1 A 2 d	1 A 2 e	1 A 2 f	1 A 2 f 1	1 A 2 f 2
1990	23 962.50	23 657.79	3 790.55	51.42	11.28	292.13	950.40	108.41	2 376.92	1 764.30	319.25
1991	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
1992	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
1993	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
1994	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
1995	23 717.21	23 460.30	3 198.95	68.25	9.41	275.48	407.06	80.31	2 358.43	1 711.69	346.78
1996	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
1997	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
1998	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
1999	23 798.23	23 562.70	3 188.42	30.46	14.67	452.62	267.30	42.99	2 380.37	1 387.70	688.94
2000	23 104.92	22 841.63	3 061.08	58.62	15.43	412.50	306.91	66.84	2 200.78	1 282.23	610.83
2001	23 771.24	23 495.32	2 823.74	37.22	9.28	343.29	291.60	50.17	2 092.18	1 198.00	582.11
2002	23 716.91	23 434.51	2 791.97	27.00	17.54	360.17	315.00	80.80	1 991.46	1 129.75	548.07
2003	24 200.40	23 897.60	2 650.37	21.35	12.34	386.65	287.10	51.12	1 891.81	994.94	581.77
2004	23 744.38	23 458.94	2 557.32	28.08	8.97	447.97	297.90	27.84	1 746.55	862.79	551.98
2005	23 747.95	23 459.14	2 476.75	47.34	8.37	395.53	310.71	34.90	1 679.90	799.92	542.41
2006	23 340.23	23 062.06	2 609.64	56.61	9.21	369.64	246.73	36.82	1 890.64	734.47	813.28
Trend											
1990–2006	*-2.6%*	*-2.5%*	*-31.2%*	*10.1%*	*-18.4%*	*26.5%*	*-74.0%*	*-66.0%*	*-20.5%*	*-58.4%*	*154.7%*
2005–2006	*-1.7%*	*-1.7%*	*5.4%*	*19.6%*	*10.0%*	*-6.5%*	*-20.6%*	*5.5%*	*12.5%*	*-8.2%*	*49.9%*
Share in Sector 1 A 2 Manufacturing Industry and Combustion											
1990			*100.0%*	*1.4%*	*0.3%*	*7.7%*	*25.1%*	*2.9%*	*62.7%*	*46.5%*	*8.4%*
2006			*100.0%*	*2.2%*	*0.4%*	*14.2%*	*9.5%*	*1.4%*	*72.4%*	*28.1%*	*31.2%*
Share in National Total											
1990	*55.8%*	*55.1%*	*8.8%*	*0.1%*	*0.0%*	*0.7%*	*2.2%*	*0.3%*	*5.5%*	*4.1%*	*0.7%*
2006	*53.7%*	*53.1%*	*6.0%*	*0.1%*	*0.0%*	*0.9%*	*0.6%*	*0.1%*	*4.4%*	*1.7%*	*1.9%*

Table 91: PM2.5 emissions and trends from Sector 1 A 2 Manufacturing Industry and Combustion and source categories 1990–2006.

Year	PM2.5 [Gg]	1	1 A	1 A 2	1 A 2 a	1 A 2 b	1 A 2 c	1 A 2 d	1 A 2 e	1 A 2 f	1 A 2 f 1	1 A 2 f 2
1990		19 941.51	19 846.55	3 290.81	57.62	9.40	243.44	781.44	90.34	2 108.58	1 764.30	266.05
1991		NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
1992		NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
1993		NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
1994		NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
1995		19 661.80	19 581.53	2 792.63	72.37	7.84	229.57	335.06	67.10	2 080.69	1 711.69	289.02
1996		NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
1997		NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
1998		NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
1999		19 617.63	19 544.01	2 729.27	41.09	12.23	377.19	219.78	35.89	2 043.10	1 387.70	574.41
2000		18 941.75	18 859.29	2 604.64	66.57	12.86	343.75	252.35	55.72	1 873.40	1 282.23	509.11
2001		19 510.76	19 424.45	2 389.13	47.44	7.73	286.08	239.76	41.81	1 766.31	1 198.00	485.09
2002		19 417.76	19 329.36	2 350.98	39.78	14.61	300.14	259.00	67.34	1 670.11	1 129.75	456.73
2003		19 770.00	19 675.21	2 210.94	36.01	10.29	322.21	236.06	42.60	1 563.77	994.94	484.81
2004		19 281.92	19 192.40	2 101.31	41.13	7.48	373.31	244.94	23.20	1 411.25	862.79	459.98
2005		19 236.67	19 146.09	2 021.48	58.37	6.97	329.61	255.49	29.08	1 341.96	799.92	452.02
2006		18 763.85	18 676.37	2 121.56	68.65	7.67	308.03	202.87	30.68	1 503.64	734.47	677.74
Trend												
1990–2006		*-5.9%*	*-5.9%*	*-35.5%*	*19.2%*	*-18.4%*	*26.5%*	*-74.0%*	*-66.0%*	*-28.7%*	*-58.4%*	*154.7%*
2005–2006		*-2.5%*	*-2.5%*	*5.0%*	*17.6%*	*10.0%*	*-6.5%*	*-20.6%*	*5.5%*	*12.0%*	*-8.2%*	*49.9%*
Share in Sector 1 A 2 Manufacturing Industry and Combustion												
1990				*100.0%*	*1.8%*	*0.3%*	*7.4%*	*23.7%*	*2.7%*	*64.1%*	*53.6%*	*8.1%*
2006				*100.0%*	*3.2%*	*0.4%*	*14.5%*	*9.6%*	*1.4%*	*70.9%*	*34.6%*	*31.9%*
Share in National Total												
1990		*79.4%*	*79.0%*	*13.1%*	*0.2%*	*0.0%*	*1.0%*	*3.1%*	*0.4%*	*8.4%*	*7.0%*	*1.1%*
2006		*82.8%*	*82.4%*	*9.4%*	*0.3%*	*0.0%*	*1.4%*	*0.9%*	*0.1%*	*6.6%*	*3.2%*	*3.0%*

General Methodology

Table 92 gives an overview of methodologies and data sources of sub category *1 A 2 Manufacturing Industry and Combustion*. Reported/Measured emission data is not always taken one-to-one in cases that reported fuel consumption is not in line with data from energy balance. However, in these cases data is used for emission factor derivation. For 2005 to 2006 activity data from the emission trading system (ETS) has been considered for validation of the energy statistics and ETS activity data has been used for a sectoral breakdown of category 1 A 2 f.

Table 92: Overview of 1 A 2 methodologies for main pollutants.

		Activity data	Reported/Measured emissions	Emission factors
1 A 2 a	Iron and Steel – Integrated Plants (2 units)	Reported by plant operator (yearly).	Reported by plant operator: SO_2, NO_x, CO, NMVOC, TSP, (yearly).	NH_3: National study
1 A 2 a	Iron and Steel – other	Energy balance 2005–2006: ETS data.		All pollutants: National studies
1 A 2 b	Non Ferrous Metals	Energy balance 2005–2006: ETS data.		All pollutants: National studies
1 A 2 c	Chemicals	Energy balance 2005–2006: ETS data.		All pollutants: National studies
1 A 2 d	Pulp, Paper and Print	Energy balance 2005–2006: ETS data.	Reported by Industry Association: SO_2, NO_x, CO, NMVOC, TSP (yearly).	NH_3: National study
1 A 2 e	Food Processing, Beverages and Tobacco	Energy balance 2005–2006: ETS data.		All pollutants: National studies
1 A 2 f	Cement Clinker Production	National Studies 2005–2006: ETS data.	Reported by Industry Association: SO_2, NO_x, CO, NMVOC, TSP, Heavy Metals (yearly).	NH_3: National study
1 A 2 f	Glass Production	Association of Glass Industry 2005–2006: ETS data.	Direct information from industry association: NO_x,SO_2.	CO, NMVOC, NH_3: National studies
1 A 2 f	Lime Production	Energy balance 2005–2006: ETS data.		All pollutants: National studies
1 A 2 f	Bricks and Tiles Production	Association of Bricks and Tiles Industry 2005–2006: ETS data.		All pollutants: National studies
1 A 2 f	Other	Energy balance 2005–2006: ETS data.		All pollutants: National studies

NFR 1 A 2 a Iron and Steel

In this category mainly two integrated iron and steel plants with a total capacity of 5.5 mio t crude steel per year are considered. Facilities relevant for air emissions are blast furnaces, coke ovens, iron ore sinter plants, LD converters, rolling mills, scrap preheating, collieries and other metal processing. According to the SNAP and NFR nomenclatures this activities have to be reported to several sub categories. In case of the Austrian inventory emissions from above mentioned activities are reported in sub categories *1 A 2 a* and *2 C.* Overall heavy metals, POPs and PM emissions are included in category *2 C* (SNAP 0402). Emissions from fuel combustion in other steel manufacturing industries are considered in category *1 A 2 a* too.

Integrated steelworks (two units)

Two companies report their yearly NO_x, SO_2, NMVOC, CO and PM emissions to the Umweltbundesamt. Environmental reports are availabe on the web at www.emas.gv.at under EMAS register-Nr. 221 and 216 which partly include data on air emissions. During the last years parts of the plants where reconstructed and equipped with PM emission controls which has also led to lower heavy metal and POP emissions. Reduction of SO_2 and NO_x emissions of in-plant power stations was achieved by switching from coal and residual fuel oil to natural gas.

Table 93: Emission controls of integrated iron & steel plants.

	Facility	Controlled emissions
Plant 1 1,3 mio t/a crude steel	Iron ore sinter plant:	PM: electro filter, fabric filter
	Cast house/pig iron recasting	PM
	LD converter	PM: electro filter
	Ladle furnace	PM: electro filter
Plant 2: 3,8 mio t/a crude steel	Iron ore sinter plant: 2 mio t/a sinter	PM: "AIRFINE" wet scrubber
	Coke oven: 1,9 mio t/a coke	Coke transport and quenching: PM
	Cast house	PM
	LD converter	PM
	Rolling mill	PM

Other fuel combustion

Fuel combustion in other iron and steel manufacturing industry is calculated by the simple CORINAIR methodology. Activity data is taken from energy balance. Table 94 summarizes the selected emission factors for the main pollutants and activity data for the year 2006. It is assumed that emissions are uncontrolled.

Table 94: NFR 1 A 2 a main pollutant emission factors and fuel consumption for the year 2006.

Fuel	Source of NO_x, CO, NMVOC, SO_2 emission factors	Activity [TJ]	NO_x [kg/TJ]	CO [kg/TJ]	NMVOC [kg/TJ]	SO_2 [kg/TJ]	NH_3 [kg/TJ]
Coke oven coke	(BMWA 1990) [1]	240	220.0	150.0	8.0	500.0	0.01
Residual fuel oil < 1% S	(BMWA 1996) [1]	11	118.0	10.0	0.8	92.0	2.70
Residual fuel oil ≥ 1% S	(BMWA 1996) [1]	662	235.0	15.0	8.0	398.0	2.70
Heating oil	(BMWA 1996) [2]	3	65.0	15.0	4.8	45.0	2.70
Kerosene	(BMWA 1996) [3]	2	118.0	15.0	4.8	92.0	2.70
Natural gas	(BMWA 1996) [1]	7 303	41.0	5.0	0.5	NA	1.00
LPG	(BMWA 1996) [4]	10	41.0	5.0	0.5	6.0[6]	1.00

(1) *Default emission factors for industry*

(2) *Default emission factors for district heating plants*

(3) *Upper values from residual fuel oil < 1% S and heating oil*

(4) *Values for natural gas are selected*

(5) *Values for bark are selected*

(6) *From (LEUTGÖB et al. 2003)*

NH_3 emission factors are taken from (UMWELTBUNDESAMT 1993). PM, HM and POP emission factors are described in a separate section below.

NFR 1 A 2 b Non-ferrous Metals

This category enfolds emissions from fuel combustion in non ferrous metals industry including heavy metal and POPs emissions from melting of products. Fuel consumption activity data is taken from the energy balance.

Fuel Combustion

The following Table 95 shows fuel consumption and main pollutant emission factors of category *1 A 2 b* for the year 2006.

Table 95: NFR 1 A 2 b main pollutant emission factors and fuel consumption for the year 2006.

Fuel	Source of NO_x, CO, NMVOC, SO_2 emission factors	Activity [TJ]	NO_x [kg/TJ]	CO [kg/TJ]	NMVOC [kg/TJ]	SO_2 [kg/TJ]	NH_3 [kg/TJ]
Coke oven coke	(BMWA 1990) (1)	123	220.0	150.0	8.0	500.0	0.01
Residual fuel oil < 1% S	(BMWA 1996) (1)	223	118.0	10.0	0.8	92.0	2.70
Residual fuel oil ≥ 1% S	(BMWA 1996) (1)	13	235.0	15.0	8.0	398.0	2.70
Heating oil	(BMWA 1996) (2)	24	65.0	15.0	4.8	45.0	2.70
Kerosene	(BMWA 1996) (3)	4	118.0	15.0	4.8	92.0	2.70
Natural Gas	(BMWA 1996) (1)	3 265	41.0	5.0	0.5	NA	1.00
LPG	(BMWA 1996) (4)	171	41.0	5.0	0.5	6.0(5)	1.00
Petrol coke	(BMWA 1990) (6)	31	220.0	150.0	8.0	323.0(7)	0.01

(1) *Default emission factors for industry*

(2) *Default emission factors for district heating plants*

(3) *Upper values from residual fuel oil < 1% S and heating oil*

(4) *Values for natural gas are selected*

(5) *From (LEUTGÖB et al. 2003)*

(6) *Values for coke oven coke are selected*

(7) *Assuming 0.5% S-content and NCV of 31 GJ/t.*

NFR 1 A 2 c Chemicals

Category 1 A 2 c includes emissions from fuel combustion in chemicals manufacturing industry. Because the inventory is linked with the NACE/ISIC consistent energy balance, plants which mainly produce pulp are considered in this category. Main polluters are pulp and basic anorganic chemicals manufacturers. Fuel consumption is taken from the energy balance. Main pollutant emission factors used for emission calculation are industrial boilers default values or derived from plant specific measurements.

Table 96 sumarizes activity data and emission factors for 2006. Underlined values indicate non default emission factors.

Table 96: NFR 1 A 2 c main pollutant emission factors and fuel consumption for the year 2006.

Fuel	Source of NO_X, CO, NMVOC, SO_2 emission factors	Activity [TJ]	NO_X [kg/TJ]	CO [kg/TJ]	NMVOC [kg/TJ]	SO_2 [kg/TJ]	NH_3 [kg/TJ]
Hard coal	(BMWA 1990) (1)	1 069	80.3(5)	150.0	15.0	60.0(9)	0.01
Coke oven coke	(BMWA 1990) (1)	47	220.0	150.0	8.0	500.0	0.01
Residual fuel oil < 1% S	(BMWA 1996) (1)	427	118.0	10.0	0.8	92.0	2.70
Residual fuel oil ≥ 1% S	(BMWA 1996) (1)	93	235.0	15.0	8.0	398.0	2.70
Heating oil	(BMWA 1996) (2)	49	65.0	15.0	4.8	45.0	2.70
Natural Gas	(BMWA 1996) (1)	14 966	41.0	5.0	0.5	NA	1.00
LPG	(BMWA 1996) (3)	18	41.0	5.0	0.5	6.0(4)	1.00
Industrial waste	(BMWA 1990) (1)	4 611	47.0(6)	200.0	38.00	65.00(6)	0.02
Solid biomass	(BMWA 1996) (1)	1 666	100.0(7)	72.00	5.0	30.0	5.00
Biogas	(BMWA 1990) (8)	575	150.0	5.0	0.5	NA	1.00

(1) *Default emission factors for industry*

(2) *Default emission factors for district heating plants*

(3) *Values for natural gas are selected*

(4) *From (LEUTGÖB et al. 2003)*

(5) *50% of hard coal are assigned to fluidized bed boilers in pulp industry with comparatively low EF. Emissions are taken from DKDB.*

(6) *About 50% of waste composition is known as MSW fractions and sludges. Remaining amount is assumed to be gaseous with low sulphur content. A comparison to DKDB is used for verification. The selected NO_x emission factor is taken from (WINDSPERGER et al. 2003). The SO_2 emission factor is derived from plant specific data of the DKDB.*

(7) *Assumed to be consumed by one plant. The selected NO_x emission factor is derived from plant specific data of the DKDB.*

(8) *Uncontrolled default emission factors for natural gas fired industrial boilers are selected.*

(9) *For hard coal an uncontrolled SO_2 emission factor of 600 kg/TJ with an control efficiency of 90% is assumed.*

NFR 1 A 2 d Pulp, Paper and Print

Category 1 A 2 d includes emissions from fuel combustion in pulp, paper and print industry. Plants which mainly produce pulp are considered in category *1 A 2 c Chemical*s except black liquor recovery boilers. In 2006 all black liquor recovery boilers are equipped with flue gas desulphurization and electrostatic precipitators. Additionally all fluidized bed boilers are equipped with electrostatic precipitators and/or fabric filters. A detailed description of boilers, emissions and emission controls is provided in the unpublished study (UMWELTBUNDESAMT 2005).

Fuel consumption activity data is taken from the energy balance. SO_2 emissions are taken from (AUSTROPAPIER 2002–2004). TSP emissions are taken from (UMWELTBUNDESAMT 2005). Other main pollutant emission factors used for emission calculation are industrial boilers default values.

Table 97 shows activity data and emission factors for 2006. SO_2 emission factors were derived from national default values for industrial boilers taken from (BMWA 1990) and not highly representative for single fuels. Black liquor recovery and fluidized bed boilers are fired with combined fuels and therefore NO_x emission factors are not always representative for single fuel types. Underlined values indicate non default emission factors.

Table 97: NFR 1 A 2 d main pollutant emission factors and fuel consumption for the year 2006.

Fuel	Source of NO_x, CO, NMVOC, SO_2 emission factors	Activity [TJ]	NO_x [kg/TJ]	CO [kg/TJ]	NMVOC [kg/TJ]	SO_2 [kg/TJ]	NH_3 [kg/TJ]
Hard coal	(BMWA 1990) [1]	5 155	120.0[9]	150.0	15.0	112.0	0.01
Brown coal	(BMWA 1990) [1]	34	170.0	150.0	23.0	92.8	0.02
Brown coal briquettes	(BMWA 1990) [1]	NO	170.0	150.0	23.0	92.8	0.02
Coke oven coke	(BMWA 1990) [1]	NO	220.0	150.0	8.0	122.5	0.01
Residual fuel oil < 1% S	(BMWA 1996) [1]	179	118.0	10.0	0.8	16.1	2.70
Residual fuel oil ≥ 1% S	(BMWA 1996) [1]	1 332	235.0	15.0	8.0	69.7	2.70
Heating oil	(BMWA 1996) [2]	32	65.0	15.0	4.8	7.9	2.70
Kerosene	(BMWA 1996) [6]	NO	118.0	15.0	4.8	16.1	2.7
LPG	(BMWA 1996) [3]	42	41.0	5.0	0.5	6.0[4]	1.00
Natural Gas	(BMWA 1996) [1]	28 648	41.0	5.0	0.5	NA	1.00
Industrial waste	(BMWA 1990) [1]	153	100.0	200.0	38.00	22.8	0.02
Black liquor	(BMWA 1990) [1]	27 350	77.0[7]	20.0	4.0	22.8	0.02
Fuel wood	(BMWA 1996) [8]	< 1	110.0	370.0	5.00	10.5	5.00
Solid biomass	(BMWA 1996) [1]	6 712	120.0[9]	72.00	5.0	10.5	5.00
Biogas	(BMWA 1990) [5]	178	150.0	5.0	0.5	NA	1.00
Sewage sludge gas	(BMWA 1990) [5]	165	150.0	5.0	0.5	NA	1.00

(1) *Default emission factors for industry*

(2) *Default emission factors for district heating plants*

(3) *Values for natural gas are selected*

(4) *From (LEUTGÖB et al. 2003)*

(5) *Uncontrolled default emission factors for natural gas fired industrial boilers are selected.*

(6) *Upper values from residual fuel oil < 1% S and heating oil*

(7) *NO_x emission factor for black liquor is derived from partly continuous measurements according to (UMWELTBUNDESAMT 2005).*

(8) *Emission factors of wood chips fired district heating boilers are selected.*

(9) *NO_x emission factor of combinded hard coal, paper sludge and bark fired boilers is taken from (UMWELTBUNDESAMT 2003a).*

NFR 1 A 2 e Food Processing, Beverages and Tobacco

Category 1 A 2 e includes emissions from fuel combustion in food processing, beverages and tobacco industry. Due to the low fuel consumption it is assumed that default emission factors of uncontrolled industrial boilers are appropriate although it is known that sugar factories operate some natural gas and coke oven coke fired lime kilns. It is assumed that any type of secondary emission control is not occuring within this sector.

Fuel consumption activity data is taken from the energy balance. Main pollutant emission factors used for emission calculation are industrial boilers default values taken from (BMWA 1990).

Table 98 sumarizes activity data and emission factors for 2006.

Table 98: NFR 1 A 2 e main pollutant emission factors and fuel consumption for the year 2006.

Fuel	Source of NO_x, CO, NMVOC, SO_2 emission factors	Activity [TJ]	NO_x [kg/TJ]	CO [kg/TJ]	NMVOC [kg/TJ]	SO_2 [kg/TJ]	NH_3 [kg/TJ]
Hard coal	(BMWA 1990) (1)	4	250.0	150.0	15.0	600.0	0.01
Brown coal	(BMWA 1990) (1)	NO	170.0	150.0	23.0	630.0	0.02
Brown coal briquettes	(BMWA 1990) (1)	NO	170.0	150.0	23.0	630.0	0.02
Coke oven coke	(BMWA 1990) (1)	98	220.0	150.0	8.0	500.0	0.01
Residual fuel oil < 1% S	(BMWA 1996) (1)	1 131	118.0	10.0	0.8	92.0	2.70
Residual fuel oil ≥ 1% S	(BMWA 1996) (1)	108	235.0	15.0	8.0	398.0	2.70
Heating oil	(BMWA 1996) (2)	490	65.0	15.0	4.8	45.0	2.70
Kerosene	(BMWA 1996) (6)	NO	118.0	15.0	4.8	92.0	2,7
LPG	(BMWA 1996) (3, 8)	175	41.0	5.0	0.5	6.0(4)	1.00
Natural Gas	(BMWA 1996) (1)	12 398	41.0	5.0	0.5	NA	1.00
Industrial waste	(BMWA 1990) (1)	NO	100.0	200.0	38.00	130.0	0.02
Fuel wood	(BMWA 1996) (7)	20	110.0	370.0	5.00	11.0	5.00
Solid biomass	(BMWA 1996) (1)	309	134.0	72.00	5.0	60.0	5.00
Biogas	(BMWA 1990) (5)	42	150.0	5.0	0.5	NA	1.00

(1) Default emission factors for industry

(2) Default emission factors for district heating plants

(3) Values for natural gas are selected

(4) From (LEUTGÖB et al. 2003)

(5) Uncontrolled default emission factors for natural gas fired industrial boilers are selected.

(6) Upper values from residual fuel oil < 1% S and heating oil.

(7) Emission factors of wood chips fired district heating boilers are selected.

(8) According to a sample survey (WINDSPERGER et al. 2003) natural gas NO_x emissions factors are in the range of 41 (furnaces) to 59 (boilers) kg/TJ.

NFR 1 A 2 f i Other mobile in industry – soil abrasion

PM emissions from abrasion of offroad machinery are estimated by means of machinery stock, average operating hours and an PM emission factor of 30 [g TSP/machine operating hour]. The share in TSP emissions is 45% for PM10 and 12% for PM2.5. The following Table 99 presents the parameters used for 2006 emission calculation. Emission factors are taken from (WINIWARTER et al. 2007). Activity data is consistent with activity data used for calculation of exhaust emissions.

Table 99: Industry offroad machinery parameters for the year 2006.

Machinery	Stock	Avg. operating hours/year
Large construction equipment	9 830	1 000
Small construction equipment	39 322	550
Large industry equipment	12 753	865
Small industry equipment	12 541	890
Total	**74 445**	

NFR 1 A 2 f ii Other Manufacturing Industries

Category 1 A 2 f includes emissions from fuel combustion in other manufacturing industries. It considers furnaces and kilns of cement, lime, bricks/tiles and glass manufacturing industries, magnesit sinter plants, asphalt concrete plants, fine ceramic materials production as well as boilers of all industrial branches not considered in categories *1 A 2 a* to *1 A 2 e*.

Table 100 shows total fuel consumption and emissions of main pollutants for sub categories of *1 A 2 f* for the year 2006.

Table 100: NFR 1 A 2 f ii Other Manufacturing Industries. Fuel consumption and emissions of main pollutants by sub category for the year 2006.

Category	Fuel Consumption [TJ]	NO_x [Gg]	CO [Gg]	NMVOC [Gg]	SO_2 [Gg]	NH_3 [Gg]
SNAP 0301 Other boilers	42 183	3.43	1.80	0.15	1.59	0.10
SNAP 030311 Cement Clinker Production	13 448	4.88	8.40	0.28	0.48	0.01
SNAP 030312 Lime Production	2 915	0.83	0.09	0.00	0.13	0.00
SNAP 030317 Glass Production	3 098	0.90	0.02	0.00	0.10	0.00
SNAP 030319 Bricks and Tiles Production	4 160	1.04	0.11	0.01	0.20	0.01
SNAP 030323 Magnesia Production	3 610	1.02	0.10	0.01	0.05	0.00
Total	**69 414**	**12.09**	**10.50**	**0.46**	**2.55**	**0.12**

Other manufacturing industry – boilers (SNAP 0301)

This sub category includes emissions of industrial boilers not considered in categories 1 A 2 a to 1 A 2 e. No specific distinction of technologies is made but national default emission factors of industrial boilers (BMWA 1990) are taken for emission calculation. It is assumed that facilities are not equipped with secondary emission controls. Activity data is taken from the energy balance.

Activity data and main pollutant emission factors are shown in Table 104. According to the energy balance total fuel consumption in 2006 is 42 PJ of which natural gas consumption is 21.7 PJ, biomass and industrial waste consumption is 13.1 PJ and consumption of oil products is 7.2 PJ.

Cement clinker manufacturing industry (SNAP 030311)

Currently nine cement clinker manufacturing plants are operated in Austria. Some rotary kilns are operated with a high share of industrial waste. In 2006 all exhaust streams from kilns and product heat recovery units were controlled by electrostatic precipitators. All plants are equipped with continuous emission measurement devices for PM, NO_x and SO_x, four plants with CO, two plants with TOC and one plant with a continous Hg measurment device (MAUSCHITZ 2004). Annual activity data for 1990 to 2005 and emissions of 25 pollutants of all plants are estimated in periodic surveys (HACKL & MAUSCHITZ 1995, 1997, 2001, 2003, 2007) and (MAUSCHITZ 2004). Emission values of 2006 were calculated by ETS 2006 activity data and 2005 IEFs. Table 101 shows detailled fuel consumption data for 2006.

Table 101: Cement clinker manufacturing industry. Fuel consumption for the year 2006.

Fuel	Activity [TJ]
Hard coal	3 912
Brown coal	1 689
Petrol coke	697
Residual fuel oil < 1% S	43
Residual fuel oil 0.5% S	NO
Residual fuel oil ≥ 1% S	454
Natural Gas	115
Industrial waste	5 819
Pure biogenic residues	717
Total	**13 448**

Lime manufacturing industry (SNAP 030312)

This category includes emissions from natural gas fired lime kilns. From 1990 to 2004 it includes magnesit sinter plants because sectoral data is available from the year 2005 on only (ETS data). Natural gas consumption is calculated by subtracting natural gas consumption of glass manufacturing industry (SNAP 030317), bricks and tiles industry (SNAP 030319), magnesit sinter industry (SNAP 030323) and cement industry (SNAP 030311) from final consumption of energy balance category *Non Metallic Mineral Products*. Thus it is assumed that uncertainty of this "residual" activity data could be rather high especially for the last inventory year because the energy balance is based on preliminary data. Lime production data are shown in Table 102. Heavy metals emission factors are presented in the following subchapter. Fuel consumption and main pollutant emission factors are shown in Table 104.

Table 102: Lime production 1990 to 2006.

Year	Lime [kt]
1990	513
1995	523
2000	654
2005	760
2006	781

Glass manufacturing industry (SNAP 030317)

This category includes emissions from glass melting furnaces. Fuel consumption 1990 to 1994 is taken from (WIFO 1996). For the years 1997 and 2002 fuel consumption, SO_2 and NO_x emissions are reported from the Austrian association of glass manufacturing industry to the Umweltbundesamt by personal communication. Activity data for the years in between are interpolated. Natural gas consumption 2003 to 2004 is estimated by means of glass production data and an energy intensity rate of 7.1 GJ/t glass. Fuel consumption 2005 to 2006 is taken from ETS. NO_x and SO_2 emissions for missing years of the time series are calculated by implied emission factors derived from years were complete data is available. SO_2 emissions include process emissions. Fuel consumption and main pollutant emission factors are shown in Table 104. Table 103 shows the sum of flat and packaging glass production data 1990 to 2006. The share of flat glass in total glass production is about 5%.

Table 103: Glass production 1990 to 2006.

Year	Glass [kt]
1990	399
1995	435
2000	375
2001	441
2002	389
2003	477
2004	357
2005	418
2006	448

Bricks and tiles manufacturing industry (SNAP 030319)

This category includes emissions from fuel combustion in bricks and tiles manufacturing industry. Bricks are baked with continuously operated natural gas or fuel oil fired tunnel kilns at temperatures around 1000°C. The chlorine content of porousing material is limited by a national regulation (HÜBNER 2001b). Activity data 1990 to 1995 is communicated by the Austrian association of non metallic mineral industry. Activity data 1996 to 2004 are linearly extrapolated 1995 activity data. Activity data 2005 to 2006 is taken from ETS. For main pollutants default emissions factors of industry are selected except for natural gas combustion for which the NO_x emission factor (294 kg/TJ) is taken from (WINDSPERGER et al. 2003). Table 104 presents fuel consumption and main pollutant emission factors.

1 A 2 f ii Fuel consumption and main pollutant emission factors

Table 104 shows activity data and main pollutant emission factors of 1 A 2 f sub categories except for SNAP 030311 cement industry were emission factors are not available by type of fuel. Underlined cells indicate emission factors other than default values for industrial boilers.

Table 104: NFR 1 A 2 f main pollutant emission factors and fuel consumption for the year 2006 by sub category.

Fuel	Source of NO_x, CO, NMVOC, SO_2 emission factors	Activity [TJ]	NO_x [kg/TJ]	CO [kg/TJ]	NMVOC [kg/TJ]	SO_2 [kg/TJ]	NH_3 [kg/TJ]
SNAP 0301 Other boilers							
Hard coal	(BMWA 1990)(1)	NO	250.0	150.0	15.0	600.0	0.01
Coke oven coke	(BMWA 1990)(1)	2	220.0	150.0	8.0	500.0	0.01
Brown coal	(BMWA 1990)(1)	48	170.0	150.0	23.0	630.0	0.02
Residual fuel oil < 1% S	(BMWA 1996)(1)	3 254	118.0	10.0	0.8	92.0	2.70
Residual fuel oil ≥ 1% S	(BMWA 1996)(1)	863	235.0	15.0	8.0	398.0	2.70
Heating oil, Diesel oil	(BMWA 1996)(2)	2 028	65.0	15.0	4.8	45.0	2.70
Kerosene	(BMWA 1996)(6)	7	118.0	15.0	4.8	92.0	2.70
LPG	(BMWA 1996)(3)	1 124	41.0	5.0	0.5	6.0(4)	1.00
Natural gas	(BMWA 1996)(1)	21 674	41.0	5.0	0.5	NA	1.00
Industrial waste	(BMWA 1990)(1)	1 549	100.0	200.0	38.00	130.0	0.02
Fuel wood	(BMWA 1996)(7)	1 516	110.0	370.0	5.00	11.0	5.00

Fuel	Source of NO_x, CO, NMVOC, SO_2 emission factors	Activity [TJ]	NO_x [kg/TJ]	CO [kg/TJ]	NMVOC [kg/TJ]	SO_2 [kg/TJ]	NH_3 [kg/TJ]
Solid biomass	(BMWA 1996)(1)	10 015	143.0	72.00	5.0	60.0	5.00
Sewage sludge	(BMWA 1996)(1)	42	100.0	200.0	38.00	NA	0.02
Biogas	(BMWA 1990)(5)	< 1	150.0	4.0	0.5	NA	1.00
SNAP 030312 Lime manufacturing							
Biofuels	(BMWA 1996) (1)	42	143.0	72.00	5.00	60.00	5.00
Residual fuel oil ≥ 1% S	(BMWA 1996) (1)	320	235.0	15.0	8.0	398.0	2.70
Natural Gas	(BMWA 1996) (1)	2 621	294.0(8)	30.0(9)	0.5	NA	1.00
SNAP 030317 Glass manufacturing							
Residual fuel oil	(BMWA 1996) (1)	127	299.1	15.0	8.0	432.1(10)	2.70
LPG	(BMWA 1996) (3)	NO	299.1	5.0	0.5	34.1(10)	1.00
Natural Gas	(BMWA 1996) (1)	2 970	299.1	5.0	0.5	34.1(10)	1.00
SNAP 030319 Bricks and tiles manufacturing							
Brown coal	(BMWA 1990) (1)	37	170.0	150.0	23.0	630.0	0.02
Coke oven coke	(BMWA 1990) (1)	73	220.0	150.0	8.0	500.0	0.01
Petrol coke	(BMWA 1990) (1)	61	220.0	150.0	8.0	81.0(11)	0.01
Residual fuel oil < 1% S	(BMWA 1996) (1)	13	118.0	10.0	0.8	92.0	2.70
Residual fuel oil ≥ 1% S	(BMWA 1996) (1)	148	235.0	15.0	8.0	398.0	2.70
LPG	(BMWA 1996) (3)	56	41.0	5.0	0.5	6.0(4)	1.00
Natural Gas	(BMWA 1996) (1)	2 902	294.0(8)	5.0	0.5	NA	1.00
Industrial waste	(BMWA 1990) (1)	67	100.0	200.0	38.0	130.0	0.02
Solid biomass	(BMWA 1996) (1)	730	143.0	72.00	5.0	60.0	5.00

(1) *Default emission factors for industry.*

(2) *Default emission factors for district heating plants.*

(3) *Values for natural gas are selected.*

(4) *From (LEUTGÖB et al. 2003)*

(5) *Uncontrolled default emission factors for natural gas fired industrial boilers are selected.*

(6) *Upper values from residual fuel oil < 1% S and heating oil.*

(7) *Emission factors of wood chips fired district heating boilers are selected.*

(8) *NO_x emission factor of natural gas fired lime kilns and bricks and tiles production is taken from (WINDSPERGER et al. 2003).*

(9) *CO emission factor of natural gas fired lime kilns is assumed to be 5 times higher than for industrial boilers.*

(10) *SO_2 emission factors of fuels used for glass manufacturing include emissions from product processing.*

(11) *The same SO_2 emission factor as for SNAP 030323 Petrol coke is selected.*

Emission factors for heavy metals, POPS and PM in NFR 1 A 2

In the following the emission factors for heavy metals, POPs and PM which are used in NFR 1 A 2 are described.

Emission factors for heavy metals used in NFR 1 A 2

For cement industries (SNAP 030311) emission values were taken from (HACKL & MAUSCHITZ, 2001); in the Tables presented below implied emission factors (IEF) are given.

For the other sub categories emission factors were applied, references are provided below.

Coal

Emission factors for 1995 were taken from (Corinair 1995), Chapter B112, Table 12. For 1990 the emission factors were assumed to be 50% and for 1985 100% higher, respectively.

Fuel Oil

For fuel oil the same emission factors as for 1 A 1 were used.

Other Fuels

For fuel wood and wood wastes the value from (OBERNBERGER 1995) for plants > 4 MW was used for 1985 and 1990. For fuel wood from 1995 onwards the value taken from personal information about emission factors for wood waste from the author was used.

For wood wastes from 1995 onwards the value for fuel wood of category 1 A 4 a (7 mg/GJ for Cd, 2 mg/GJ for Hg and 50 mg/GJ for Pb, valid for small plants) and a value of 0.8 mg/GJ for Cd, 13 mg/GJ for Hg and 1.0 mg/GJ for Pb, respectively, which are valid for plants with higher capacity (measurements at Austrian fluid bed combustion plants by FTU in 1999/2000) was weighted according to the share of overall installed capacity of the Austrian industry (25% high capacity and 75% low [< 5 MW] capacity).

Table 105: Cd emission factors for NFR 1 A 2 Manufacturing Industries and Construction.

Cadmium EF [mg/GJ]	1985	1990	1995	2006
Coal				
102A Hard coal 107A Coke oven coke	0.20	0.15	0.10	0.10
102A Hard coal 030311 IEF!	1.13	0.56	0.79	0.11
105A Brown coal 106A brown coal briquettes	0.80	0.60	0.40	0.40
105A Brown coal 030311 IEF!	4.53	2.24	3.16	0.44
Oil				
204A Heating and other gas oil 2050 Diesel	0.02 (all years)			
203B light fuel oil	0.05 (all years)			
203B light fuel oil 030311 IEF!	0.28	0.19	0.40	0.05
203C medium fuel oil	0.50 (all years)			
203C medium fuel oil 030311 IEF!	0.28	0.19	0.40	0.05
203D heavy fuel oil	1.00	0.75	0.50	0.50
203D heavy fuel oil 030311 IEF!	5.66	2.79	3.95	0.55
Other Fuels				
111A Fuel wood 215A Black liquor	6.10	6.10	2.50	2.50
116A Wood waste 115A Industrial waste	6.10	6.10	2.35	2.35
115A Industrial waste 030311 IEF!	34.55	22.73	18.57	2.58

Table 106: Hg emission factors for NFR 1 A 2 Manufacturing Industries and Construction.

Mercury EF [mg/GJ]	1985	1990	1995	2006
Coal				
102A Hard coal 107A Coke oven coke	3.40	2.55	1.70	1.70
102A Hard coal 030311 IEF!	163.57	96.75	12.21	10.15
105A Brown coal 106A brown coal briquettes	8.80	6.60	4.40	4.40
105A Brown coal 030311 IEF!	423.36	250.40	31.61	26.26
Oil				
204A Heating and other gas oil 2050 Diesel	0.007 (all years)			
203B light fuel oil	0.015 (all years)			
203B light fuel oil 030311 IEF!	0.72	0.57	0.11	0.09
203C medium fuel oil	0.04 (all years)			
203C medium fuel oil 030311 IEF!	1.92	1.52	0.29	0.24
203D heavy fuel oil	0.75 (all years)			
203D heavy fuel oil 030311 IEF!	3.61	2.85	0.54	0.45
Other Fuels				
111A Fuel wood 215A Black liquor 116A Wood waste 115A Industrial waste	1.90	1.90	1.25	1.25
115A Industrial waste 030311 IEF!	91.41	72.09	8.98	7.46

Table 107: Pb emission factors for NFR 1 A 2 Manufacturing Industries and Construction.

LEAD EF [mg/GJ]	1985	1990	1995	2006
Coal				
102A Hard coal 107A Coke oven coke	12.00	9.00	6.00	6.00
102A Hard coal 030311 IEF!	144.44	33.36	3.37	0.57
105A Brown coal 106A brown coal briquettes	7.80	5.85	3.90	3.90
105A Brown coal 030311 IEF!	93.88	21.68	2.19	0.37
Oil				
204A Heating and other gas oil 2050 Diesel	0.02 (all years)			
203B light fuel oil	0.05 (all years)			
203B light fuel oil 030311 IEF!	0.60	0.19	0.03	> 0.01
203C medium fuel oil	1.20 (all years)			
203C medium fuel oil 030311 IEF!	1.44	0.44	0.07	0.01
203D heavy fuel oil	0.25	0.19	0.13	0.13
203D heavy fuel oil 030311 IEF!	3.01	0.69	0.07	0.01
Other Fuels				
111A Fuel wood 215A Black liquor 116A Wood waste	26.3	26.3	21.15	21.15
115A Industrial waste	72.00 (all years)			
115A Industrial waste 030311 IEF!	866.62	266.85	40.48	6.82

Emission factors not related to fuel input

The following Tables show production data of iron and steel, non ferrous metals and other activity data for selected years used as activity data for calculating heavy metals and POPs emissions from products processing.

Table 108: Non ferrous metals production [Mg].

Year	Secondary Lead (SNAP 030307)	Secondary Copper (SNAP 030309)	Secondary Aluminium (SNAP 030310)	Nickel Production (SNAP 030324)
	[Mg]			
1990	23 511	79 742	60 000	638
1995	21 869	69 830	60 000	822
2000	21 869	69 830	190 000	4 000
2006	21 869	69 830	259 000	4 000

Sources of activity data are:

Secondary Lead: (ÖSTAT Industrie- und Gewerbestatistik)

Secondary Copper: Plant specific

Secondary Aluminium: (ÖSTAT Industrie- und Gewerbestatistik); (UMWELTBUNDESAMT 2000)

Nickel Production: (ÖSTAT Industrie- und Gewerbestatistik); (EUROPEAN COMMISSION 2000)

Table 109: Activity data for calculation of HM and POP emissions with EF not related to fuel input.

Year	Cast Iron Production [Mg]	Cement clinker [kt]	Cement [kt]
1990	110 000	3 694	4 679
1995	69 000	2 930	3 839
2000	74 654	3 053	4 047
2006	80 782	3 653	4 886

Table 110: Asphalt concrete production 1990 and 2006.

Year	Asphalt concrete [kt]
1990	403
2006	522

Emission factors for Iron and Steel: reheating furnaces were taken from (WINIWARTER & SCHNEIDER 1995).

Secondary lead is produced by two companies which use lead accumulators and plumbiferous metal ash as secondary raw materials. Lead recuperation is processed in rotary furnaces.

The emission factor for secondary lead for the years 1985 and 1990 were taken from (WINIWARTER & SCHNEIDER 1995), (VAN DER MOST et al. 1992) and (JOCKL & HARTJE 1991).

The emission factor for secondary lead production for 1995 was taken from (WINDSPERGER & TURI 1997). Measurements at Austrian facilities in 2000 showed that emissions decrease by about 80%, thus 20% of the value used for 1995 was used for the years from 2000 onwards.

The emission factors for secondary copper production base on measurements at an Austrian facility in 1994; as re-designs at the main Austrian facility do not influence emissions significantly, this values are also used for 2000.

The Pb emission factor for secondary aluminium production is based on the following regulations/assumptions: (i) TSP emissions from aluminium production is legally limited to 20 mg/m³ (BGBl. II 1/1998 for Al), (ii) as the facilities have to be equipped with PM filter to reach this limit, the emissions are usually well below the legal emission limit, (iii) thus PM emissions were estimated to be 5 mg/m³; (iv) using results from BAT documents (0.25% Pb content in PM; 126–527 mg PM/t Al; (BOIN et al. 2000) and (EUROPEAN COMMISSION, IPPC Bureau 2000) an emission factor of 200 mg/t Al was calculated.

For lime production the emission factors for cement production (taken from (HACKL & MAUSCHITZ 2001)) were used, as the two processes are technologically comparable.

Pb and Cd emission factors for glass production base on measurements at two Austrian facilities for the year 2000. As emission limits are legally restricted, and for 1995 the emission allowances were higher, for 1995 twice the value of 2000 was used. For 1990 and 1985 the Cd and Pb emission factors as well as the Hg emission factor were taken (WINIWARTER & SCHNEIDER 1995).

Heavy metals emissions from burning of fine ceramic materials arise if metal oxides are used as pigments for glaze. The emission factors for fine ceramic materials base on results from (BOOS 2001), assuming that HM concentrations in waste gas is 5% of raw gas concentrations.

Emission factors for nickel production base on measurements at the only relevant Austrian facility.

Table 111: HM emission factors not related to fuel input for NFR 1 A 2 Manufacturing Industries and Construction.

NFR	SNAP	Category Description	EF [mg/MG Product]		
			Cd	Hg	Pb
1 A 2 a	030302 X47	Iron and Steel: reheating furnaces	50	–	2 400
1 A 2 b	030307	Secondary lead	3 500–200[90]	–	389 000–24 000[90]
1 A 2 b	030309	Secondary copper	170	80	6 790
1 A 2 b	030310	Secondary aluminium	–	–	200
1 A 2 f	030312	Lime production	8.7	21	29
1 A 2 f	030317	Other glass	150–8[90]	50–30[90]	12 000–200[90]
1 A 2 f	030320	Fine ceramic materials	150	–	5 000
1 A 2 b	030324	Nickel production	5	570	230

Emission factors for POPs used in NFR 1 A 2

For cement industries the dioxin emission factor of 0.01 µg/GJ is derived from measured 0,02 ng TE/Nm³ at 10% O_2 (WURST & HÜBNER 1997) assuming a flue gas volume of 1600–1700 Nm³/t cement clinker (HÜBNER 2001b) and an average energy demand of 3.55 GJ/t cement clinker. HCB emission factors are taken from (HÜBNER 2001b). The PAK4 emission factor of 0.28 mg/GJ fuel input is derived on actual measurements communicated to the Umweltbundesamt.

The dioxin emission factor for bricks and tiles and lime production is based on findings of the study (WURST & HÜBNER 1997). HCB emissions were calculated on the basis of dioxin emissions and assuming a factor of 200.

[90] upper value for 1985, lower value for 2000; years in between were linearly interpolated

For pulp and paper industries the dioxin emission factor of 0.009 µgTE/GJ for all fuels bases on measurements of fluidized bed combustors in pulp and paper industries (FTU 1997) and data from literature with typical fuel mixes (LAI-report 1995), (NUSSBAUMER 1994). HCB emissions were calculated on the basis of dioxin emissions and assuming a factor of 200.

For the other sub categories emission factors for plants with different capacities were applied, together with assumptions on plant structure of the Austrian industry mean values for each fuel were calculated. The IEFs (average EF per fuel category) were used for all years; they are presented in Table 113.

Emission factors for dioxin were taken from (FTU 1997) and measurements at Austrian plants (FTU 2000).

References for PAK emission factors are provided in the following table.

Table 112: Source of PAH emission factor of different fuels.

PAH4 EF [mg/GJ]	Small plants ≤ 0.35 MW	Medium plants 0.35–1 MW	Large plants 1–50 MW	Source of EF
Natural gas	0.04	NA	NA	Same EF as for 1 A 4 b, central heating; for larger plants not relevant
Heating oil	0.24	0.16	0.16	For small plants same EF as for 1 A 4 b, central heating; for larger plants: (UBA BERLIN, 1998) (four times the value of BaP).
Fuel oil	0.24	0.24	0.24	(UBA BERLIN, 1998) (four times the value of BaP).
Wood	85	2.7	0.055	For small plants Same EF as for 1 A 4 b, central heating; for larger plants: measurements at Austrian plants by (FTU 2000).
Coal	85	2	0.04	For small plants Same EF as for 1 A 4 b, central heating; for large plants: (UBA BERLIN, 1998) (four times the value of BaP). For medium plants: expert judgement[91].

For other oil products the same emission factors as for category 1 A 1 were used.

For gaseous biofuels the same emission factors as for gas were used.

Table 113: POP emission factors (average EF per fuel category) for 1 A 2 Manufacturing Industries and Construction.

EF	Dioxin [µg/GJ]	HCB [µg/GJ]	PAK4 [mg/GJ]
All fuels in pulp and paper ind.	0.009	1.8	0.055
Coal			
102A	0.042	4.5	2.0
102A Cement Industry (IEF 2005)	0.008	0.88	0.25
105A	0.033	3.6	2.0
105A Cement Industry (IEF 2005)	0.006	0.70	0.25
106A	0.064	6.6	2.0
107A	0.052	5.5	2.0

[91] As the size structure for coal fired plants was not known, the EF for medium plants – which is the main size – was used for all activity data in this category.

EF	Dioxin [µg/GJ]	HCB [µg/GJ]	PAK4 [mg/GJ]
Fuel Oil			
Fuel Oil (203B, 203C, 203D)	0.0009	0.12	0.24
Fuel Oil Cement Industry (IEF 2005)	0.0002	0.023	0.03
204A Heating and other gas oil	0.0006	0.095	0.18
224A Other Oil Products	0.0017	0.14	0.011
Gas			
301A Natural gas	0.0006	0.072	0.0032 (for iron and steel) 0 (other sub categories)
301A Cement Industry (IEF 2005)	0.00011	0.014	NA
303A LPG	0.0006	0.079	0.004
Bricks and tiles and lime production	0.025	5.0	0
Other Fuels			
111A Wood	0.083	13.0	2.7
115A Industrial waste 116A Wood Waste	0.083	13.0	3.3
115A Cement Industry (IEF 2005)	0.016	2.54	0.41
Gaseous biofuels (309A, 310A)	0.0006	0.072	0.0032

Emission factors not related to fuel input

Dioxin emission factors for reheating furnaces in iron and steel industries (foundries) were taken from (UBA BERLIN 1998) (average of hot air and cold air furnaces).

For calculation of PAK emissions from reheating furnaces in iron and steel industries the same emission factor as for coke in blast furnaces was used, as the coke fired reheating furnaces are technologically comparable to these.

HCB emissions for foundries were calculated on the basis of dioxin emissions and assuming a factor of 200.

The secondary lead dioxin emission factor of 3 µg/Mg product is derived from an assumed limit of 0.4 ng/Nm³ flue gas.

Secondary copper is mainly produced by one company which uses scrap as raw material. In a first step black copper is produced in a toploader kiln which is a relevant source of dioxin emissions. Black copper is further converted into blister copper which is further processed in a natural gas fired anode kiln and finally refined by electrolysis. In the 1980s secondary copper production was a main emitter of dioxin and furan emissions in Austria. Since then emission control could be achieved by changing raw materials, process optimization and a flue gas afterburner.

The dioxin emission factor from secondary copper production for the years after 1991 was taken from (WURST & HÜBNER 1997), in the years before no emission control (thermo reactor) was operating, furthermore input materials with more impurities were used. Thus emissions for these years were estimated to be about 200 times higher.

HCB emissions for secondary copper production were estimated on the basis of dioxin emissions and a factor of 330 which was calculated from different measurements at an Austrian facility (HÜBNER et al. 2000).

Secondary aluminium is mainly produced by two companies which uses scrap as raw materials. The raw material is mainly processed in rotary kilns and in some cases in hearth type furnaces. The main driver for dioxin and furan emissions is the composition of processed raw material (Chlorine content). While in the early 1990s emissions were widely uncontrolled the facilities have been recently equipped with particle filters and flue gas afterburners.

The dioxin emission factors for secondary aluminium production for the years 1985–1989 was taken from the Belgian emission inventory, as in these years in Austrian facilities hexachloro-ethan was used which results in higher emissions (and the Belgian emission factor reflect this). For 1990 the emission factor was taken from (HÜBNER 2000). For 1999 onwards a reduction by 95% was assumed, as dioxin emission reduction measures in the main Austrian plant started to operate.

HCB emissions for secondary aluminium production were estimated on the basis of dioxin emissions and a factor of 500, which was calculated taken from (AITTOLA et al. 1996).

POPs emissions are released in asphalt concrete plants when the bitumen/flint mixture is heated.

As dioxin EF the mean value of the emission factors given in (US-EPA 1998) was applied.

The PAK emission factor for asphalt concrete plants was taken from (SCHEIDL 1996).

Nickel is mainly produced by one company which uses catalysts and other potential recyclable as raw material. The raw material is processed in a rotary kiln and an electric arc furnace. Dioxin emissions 1993 are taken from an emissions declaration. Dioxin emissions of the remaining time series are calculated by multiplying production data with the implied emission factor of 1993.

The dioxin emission factor for nickel production bases on measurements in the only relevant Austrian facility.

Table 114: POP emission factors not related to fuel input for Sector 1 A 2 Manufacturing Industries and Construction.

	Dioxin [µg/t]	HCB [µg/t]	PAK4 [mg/t]
030302 x47 Iron and Steel: reheating furnaces	0.25	50	1.1
030307 Secondary lead	3	NA	NA
030309 Secondary copper	600–4[92]	200 000–1 300[92]	–
030310 Secondary aluminium	130/40–7[92]	65 000–3500[92]	–
030313 Asphalt concrete plants	0.01	2.8	0.15
030324 Nickel production	13	2 600–2.25[92]	–

Emission factors for PM used in NFR 1 A 2

As already described in Chapter 1.3 the emission inventories of PM for different years were prepared by contractors and incorporated into the inventory system afterwards.

The emission factors were taken from (WINIWARTER et al. 2001) and were used for the whole time series except for

- cement production (NFR 1 A 2 f ii): emissions taken from (HACKL & MAUSCHITZ 1995/1997/2001/2003/2007) are included in category 2 A 1.
- NFR 1 A 2 d pulp, paper and print: emission values were taken from (AUSTROPAPIER 2002–2004).

[92] Higher value for 1995/1990, lower value for 2000

For these sources IEFs are presented in the following Table. The shares of PM10 and PM2.5 were taken from (WINIWARTER et al. 2001).

Table 115: PM emission factors for NFR 1 A 2.

	TSP Emission Factors [g/GJ]				PM10	PM2.5
	1990	1995	2000	2005	[%]	[%]
Gas						
301A and 303A	0.5				90	75
301A, Pulp&Paper (IEF)	0.20	0.10	0.11	0.11	90	75
Coal						
102A and 107A	45				90	75
105A and 106A	50				90	75
105A and 106A, Pulp & Paper (IEF)	8.01	3.99	4.49	4.21	95	80
Oil						
203B and 204A	3.0				90	75
203B and 204A, Pulp & Paper (IEF)	20.04	9.98	11.22	10.52	90	75
203C	35				90	75
203D	65				90	75
203D, Pulp & Paper (IEF)	20.19	10.02	9.94	9.89	90	75
303A, Pulp & Paper (IEF)	20.04	9.98	9.37	10.52	90	74
206A	3.0				95	80
Other Fuels						
111A, 115A and 116A	55				90	75
111A, 115A and 116A, Pulp & Paper (IEF)	13.78	4.99	5.61	5.26	90	75
215 D	55				90	75
215, Pulp & Paper (IEF)	41.33	14.98	11.22	10.52	90	75
309A, 310A and 309A	0.5				90	75
309A, 310A and 309A, Pulp & Paper (IEF)	2.00	1.00	1.12	1.05	90	74

4.2.5 NFR 1 A 3 e Other Transportation-pipeline compressors (SNAP 010506)

Category 1 A 3 e considers emissions from uncontrolled natural gas powered turbines used for natural gas pipelines transport. The simple CORINAIR methodology is used for emissions calculation.

Activity data is taken from the energy balance. The following Table 116 shows activity data and main pollutant emission factors. The NO_x emission factor of 150 kg/TJ is an expert guess by Umweltbundesamt.

Table 116: 1 A 3 e main pollutant emission factors and fuel consumption for the year 2006.

Fuel	Source of NO_x, CO, NMVOC, SO_2 emission factors	Activity [TJ]	NO_x [kg/TJ]	CO [kg/TJ]	NMVOC [kg/TJ]	SO_2 [kg/TJ]	NH_3 [kg/TJ]
Natural Gas	(BMWA 1996) [(1)]	8 156	150.0	5.0	0.5	NA	1.00

(1) *Default emission factors for industry.*

4.2.6 NFR 1 A 4 Other Sectors

Category *1 A 4 Other sectors* enfolds emissions from stationary fuel combustion in the small combustion sector. It also includes emissions from mobile sources in households and gardening including snow cats and skidoos as well as from agriculture and forestry.

Source Description

Category *1 A 4 Oher Sectors* includes emissions from stationary fuel combustion in the small combustion sector as well as from some mobile machinery. Emissions of public district heating plants are included in category *1 A 1 a Public Electricity and Heat.* Emissions of district heat generation delivered to third parties by industry are included in *1 A 2 Manufacturing Industries and Construction*. Data of energy sources used for space and warm water heating in housholds and the commercial sector are collected by Statistik Austria using micro census questionnaires. According to Statistik Austria a clear distinction between "real" public district heating or micro heating networks which serve several buildings under same ownership can not always be made by the interviewed person or interviewers.

Table 117 presents new PM emission sources which have been estimated since the inventory 2007.

Table 117: New PM emission sources in 2006.

Source	NFR	PM2.5 [Mg]
Bonfire	1 A 4 a	150
Open fire pits	1 A 4 a	16
Barbecue	1 A 4 b	763
Agriculture (off-site)	1 A 4 c ii	8
Forestry	1 A 4 c ii	46
Total new sources		929

Figure 10 shows NFR 1 A 4 category definitions partly taken from the IPCC 2006 Guidelines.

Code Number and Name	Definitions
1 A 4 OTHER SECTORS	Combustion activities as described below, including combustion for the generation of electricity and heat for own use in these sectors.
1 A 4 a Commercial/Institutional	Fuel combustion in commercial and institutional buildings; all activities included in ISIC Divisions 41, 50, 51, 52, 55, 63–67, 70–75, 80, 85, 90–93 and 99. *Bonfire and open fire pits.*
1 A 4 b Residential	Fuel combustion in households.
1 A 4 b i Residential plants	Fuel combustion in buildings. *Barbecue.*
1 A 4 b ii Household and gardening (mobile) [89] (see page 132)	Fuel combusted in non commercial mobile machinery such as for gardening and other off road vehicles.
1 A 4 c Agriculture/Forestry/Fishing	Fuel combustion in agriculture, forestry, fishing and fishing industries such as fish farms. Activities included in ISIC Divisions 01, 02 and 05. Highway agricultural transportation is excluded.
1 A 4 c i Stationary	Fuels combusted in pumps, grain drying, horticultural greenhouses and other agriculture, forestry or stationary combustion in the fishing industry.
1 A 4 c ii Off-road Vehicles and Other Machinery [89] (see page 132)	Fuels combusted in traction vehicles and other mobile machinery on farm land and in forests.
1 A 4 c iii National Fishing [89] (see page 132)	Fuels combusted for inland, coastal and deep-sea fishing. Fishing should cover vessels of all flags that have refuelled in the country (include international fishing).

Figure 10: NFR 1 A 4 category definitions.

Emission Trend

The increase of heated space, water heating demand, climatic circumstances and changes of fuel mix are the most important drivers for emissions from *1 A 4 Other Sectors*. While total fuel consumption increased by 7% from 259.5 PJ in 1990 to 278.7 PJ in 2006

- a decrease in emission due to fuel switches and the installation of more efficient combustion plants (modernisation) could be noted for
  - SO_2 emissions (-74%)
  - NO_x emissions (-9%)
  - NMVOC emissions (-39%)
  - CO emissions (-32%)
  - TSP, PM10, PM2.5 emissions (-19%, -20%, -20%)
  - Cd, Hg, Pb emissions (-20%, -51%, -66%)
  - PAH, dioxin/furan, HCB emissions (-24%, -31%, -31%)
- while NH_3 emissions increased by +12%.

Tables presenting the emission trends per sub category can be found in the Annex.

In the following Tables the emission trends per sub category are presented.

Table 118: SO_2 emissions and trends from Sector 1 A 4 Other Sectors and source categories 1990–2006.

SO_2 [Gg]	1	1 A	1 A 4	1 A 4 a	1 A 4 b	1 A 4 b 1	1 A 4 b 2	1 A 4 c	1 A 4 c 1	1 A 4 c 2	1 A 4 c 3
1990	72.03	70.03	33.41	5.24	25.92	25.87	0.06	2.25	1.18	1.07	NO
1991	69.46	68.16	30.19	3.96	24.40	24.34	0.06	1.83	0.88	0.96	NO
1992	53.32	51.32	26.52	3.30	21.43	21.37	0.06	1.78	0.79	0.99	NO
1993	51.92	49.82	22.55	2.72	18.23	18.18	0.06	1.59	0.59	1.00	NO
1994	46.14	44.86	20.16	2.45	16.33	16.28	0.05	1.39	0.48	0.90	NO
1995	45.43	43.90	19.04	2.23	16.01	15.99	0.02	0.80	0.49	0.31	NO
1996	43.27	42.07	19.38	2.66	15.87	15.85	0.02	0.85	0.51	0.34	NO
1997	38.84	38.78	13.52	2.50	10.22	10.20	0.02	0.79	0.43	0.37	NO
1998	34.33	34.29	12.59	2.18	9.64	9.62	0.02	0.77	0.42	0.35	NO
1999	32.62	32.47	12.68	2.58	9.34	9.32	0.02	0.76	0.45	0.31	NO
2000	30.47	30.33	11.12	2.21	8.26	8.25	0.02	0.64	0.35	0.29	NO
2001	31.43	31.27	11.41	2.55	8.18	8.16	0.02	0.68	0.37	0.31	NO
2002	30.37	30.24	10.51	2.47	7.39	7.37	0.02	0.65	0.33	0.32	NO
2003	31.17	31.02	10.80	2.85	7.30	7.28	0.02	0.66	0.34	0.32	NO
2004	25.66	25.51	8.72	1.82	6.54	6.54	0.00	0.36	0.31	0.05	NO
2005	25.37	25.24	8.62	1.44	6.84	6.84	0.00	0.35	0.30	0.05	NO
2006	27.18	27.01	8.55	1.73	6.49	6.49	0.00	0.33	0.28	0.05	NO
Trend											
1990–2006	*-62.3%*	*-61.4%*	*-74.4%*	*-66.9%*	*-75.0%*	*-74.9%*	*-92.2%*	*-85.5%*	*-76.3%*	*-95.7%*	
2005–2006	*7.1%*	*7.0%*	*-0.8%*	*20.8%*	*-5.1%*	*-5.1%*	*0.0%*	*-5.4%*	*-6.3%*	*0.4%*	
Share in Sector 1 A 4 Other Sectors											
1990			*100.0%*	*15.7%*	*77.6%*	*77.4%*	*0.2%*	*6.7%*	*3.5%*	*3.2%*	
2006			*100.0%*	*20.3%*	*75.9%*	*75.8%*	*0.1%*	*3.8%*	*3.3%*	*0.5%*	
Share in National Total											
1990	*96.9%*	*94.2%*	*45.0%*	*7.0%*	*34.9%*	*34.8%*	*0.1%*	*3.0%*	*1.6%*	*1.4%*	
2006	*95.5%*	*94.9%*	*30.1%*	*6.1%*	*22.8%*	*22.8%*	*0.0%*	*1.2%*	*1.0%*	*0.2%*	

Table 119: NO_x emissions and trends from Sector 1 A 4 Other Sectors and source categories 1990–2006.

NO_x [Gg]	1	1 A	1 A 4	1 A 4 a	1 A 4 b	1 A 4 b 1	1 A 4 b 2	1 A 4 c	1 A 4 c 1	1 A 4 c 2	1 A 4 c 3
1990	181.43	181.43	36.96	3.45	14.09	13.02	1.07	19.42	1.05	18.36	
1991	191.77	191.77	35.91	3.07	15.34	14.26	1.07	17.50	1.04	16.47	
1992	181.32	181.32	35.57	3.39	14.18	13.09	1.09	18.00	0.95	17.05	
1993	178.50	178.50	34.98	3.34	13.64	12.54	1.10	18.00	0.80	17.20	
1994	172.61	172.61	34.68	2.94	12.63	11.50	1.13	19.10	0.65	18.45	
1995	173.72	173.72	34.99	3.53	13.37	12.20	1.16	18.10	0.73	17.37	
1996	196.48	196.48	38.11	3.70	14.32	13.17	1.15	20.09	0.80	19.28	
1997	185.57	185.57	39.44	2.96	14.71	13.56	1.15	21.77	0.88	20.89	
1998	200.67	200.67	38.46	2.69	14.74	13.59	1.15	21.03	0.88	20.15	
1999	191.64	191.64	39.12	3.20	14.81	13.80	1.00	21.11	0.97	20.15	
2000	198.16	198.16	35.90	2.89	13.60	12.62	0.98	19.40	0.85	18.55	
2001	207.84	207.84	37.84	3.48	14.33	13.36	0.97	20.02	0.96	19.07	
2002	217.39	217.39	37.15	3.44	13.69	12.74	0.95	20.02	0.92	19.10	
2003	228.75	228.75	37.51	3.97	14.04	13.18	0.86	19.50	0.99	18.52	
2004	226.71	226.71	35.80	3.12	13.21	12.38	0.83	19.48	1.00	18.48	
2005	229.95	229.95	34.92	2.87	13.71	12.91	0.80	18.34	1.02	17.32	
2006	218.27	218.27	33.62	2.79	12.98	12.21	0.77	17.85	0.95	16.90	
Trend											
1990–2006	*20.3%*	*20.3%*	*-9.0%*	*-19.2%*	*-7.9%*	*-6.2%*	*-28.1%*	*-8.1%*	*-9.6%*	*-8.0%*	
2005–2006	*-5.1%*	*-5.1%*	*-3.7%*	*-3.0%*	*-5.3%*	*-5.4%*	*-3.8%*	*-2.7%*	*-6.4%*	*-2.4%*	
Share in Sector 1 A 4 Other Sectors											
1990			*100.0%*	*9.3%*	*38.1%*	*35.2%*	*2.9%*	*52.5%*	*2.9%*	*49.7%*	
2006			*100.0%*	*8.3%*	*38.6%*	*36.3%*	*2.3%*	*53.1%*	*2.8%*	*50.3%*	
Share in National Total											
1990	*94.3%*	*94.3%*	*19.2%*	*1.8%*	*7.3%*	*6.8%*	*0.6%*	*10.1%*	*0.5%*	*9.5%*	
2006	*96.9%*	*96.9%*	*14.9%*	*1.2%*	*5.8%*	*5.4%*	*0.3%*	*7.9%*	*0.4%*	*7.5%*	

Table 120: NMVOC emissions and trends from Sector 1 A 4 Other Sectors and source categories 1990–2006.

NMVOC [Gg]	1	1 A	1 A 4	1 A 4 a	1 A 4 b	1 A 4 b 1	1 A 4 b 2	1 A 4 c	1 A 4 c 1	1 A 4 c 2	1 A 4 c 3
1990	153.12	140.91	67.11	0.68	57.31	51.04	6.27	9.12	0.35	8.77	NO
1991	160.54	147.38	70.05	0.79	61.25	54.96	6.29	8.02	0.39	7.62	NO
1992	152.39	139.26	64.59	0.60	55.72	49.39	6.33	8.27	0.36	7.91	NO
1993	149.88	137.03	64.58	0.59	55.67	49.32	6.34	8.32	0.37	7.96	NO
1994	138.58	128.32	60.51	0.55	51.12	44.80	6.32	8.84	0.32	8.52	NO
1995	133.70	124.88	61.95	0.48	53.15	46.90	6.25	8.32	0.36	7.95	NO
1996	131.19	123.28	65.44	0.53	56.05	49.87	6.18	8.85	0.39	8.46	NO
1997	112.62	105.26	53.48	1.51	41.04	34.93	6.11	10.93	2.28	8.64	NO
1998	106.59	100.74	51.36	1.39	39.64	33.61	6.03	10.33	2.16	8.16	NO
1999	100.46	95.32	51.89	1.93	39.65	33.80	5.84	10.32	2.41	7.91	NO
2000	92.52	87.36	47.86	1.90	36.56	31.21	5.35	9.40	2.26	7.14	NO
2001	89.55	86.23	49.35	1.51	38.36	33.47	4.89	9.48	2.46	7.02	NO
2002	85.37	81.89	46.71	1.27	36.21	31.75	4.45	9.23	2.28	6.96	NO
2003	83.37	79.93	46.50	1.37	36.00	32.02	3.98	9.13	2.34	6.80	NO
2004	77.73	74.46	43.62	1.49	33.41	30.02	3.40	8.72	2.26	6.45	NO
2005	75.19	72.10	43.44	1.32	34.06	31.20	2.86	8.05	2.27	5.78	NO
2006	70.12	66.99	40.86	1.34	31.95	29.56	2.39	7.57	2.11	5.45	NO
Trend											
1990–2006	-54.2%	-52.5%	-39.1%	96.6%	-44.2%	-42.1%	-61.9%	-17.0%	499.9%	-37.8%	
2005–2006	-6.8%	-7.1%	-5.9%	1.0%	-6.2%	-5.2%	-16.5%	-6.0%	-7.1%	-5.6%	
Share in Sector 1 A 4 Other Sectors											
1990			*100.0%*	*1.0%*	*85.4%*	*76.1%*	*9.3%*	*13.6%*	*0.5%*	*13.1%*	
2006			*100.0%*	*3.3%*	*78.2%*	*72.4%*	*5.9%*	*18.5%*	*5.2%*	*13.3%*	
Share in National Total											
1990	*54.1%*	*49.8%*	*23.7%*	*0.2%*	*20.2%*	*18.0%*	*2.2%*	*3.2%*	*0.1%*	*3.1%*	
2006	*40.9%*	*39.0%*	*23.8%*	*0.8%*	*18.6%*	*17.2%*	*1.4%*	*4.4%*	*1.2%*	*3.2%*	

Table 121: CO emissions and trends from Sector 1 A 4 Other Sectors and source categories 1990–2006.

CO [Gg]	1	1 A	1 A 4	1 A 4 a	1 A 4 b	1 A 4 b 1	1 A 4 b 2	1 A 4 c	1 A 4 c 1	1 A 4 c 2	1 A 4 c 3
1990	1385.17	1385.17	494.26	11.70	441.36	415.66	25.70	41.20	12.73	28.48	NO
1991	1459.72	1459.72	534.09	13.20	481.18	455.38	25.79	39.71	14.24	25.48	NO
1992	1424.19	1424.19	490.07	11.63	438.72	412.79	25.94	39.72	13.49	26.23	NO
1993	1389.45	1389.45	468.13	11.31	417.27	391.26	26.01	39.56	13.19	26.37	NO
1994	1319.28	1319.28	432.09	10.50	382.20	356.38	25.82	39.38	11.61	27.78	NO
1995	1211.36	1211.36	442.99	10.42	393.34	368.13	25.21	39.23	13.09	26.14	NO
1996	1196.34	1196.34	463.40	10.42	411.53	386.92	24.61	41.44	14.17	27.27	NO
1997	1106.65	1106.65	419.43	14.63	356.27	332.28	23.98	48.54	20.96	27.58	NO
1998	1064.77	1064.77	401.10	12.49	342.38	319.03	23.35	46.24	19.99	26.25	NO
1999	994.48	994.48	403.47	16.10	340.48	317.83	22.65	46.89	21.27	25.62	NO
2000	922.83	922.83	375.54	16.67	314.87	293.37	21.50	44.00	20.30	23.70	NO
2001	897.49	897.49	392.37	15.66	331.26	310.77	20.49	45.44	21.93	23.51	NO
2002	866.16	866.16	369.23	13.16	312.19	292.55	19.64	43.88	20.44	23.44	NO
2003	868.00	868.00	369.34	14.46	310.83	291.85	18.98	44.05	20.80	23.26	NO
2004	825.04	825.04	347.24	13.85	290.60	272.17	18.42	42.80	19.99	22.80	NO
2005	791.69	791.69	356.26	12.47	302.05	284.08	17.96	41.74	20.36	21.38	NO
2006	754.06	754.06	338.00	13.04	285.14	267.52	17.62	39.83	18.94	20.89	NO
Trend											
1990–2006	*-45.6%*	*-45.6%*	*-31.6%*	*11.4%*	*-35.4%*	*-35.6%*	*-31.4%*	*-3.3%*	*48.8%*	*-26.6%*	
2005–2006	*-4.8%*	*-4.8%*	*-5.1%*	*4.5%*	*-5.6%*	*-5.8%*	*-1.9%*	*-4.6%*	*-7.0%*	*-2.3%*	
Share in Sector 1 A 4 Other Sectors											
1990			*100.0%*	*2.4%*	*89.3%*	*84.1%*	*5.2%*	*8.3%*	*2.6%*	*5.8%*	
2006			*100.0%*	*3.9%*	*84.4%*	*79.1%*	*5.2%*	*11.8%*	*5.6%*	*6.2%*	
Share in National Total											
1990	*95.9%*	*95.9%*	*34.2%*	*0.8%*	*30.6%*	*28.8%*	*1.8%*	*2.9%*	*0.9%*	*2.0%*	
2006	*96.0%*	*96.0%*	*43.0%*	*1.7%*	*36.3%*	*34.1%*	*2.2%*	*5.1%*	*2.4%*	*2.7%*	

Table 122: NH_3 emissions and trends from Sector 1 A 4 Other Sectors and source categories 1990–2006.

NH_3 [Gg]	1	1 A	1 A 4	1 A 4 a	1 A 4 b	1 A 4 b 1	1 A 4 b 2	1 A 4 c	1 A 4 c 1	1 A 4 c 2	1 A 4 c 3
1990	4.280	4.280	0.633	0.073	0.516	0.516	0.000	0.044	0.035	0.008	
1991	5.848	5.848	0.690	0.073	0.573	0.573	0.000	0.044	0.036	0.007	
1992	6.669	6.669	0.658	0.079	0.538	0.537	0.000	0.042	0.034	0.008	
1993	7.451	7.451	0.672	0.082	0.551	0.551	0.000	0.039	0.031	0.008	
1994	7.656	7.656	0.617	0.070	0.513	0.513	0.000	0.034	0.026	0.008	
1995	7.490	7.490	0.679	0.085	0.556	0.556	0.000	0.038	0.030	0.008	
1996	7.012	7.012	0.752	0.097	0.614	0.614	0.000	0.041	0.033	0.008	
1997	6.519	6.519	0.697	0.106	0.550	0.549	0.000	0.041	0.033	0.008	
1998	6.552	6.552	0.692	0.097	0.555	0.554	0.000	0.040	0.032	0.008	
1999	5.919	5.919	0.718	0.108	0.566	0.566	0.000	0.044	0.036	0.008	
2000	5.423	5.423	0.656	0.089	0.527	0.526	0.000	0.040	0.033	0.007	
2001	5.276	5.276	0.724	0.120	0.559	0.559	0.000	0.045	0.037	0.007	
2002	5.225	5.225	0.704	0.120	0.540	0.540	0.000	0.044	0.036	0.008	
2003	5.046	5.046	0.756	0.142	0.568	0.568	0.000	0.046	0.039	0.007	
2004	4.547	4.547	0.697	0.107	0.542	0.542	0.000	0.047	0.040	0.007	
2005	4.170	4.170	0.731	0.107	0.575	0.574	0.000	0.049	0.042	0.007	
2006	3.762	3.762	0.711	0.115	0.550	0.550	0.000	0.046	0.039	0.007	
Trend											
1990–2006	*-12.1%*	*-12.1%*	*12.4%*	*58.5%*	*6.5%*	*6.6%*	*-25.0%*	*5.1%*	*10.8%*	*-19.1%*	
2005–2006	*-9.8%*	*-9.8%*	*-2.7%*	*7.5%*	*-4.3%*	*-4.3%*	*0.0%*	*-5.7%*	*-6.2%*	*-2.0%*	
Share in Sector 1 A 4 Other Sectors											
1990			*100.0%*	*11.5%*	*81.6%*	*81.5%*	*0.0%*	*6.9%*	*5.6%*	*1.3%*	
2006			*100.0%*	*16.2%*	*77.3%*	*77.3%*	*0.0%*	*6.5%*	*5.5%*	*0.9%*	
Share in National Total											
1990	*6.0%*	*6.0%*	*0.9%*	*0.1%*	*0.7%*	*0.7%*	*0.0%*	*0.1%*	*0.0%*	*0.0%*	
2006	*5.7%*	*5.7%*	*1.1%*	*0.2%*	*0.8%*	*0.8%*	*0.0%*	*0.1%*	*0.1%*	*0.0%*	

Table 123: Cd emissions and trends from Sector 1 A 4 Other Sectors and source categories 1990–2006.

Cd [Mg]	1	1 A	1 A 4	1 A 4 a	1 A 4 b	1 A 4 b 1	1 A 4 b 2	1 A 4 c	1 A 4 c 1	1 A 4 c 2	1 A 4 c 3
1990	1.059	1.059	0.420	0.076	0.311	0.311	0.000	0.033	0.032	0.000	
1991	1.091	1.091	0.446	0.065	0.345	0.345	0.000	0.036	0.036	0.000	
1992	0.975	0.975	0.410	0.060	0.315	0.315	0.000	0.035	0.034	0.000	
1993	0.939	0.939	0.377	0.042	0.300	0.300	0.000	0.035	0.035	0.000	
1994	0.879	0.879	0.340	0.035	0.275	0.275	0.000	0.031	0.030	0.000	
1995	0.810	0.810	0.347	0.026	0.286	0.286	0.000	0.035	0.035	0.000	
1996	0.844	0.844	0.373	0.032	0.302	0.302	0.000	0.039	0.038	0.000	
1997	0.804	0.804	0.342	0.036	0.269	0.269	0.000	0.037	0.037	0.000	
1998	0.735	0.735	0.320	0.028	0.257	0.257	0.000	0.036	0.035	0.000	
1999	0.804	0.804	0.338	0.042	0.256	0.256	0.000	0.039	0.039	0.000	
2000	0.759	0.759	0.318	0.043	0.237	0.237	0.000	0.039	0.038	0.000	
2001	0.795	0.795	0.333	0.033	0.257	0.257	0.000	0.044	0.044	0.000	
2002	0.804	0.804	0.321	0.032	0.246	0.246	0.000	0.043	0.043	0.000	
2003	0.831	0.831	0.332	0.036	0.250	0.250	0.000	0.046	0.046	0.000	
2004	0.829	0.829	0.327	0.044	0.236	0.236	0.000	0.048	0.048	0.000	
2005	0.883	0.883	0.345	0.044	0.249	0.249	0.000	0.052	0.051	0.000	
2006	0.899	0.899	0.335	0.045	0.242	0.242	0.000	0.049	0.048	0.000	
Trend											
1990–2006	*-15.1%*	*-15.1%*	*-20.2%*	*-41.2%*	*-22.4%*	*-22.4%*	*1.2%*	*49.1%*	*49.5%*	*8.8%*	
2005–2006	*1.8%*	*1.8%*	*-2.9%*	*0.3%*	*-2.8%*	*-2.8%*	*1.1%*	*-6.1%*	*-6.1%*	*0.9%*	
Share in Sector 1 A 4 Other Sectors											
1990			*100.0%*	*18.0%*	*74.2%*	*74.2%*	*0.0%*	*7.8%*	*7.7%*	*0.1%*	
2006			*100.0%*	*13.3%*	*72.2%*	*72.2%*	*0.0%*	*14.5%*	*14.4%*	*0.1%*	
Share in National Total											
1990	*67.1%*	*67.1%*	*26.6%*	*4.8%*	*19.7%*	*19.7%*	*0.0%*	*2.1%*	*2.0%*	*0.0%*	
2006	*79.9%*	*79.9%*	*29.8%*	*4.0%*	*21.5%*	*21.5%*	*0.0%*	*4.3%*	*4.3%*	*0.0%*	

Table 124: Hg emissions and trends from Sector 1 A 4 Other Sectors and source categories 1990–2006.

Hg[Mg]	1	1A	1A4	1A4a	1A4b	1A4b1	1A4b2	1A4c	1A4c1	1A4c2	1A4c3
1990	1.5600	1.5600	0.4269	0.0268	0.3864	0.3863	0.0000	0.0138	0.0136	0.0001	NO
1991	1.4994	1.4994	0.4697	0.0277	0.4266	0.4266	0.0000	0.0154	0.0153	0.0001	NO
1992	1.1802	1.1802	0.4167	0.0241	0.3782	0.3782	0.0000	0.0144	0.0143	0.0001	NO
1993	0.9554	0.9554	0.3677	0.0198	0.3345	0.3345	0.0000	0.0135	0.0133	0.0001	NO
1994	0.7580	0.7580	0.3328	0.0185	0.3025	0.3024	0.0000	0.0119	0.0118	0.0001	NO
1995	0.7129	0.7129	0.3297	0.0157	0.3011	0.3011	0.0000	0.0129	0.0128	0.0001	NO
1996	0.7082	0.7082	0.3349	0.0179	0.3035	0.3034	0.0000	0.0136	0.0135	0.0001	NO
1997	0.6828	0.6828	0.2861	0.0208	0.2526	0.2526	0.0000	0.0126	0.0125	0.0001	NO
1998	0.6004	0.6004	0.2628	0.0170	0.2340	0.2340	0.0000	0.0118	0.0116	0.0001	NO
1999	0.6480	0.6480	0.2597	0.0199	0.2271	0.2271	0.0000	0.0127	0.0126	0.0001	NO
2000	0.6432	0.6432	0.2389	0.0213	0.2054	0.2054	0.0000	0.0122	0.0121	0.0001	NO
2001	0.6994	0.6994	0.2460	0.0193	0.2131	0.2130	0.0000	0.0136	0.0135	0.0001	NO
2002	0.6640	0.6640	0.2249	0.0159	0.1959	0.1959	0.0000	0.0130	0.0129	0.0001	NO
2003	0.7000	0.7000	0.2226	0.0177	0.1912	0.1912	0.0000	0.0137	0.0135	0.0001	NO
2004	0.6518	0.6518	0.2045	0.0179	0.1727	0.1727	0.0000	0.0140	0.0138	0.0001	NO
2005	0.6700	0.6700	0.2140	0.0169	0.1821	0.1821	0.0000	0.0150	0.0149	0.0001	NO
2006	0.6934	0.6934	0.2084	0.0181	0.1762	0.1762	0.0000	0.0141	0.0140	0.0001	NO
Trend											
1990–2006	*-55.6%*	*-55.6%*	*-51.2%*	*-32.5%*	*-54.4%*	*-54.4%*	*1.2%*	*2.6%*	*2.5%*	*8.8%*	
2005–2006	*3.5%*	*3.5%*	*-2.6%*	*7.3%*	*-3.2%*	*-3.2%*	*1.1%*	*-6.0%*	*-6.1%*	*0.9%*	
Share in Sector 1 A 4 Other Sectors											
1990			*100.0%*	*6.3%*	*90.5%*	*90.5%*	*0.0%*	*3.2%*	*3.2%*	*0.0%*	
2006			*100.0%*	*8.7%*	*84.5%*	*84.5%*	*0.0%*	*6.8%*	*6.7%*	*0.1%*	
Share in National Total											
1990	*72.8%*	*72.8%*	*19.9%*	*1.3%*	*18.0%*	*18.0%*	*0.0%*	*0.6%*	*0.6%*	*0.0%*	
2006	*67.6%*	*67.6%*	*20.3%*	*1.8%*	*17.2%*	*17.2%*	*0.0%*	*1.4%*	*1.4%*	*0.0%*	

Table 125: Pb emissions and trends from Sector 1 A 4 Other Sectors and source categories 1990–2006.

Pb [Mg]	1	1 A	1 A 4	1 A 4 a	1 A 4 b	1 A 4 b 1	1 A 4 b 2	1 A 4 c	1 A 4 c 1	1 A 4 c 2	1 A 4 c 3
1990	174.165	174.165	7.769	0.460	5.935	3.813	2.121	1.375	0.135	1.240	NO
1991	143.809	143.809	7.463	0.411	5.975	4.224	1.751	1.076	0.152	0.924	NO
1992	100.667	100.667	6.417	0.380	5.154	3.774	1.380	0.883	0.143	0.740	NO
1993	70.612	70.612	5.393	0.268	4.439	3.415	1.024	0.686	0.137	0.549	NO
1994	47.308	47.308	4.448	0.229	3.740	3.105	0.635	0.479	0.121	0.358	NO
1995	11.333	11.333	3.447	0.184	3.129	3.129	0.000	0.135	0.134	0.000	NO
1996	11.175	11.175	3.583	0.231	3.208	3.208	0.000	0.144	0.144	0.000	NO
1997	9.640	9.640	3.126	0.252	2.738	2.738	0.000	0.136	0.135	0.000	NO
1998	8.232	8.232	2.891	0.196	2.567	2.567	0.000	0.128	0.127	0.000	NO
1999	7.532	7.532	2.959	0.321	2.498	2.498	0.000	0.140	0.139	0.000	NO
2000	6.424	6.424	2.742	0.316	2.291	2.291	0.000	0.135	0.135	0.000	NO
2001	6.697	6.697	2.824	0.239	2.432	2.432	0.000	0.153	0.153	0.000	NO
2002	6.758	6.758	2.675	0.238	2.288	2.288	0.000	0.148	0.148	0.000	NO
2003	6.952	6.952	2.703	0.264	2.282	2.282	0.000	0.157	0.157	0.000	NO
2004	7.118	7.118	2.580	0.323	2.096	2.096	0.000	0.162	0.161	0.000	NO
2005	7.164	7.164	2.722	0.334	2.214	2.214	0.000	0.174	0.174	0.000	NO
2006	7.488	7.488	2.640	0.332	2.144	2.144	0.000	0.164	0.163	0.000	NO
Trend											
1990–2006	*-95.7%*	*-95.7%*	*-66.0%*	*-27.8%*	*-63.9%*	*-43.8%*	*-100.0%*	*-88.1%*	*21.3%*	*-100.0%*	
2005–2006	*4.5%*	*4.5%*	*-3.0%*	*-0.5%*	*-3.2%*	*-3.2%*	*1.5%*	*-6.1%*	*-6.1%*	*0.9%*	
Share in Sector 1 A 4 Other Sectors											
1990			*100.0%*	*5.9%*	*76.4%*	*49.1%*	*27.3%*	*17.7%*	*1.7%*	*16.0%*	
2006			*100.0%*	*12.6%*	*81.2%*	*81.2%*	*0.0%*	*6.2%*	*6.2%*	*0.0%*	
Share in National Total											
1990	*84.0%*	*84.0%*	*3.7%*	*0.2%*	*2.9%*	*1.8%*	*1.0%*	*0.7%*	*0.1%*	*0.6%*	
2006	*53.0%*	*53.0%*	*18.7%*	*2.4%*	*15.2%*	*15.2%*	*0.0%*	*1.2%*	*1.2%*	*0.0%*	

Table 126: PAH emissions and trends from Sector 1 A 4 Other Sectors and source categories 1990–2006.

PAH [Mg]	1	1 A	1 A 4	1 A 4 a	1 A 4 b	1 A 4 b 1	1 A 4 b 2	1 A 4 c	1 A 4 c 1	1 A 4 c 2	1 A 4 c 3
1990	9.473	9.473	8.554	0.163	7.920	7.893	0.027	0.471	0.351	0.120	NO
1991	10.318	10.318	9.332	0.152	8.680	8.653	0.027	0.500	0.393	0.107	NO
1992	9.398	9.398	8.442	0.155	7.811	7.784	0.027	0.476	0.365	0.111	NO
1993	9.283	9.283	8.328	0.117	7.733	7.705	0.028	0.477	0.365	0.112	NO
1994	8.395	8.395	7.455	0.119	6.915	6.887	0.028	0.422	0.302	0.119	NO
1995	8.851	8.851	7.892	0.111	7.314	7.286	0.028	0.466	0.355	0.112	NO
1996	9.566	9.566	8.447	0.138	7.801	7.773	0.028	0.508	0.386	0.122	NO
1997	8.583	8.583	7.548	0.152	6.900	6.872	0.028	0.496	0.366	0.130	NO
1998	8.299	8.299	7.119	0.121	6.531	6.503	0.028	0.467	0.341	0.125	NO
1999	8.318	8.318	7.140	0.150	6.476	6.448	0.028	0.514	0.387	0.128	NO
2000	7.781	7.781	6.512	0.157	5.863	5.836	0.027	0.492	0.372	0.120	NO
2001	8.475	8.475	7.111	0.123	6.427	6.400	0.027	0.560	0.434	0.126	NO
2002	8.288	8.288	6.787	0.114	6.125	6.097	0.027	0.548	0.419	0.130	NO
2003	8.618	8.618	6.978	0.129	6.268	6.241	0.027	0.580	0.451	0.130	NO
2004	8.497	8.497	6.791	0.152	6.029	6.001	0.027	0.610	0.476	0.134	NO
2005	8.766	8.766	6.974	0.156	6.186	6.158	0.027	0.632	0.503	0.129	NO
2006	8.310	8.310	6.522	0.159	5.780	5.753	0.028	0.582	0.453	0.130	NO
Trend											
1990–2006	*-12.3%*	*-12.3%*	*-23.8%*	*-2.7%*	*-27.0%*	*-27.1%*	*2.6%*	*23.6%*	*28.8%*	*8.4%*	
2005–2006	*-5.2%*	*-5.2%*	*-6.5%*	*1.6%*	*-6.5%*	*-6.6%*	*1.4%*	*-7.8%*	*-10.0%*	*0.9%*	
Share in Sector 1 A 4 Other Sectors											
1990			*100.0%*	*1.9%*	*92.6%*	*92.3%*	*0.3%*	*5.5%*	*4.1%*	*1.4%*	
2006			*100.0%*	*2.4%*	*88.6%*	*88.2%*	*0.4%*	*8.9%*	*6.9%*	*2.0%*	
Share in National Total											
1990	*54.7%*	*54.7%*	*49.4%*	*0.9%*	*45.8%*	*45.6%*	*0.2%*	*2.7%*	*2.0%*	*0.7%*	
2006	*95.2%*	*95.2%*	*74.7%*	*1.8%*	*66.2%*	*65.9%*	*0.3%*	*6.7%*	*5.2%*	*1.5%*	

Table 127: Dioxin emissions and trends from Sector 1 A 4 Other Sectors and source categories 1990–2006.

Dioxin [g]	1	1 A	1 A 4	1 A 4 a	1 A 4 b	1 A 4 b 1	1 A 4 b 2	1 A 4 c	1 A 4 c 1	1 A 4 c 2	1 A 4 c 3
1990	101.84	101.84	45.44	1.97	41.67	41.62	0.05	1.80	1.68	0.13	NO
1991	80.87	80.87	49.77	1.84	45.95	45.90	0.05	1.99	1.88	0.11	NO
1992	53.86	53.86	45.31	1.91	41.55	41.49	0.05	1.86	1.74	0.12	NO
1993	49.34	49.34	42.67	1.47	39.37	39.32	0.05	1.84	1.72	0.12	NO
1994	44.54	44.54	38.11	1.47	35.09	35.03	0.05	1.55	1.43	0.12	NO
1995	45.79	45.79	39.64	1.39	36.48	36.42	0.05	1.77	1.66	0.12	NO
1996	48.22	48.22	41.90	1.69	38.29	38.24	0.05	1.92	1.79	0.13	NO
1997	46.92	46.92	36.95	1.80	33.34	33.28	0.05	1.82	1.69	0.13	NO
1998	44.45	44.45	34.56	1.46	31.41	31.35	0.05	1.70	1.57	0.13	NO
1999	40.74	40.74	34.64	1.74	31.00	30.94	0.05	1.91	1.77	0.13	NO
2000	37.69	37.69	31.74	1.86	28.05	28.00	0.05	1.83	1.70	0.12	NO
2001	40.55	40.55	34.25	1.56	30.58	30.53	0.05	2.11	1.98	0.13	NO
2002	39.08	39.08	32.57	1.52	29.01	28.96	0.05	2.04	1.90	0.13	NO
2003	40.04	40.04	33.41	1.73	29.50	29.45	0.05	2.18	2.04	0.13	NO
2004	39.08	39.08	32.31	2.02	28.00	27.95	0.05	2.29	2.15	0.14	NO
2005	40.31	40.31	33.58	2.20	28.97	28.92	0.05	2.41	2.27	0.13	NO
2006	38.62	38.62	31.47	2.21	27.08	27.03	0.05	2.18	2.05	0.13	NO
Trend											
1990–2006	*-62.1%*	*-62.1%*	*-30.7%*	*12.4%*	*-35.0%*	*-35.1%*	*3.2%*	*20.9%*	*22.0%*	*6.8%*	
2005–2006	*-4.2%*	*-4.2%*	*-6.3%*	*0.4%*	*-6.5%*	*-6.6%*	*1.6%*	*-9.4%*	*-10.0%*	*0.9%*	
Share in Sector 1 A 4 Other Sectors											
1990			*100.0%*	*4.3%*	*91.7%*	*91.6%*	*0.1%*	*4.0%*	*3.7%*	*0.3%*	
2006			*100.0%*	*7.0%*	*86.1%*	*85.9%*	*0.2%*	*6.9%*	*6.5%*	*0.4%*	
Share in National Total											
1990	*63.5%*	*63.5%*	*28.4%*	*1.2%*	*26.0%*	*26.0%*	*0.0%*	*1.1%*	*1.0%*	*0.1%*	
2006	*88.4%*	*88.4%*	*72.0%*	*5.1%*	*62.0%*	*61.9%*	*0.1%*	*5.0%*	*4.7%*	*0.3%*	

Table 128: HCB emissions and trends from Sector 1 A 4 Other Sectors and source categories 1990–2006.

HCB [kg]	1	1 A	1 A 4	1 A 4 a	1 A 4 b	1 A 4 b 1	1 A 4 b 2	1 A 4 c	1 A 4 c 1	1 A 4 c 2	1 A 4 c 3
1990	72.572	72.572	54.209	1.480	50.165	50.154	0.010	2.564	2.539	0.025	NO
1991	69.706	69.706	59.783	1.363	55.554	55.543	0.010	2.866	2.843	0.022	NO
1992	56.940	56.940	54.500	1.424	50.396	50.386	0.011	2.680	2.657	0.023	NO
1993	53.583	53.583	51.607	1.052	47.880	47.869	0.011	2.675	2.651	0.023	NO
1994	48.036	48.036	46.092	1.068	42.779	42.768	0.011	2.245	2.220	0.025	NO
1995	50.201	50.201	48.312	0.995	44.703	44.693	0.011	2.613	2.589	0.024	NO
1996	53.148	53.148	51.245	1.250	47.153	47.143	0.011	2.841	2.816	0.025	NO
1997	49.073	49.073	45.265	1.309	41.252	41.242	0.011	2.703	2.676	0.027	NO
1998	46.454	46.454	42.667	1.018	39.120	39.109	0.011	2.529	2.503	0.026	NO
1999	44.745	44.745	43.028	1.197	38.980	38.969	0.011	2.851	2.825	0.026	NO
2000	41.021	41.021	39.336	1.268	35.317	35.306	0.011	2.752	2.727	0.025	NO
2001	44.318	44.318	42.420	1.009	38.216	38.205	0.011	3.195	3.169	0.026	NO
2002	41.801	41.801	39.861	0.954	35.817	35.806	0.011	3.090	3.063	0.027	NO
2003	42.362	42.362	40.412	1.079	36.014	36.004	0.011	3.319	3.292	0.027	NO
2004	40.481	40.481	38.462	1.272	33.694	33.683	0.011	3.497	3.469	0.027	NO
2005	41.825	41.825	39.816	1.355	34.759	34.749	0.011	3.702	3.676	0.026	NO
2006	39.271	39.271	37.195	1.372	32.464	32.453	0.011	3.360	3.333	0.027	NO
Trend											
1990–2006	*-45.9%*	*-45.9%*	*-31.4%*	*-7.3%*	*-35.3%*	*-35.3%*	*3.2%*	*31.0%*	*31.2%*	*6.8%*	
2005–2006	*-6.1%*	*-6.1%*	*-6.6%*	*1.3%*	*-6.6%*	*-6.6%*	*1.6%*	*-9.2%*	*-9.3%*	*0.9%*	
Share in Sector 1 A 4 Other Sectors											
1990			*100.0%*	*2.7%*	*92.5%*	*92.5%*	*0.0%*	*4.7%*	*4.7%*	*0.0%*	
2006			*100.0%*	*3.7%*	*87.3%*	*87.3%*	*0.0%*	*9.0%*	*9.0%*	*0.1%*	
Share in National Total											
1990	*79.1%*	*79.1%*	*59.1%*	*1.6%*	*54.7%*	*54.7%*	*0.0%*	*2.8%*	*2.8%*	*0.0%*	
2006	*91.1%*	*91.1%*	*86.3%*	*3.2%*	*75.3%*	*75.3%*	*0.0%*	*7.8%*	*7.7%*	*0.1%*	

Table 129: TSP emissions and trends from Sector 1 A 4 Other Sectors and source categories 1990–2006.

TSP [Mg]	1	1 A	1 A 4	1 A 4 a	1 A 4 b	1 A 4 b 1	1 A 4 b 2	1 A 4 c	1 A 4 c 1	1 A 4 c 2	1 A 4 c 3
1990	31811.93	31164.90	14771.80	817.38	10506.81	10249.33	257.48	3447.62	443.75	3003.87	NO
1991	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
1992	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
1993	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
1994	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
1995	32200.20	31655.16	13598.75	572.17	9817.10	9565.99	251.11	3209.48	466.43	2743.05	NO
1996	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
1997	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
1998	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
1999	32714.34	32214.70	13122.59	658.35	8957.02	8732.47	224.55	3507.22	517.30	2989.93	NO
2000	32097.98	31539.83	12191.61	618.12	8308.42	8096.16	212.26	3265.07	488.56	2776.51	NO
2001	32928.52	32343.35	12826.13	562.47	8869.00	8667.76	201.24	3394.66	546.77	2847.89	NO
2002	33010.37	32411.64	12456.87	553.93	8512.16	8321.72	190.44	3390.78	522.58	2868.19	NO
2003	33725.61	33083.57	12610.35	609.04	8629.13	8452.92	176.21	3372.18	550.47	2821.70	NO
2004	33401.68	32796.86	12142.91	609.76	8200.89	8036.00	164.89	3332.25	557.23	2775.02	NO
2005	33535.63	32923.65	12260.17	540.26	8574.95	8420.42	154.53	3144.95	587.53	2557.43	NO
2006	33224.22	32635.35	11910.17	562.26	8314.62	8169.16	145.46	3033.28	558.71	2474.58	NO
Trend											
1990–2006	*4.4%*	*4.7%*	*-19.4%*	*-31.2%*	*-20.9%*	*-20.3%*	*-43.5%*	*-12.0%*	*25.9%*	*-17.6%*	
2005–2006	*-0.9%*	*-0.9%*	*-2.9%*	*4.1%*	*-3.0%*	*-3.0%*	*-5.9%*	*-3.6%*	*-4.9%*	*-3.2%*	
Share in Sector 1 A 4 Other Sectors											
1990			*100.0%*	*5.5%*	*71.1%*	*69.4%*	*1.7%*	*23.3%*	*3.0%*	*20.3%*	
2006			*100.0%*	*4.7%*	*69.8%*	*68.6%*	*1.2%*	*25.5%*	*4.7%*	*20.8%*	
Share in National Total											
1990	*46.4%*	*45.4%*	*21.5%*	*1.2%*	*15.3%*	*14.9%*	*0.4%*	*5.0%*	*0.6%*	*4.4%*	
2006	*44.3%*	*43.5%*	*15.9%*	*0.7%*	*11.1%*	*10.9%*	*0.2%*	*4.0%*	*0.7%*	*3.3%*	

Table 130: PM10 emissions and trends from Sector 1 A 4 Other Sectors and source categories 1990–2006.

PM10 [Mg]	1	1 A	1 A 4	1 A 4 a	1 A 4 b	1 A 4 b 1	1 A 4 b 2	1 A 4 c	1 A 4 c 1	1 A 4 c 2	1 A 4 c 3
1990	23962.50	23657.79	13489.88	752.23	9558.16	9300.68	257.48	3179.50	399.38	2780.12	NO
1991	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
1992	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
1993	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
1994	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
1995	23717.21	23460.30	12424.22	531.65	8936.79	8685.68	251.11	2955.79	419.79	2535.99	NO
1996	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
1997	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
1998	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
1999	23798.23	23562.70	11998.32	609.14	8160.05	7935.50	224.55	3229.13	465.57	2763.56	NO
2000	23104.92	22841.63	11150.49	572.90	7575.09	7362.83	212.26	3002.50	439.71	2562.79	NO
2001	23771.24	23495.32	11721.90	522.82	8078.51	7877.27	201.24	3120.57	492.09	2628.48	NO
2002	23716.91	23434.51	11371.88	515.13	7756.27	7565.83	190.44	3100.48	470.32	2630.15	NO
2003	24200.40	23897.60	11477.47	564.73	7860.12	7683.91	176.21	3052.61	495.42	2557.19	NO
2004	23744.38	23458.94	11052.55	565.38	7473.57	7308.68	164.89	3013.59	501.51	2512.08	NO
2005	23747.95	23459.14	11153.95	502.83	7809.19	7654.66	154.53	2841.93	528.77	2313.16	NO
2006	23340.23	23062.06	10827.64	522.63	7573.99	7428.53	145.46	2731.03	502.84	2228.19	NO
Trend											
1990–2005	*-2.6%*	*-2.5%*	*-19.7%*	*-30.5%*	*-20.8%*	*-20.1%*	*-43.5%*	*-14.1%*	*25.9%*	*-19.9%*	
2005–2006	*-1.7%*	*-1.7%*	*-2.9%*	*3.9%*	*-3.0%*	*-3.0%*	*-5.9%*	*-3.9%*	*-4.9%*	*-3.7%*	
Share in Sector 1 A 4 Other Sectors											
1990			*100.0%*	*5.6%*	*70.9%*	*68.9%*	*1.9%*	*23.6%*	*3.0%*	*20.6%*	
2006			*100.0%*	*4.8%*	*70.0%*	*68.6%*	*1.3%*	*25.2%*	*4.6%*	*20.6%*	
Share in National Total											
1990	*55.8%*	*55.1%*	*31.4%*	*1.8%*	*22.2%*	*21.6%*	*0.6%*	*7.4%*	*0.9%*	*6.5%*	
2006	*53.7%*	*53.1%*	*24.9%*	*1.2%*	*17.4%*	*17.1%*	*0.3%*	*6.3%*	*1.2%*	*5.1%*	

Table 131: PM2.5 emissions and trends from Sector 1 A 4 Other Sectors and source categories 1990–2006.

PM2.5 [Gg]	1	1 A	1 A 4	1 A 4 a	1 A 4 b	1 A 4 b 1	1 A 4 b 2	1 A 4 c	1 A 4 c 1	1 A 4 c 2	1 A 4 c 3
1990	19941.51	19846.55	12292.16	681.79	8609.51	8352.03	257.48	3000.87	355.00	2645.87	NO
1991	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
1992	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
1993	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
1994	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
1995	19661.80	19581.53	11331.00	489.62	8056.47	7805.36	251.11	2784.91	373.15	2411.76	NO
1996	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
1997	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
1998	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
1999	19617.63	19544.01	10964.02	559.36	7363.09	7138.54	224.55	3041.58	413.84	2627.74	NO
2000	18941.75	18859.29	10194.41	527.24	6841.75	6629.49	212.26	2825.41	390.85	2434.56	NO
2001	19510.76	19424.45	10705.43	483.17	7288.01	7086.77	201.24	2934.25	437.41	2496.83	NO
2002	19417.76	19329.36	10382.10	476.33	7000.38	6809.94	190.44	2905.39	418.07	2487.33	NO
2003	19770.00	19675.21	10450.39	520.42	7091.11	6914.90	176.21	2838.86	440.38	2398.48	NO
2004	19281.92	19192.40	10067.36	521.00	6746.26	6581.37	164.89	2800.10	445.79	2354.32	NO
2005	19236.67	19146.09	10145.44	465.39	7043.43	6888.90	154.53	2636.62	470.02	2166.60	NO
2006	18763.85	18676.37	9843.67	482.99	6833.35	6687.89	145.46	2527.32	446.97	2080.36	NO
Trend											
1990–2006	*-5.9%*	*-5.9%*	*-19.9%*	*-29.2%*	*-20.6%*	*-19.9%*	*-43.5%*	*-15.8%*	*25.9%*	*-21.4%*	
2005–2006	*-2.5%*	*-2.5%*	*-3.0%*	*3.8%*	*-3.0%*	*-2.9%*	*-5.9%*	*-4.1%*	*-4.9%*	*-4.0%*	
Share in Sector 1 A 4 Other Sectors											
1990			*100.0%*	*5.5%*	*70.0%*	*67.9%*	*2.1%*	*24.4%*	*2.9%*	*21.5%*	
2006			*100.0%*	*4.9%*	*69.4%*	*67.9%*	*1.5%*	*25.7%*	*4.5%*	*21.1%*	
Share in National Total											
1990	*79.4%*	*79.0%*	*48.9%*	*2.7%*	*34.3%*	*33.2%*	*1.0%*	*11.9%*	*1.4%*	*10.5%*	
2006	*82.8%*	*82.4%*	*43.4%*	*2.1%*	*30.1%*	*29.5%*	*0.6%*	*11.2%*	*2.0%*	*9.2%*	

Methodology

The CORINAIR methodology is applied.

Three technology-dependent main sub categories (heating types) are considered in this category:

1. Central Heatings (CH)
2. Apartment Heatings (AH)
3. Stoves (ST)

Information about type of heatings is collected by household micro census surveys carried out by STATISTIK AUSTRIA (formerly ÖSTAT) for the years 1988, 1990, 1992, 1999/2000 and 2004. Number of interviews, type of questionnaires and interview modes were not consistent for all micro census'. Up to the year 2000 householders were asked by face to face interviews wheras in 2004 data were collected by telephone interviews. In 2006 a small sample of housheolds were additionally interrogated on a voluntary basis for their daily natural gas usage over a two week period each in winter and summer. The collected data was used to supplement and confirm micro census data.

New boilers such as condensing oil and gas boilers with comparatively low NO_x emissions, controlled pellet boilers, wood gasification boilers and wood chip fired boilers with comparatively low VOC, CO, PM and POPs emissions are considered from 2000 onwards.

For each technology fuel dependent emission factors are applied.

Activity data

Total fuel consumption for each of the sub categories of 1 A 4 is taken from the national energy balance. From the view of energy statistics compilers this sector is sometimes the residual of gross inland fuel consumption because fuel consumption data of energy industries and manufacturing industry is collected each year in more detail and therefore of higher quality. However, in case of the Austrian energy balance fuel consumption of the small combustion sector is modelled over time series in consideration of heating degree days and micro census data. Activity data by type of heating is selected as the following:

1 A 4 a Commercial/Institutional; 1 A 4 b i Agriculture/Forestry/Fishing

There is no information about the structure of devices within these categories. It is assumed that the fuel consumption reported in (IEA JQ 2007) is combusted in devices similar to central heatings and therefore the respective emission factors are applied.

1 A 4 b i Residential

Energy consumption by type of fuel and by type of heating is taken from a statistical evaluation of micro census data 1990, 1992, 1999 and 2004 (STATISTIK AUSTRIA 2002). The calculated shares are used to subdivide total final energy consumption to the several technologies. For the years in between the shares are interpolated and the shares of 2004 are taken for the years 2005 and 2006.

The share of natural gas and heating oil condensing boilers in central and apartment heatings and new biomass boilers is estimated by means of projected boiler change rates from (LEUTGÖB et al. 2003). A later comparison with sales statistics from the Austrian Association of Boiler Suppliers implies a yearly fuel consumption of about 3 t heating oil by boiler in 2004. For the year 2006 it is assumed that 16% of oil central heatings and 8% of oil apartement heatings have about half NO_x emissions (20 kg NO_X/TJ) than conventional heatings (42 kg NO_X/TJ).

Pellet consumption 2004 (250 kt) is taken from a survey of the Provincial Chamber of Agriculture of Lower Austria. Pellet consumption 2005 and 2006 (300 kt) is taken from the Austrian association of pellets manufacturers 'ProPellets'. Wood chip consumption is calculated by subtracting pellet consumption from non-fuelwood biomass consumption taken from energy statistics. Pellet boilers are considered to have lower PM, POPs, NMVOC and CO emissions than wood chips fired boilers.

The share of wood gasification or other modern wood boilers in total fuel wood fired heatings is calculated by an annual substitution rate of 3 000 central heatings from 1992 on assuming an average annual fuel consumption of 190 GJ/boiler which is approximately 10 t of fuel wood. From 2004 on fuel wood boiler sales since 2001 are used for consumption estimates (31 000 new boilers in 2006). The calculated average consumption rate of 110 GJ per boiler and year has been calculated by means of micro census data 2004 (31.4 PJ fuel wood used by 283 400 households). Controlled wood gasification boilers are considered with lower POPs, NMVOC and CO emissions than manually operated heatings.

75 000 gasoil fired central heatings with blue flame burners are considered with lower PAH emissions than yellow flame burners. Activity data of blue flame burners are estimated by an annual exchange rate of 5 000 boilers assuming an average annual consumption of 80 GJ/boiler (1.9 t heating oil equivalent) from 1991 on.

Table 132: NFR 1 A 4 b i percentual consumption by type of heating.

Year	Natural Gas			Fuel Oil, LPG	Gas Oil			Hard Coal (+ Briquettes)		
	CH	AH	ST	CH	CH	AH	ST	CH	AH	ST
		[%]		[%]		[%]			[%]	
1990	22.6	38.4	39.1	100	75.0	10.0	15.0	60.6	9.4	30.0
1991	26.0	36.4	37.6	100	75.0	10.0	15.0	62.3	8.8	29.0
1992	28.6	37.8	33.5	100	76.2	9.4	14.4	62.0	8.8	29.3
1993	31.3	39.2	29.5	100	77.3	8.9	13.8	61.6	8.7	29.6
1994	33.9	40.6	25.4	100	78.5	8.3	13.3	61.3	8.7	30.0
1995	36.6	42.1	21.4	100	79.6	7.7	12.7	61.0	8.7	30.3
1996	39.2	43.5	17.3	100	80.8	7.2	12.1	60.7	8.7	30.6
1997	41.9	44.9	13.2	100	81.9	6.6	11.5	60.4	8.7	30.9
1998	44.5	46.3	9.2	100	83.1	6.0	10.9	60.0	8.7	31.3
1999	47.1	47.7	5.1	100	84.2	5.4	10.4	59.7	8.7	31.6
2000	47.1	47.7	5.1	100	84.2	5.4	10.4	59.7	8.7	31.6
2001	49.5	45.9	4.5	100	84.1	6.1	9.8	61.0	9.3	29.7
2002	51.9	44.2	3.9	100	83.9	6.8	9.3	62.4	9.8	27.8
2003	54.3	42.4	3.3	100	83.8	7.4	8.7	63.7	10.4	25.9
2004 2005 2006	56.7	40.6	2.7	100	83.7	8.1	8.2	65.0	11.0	24.0

Table 133: NFR 1 A 4 b i Type of heatings split.

Year	Brown Coal			Brown Coal Briquettes			Coke		
	CH	AH	ST	CH	AH	ST	CH	AH	ST
		[%]			[%]			[%]	
1990	60.6	9.4	30.0	60.6	9.4	30.0	60.6	9.4	30.0
1991	62.3	8.8	29.0	62.3	8.8	29.0	62.3	8.8	29.0
1992	60.4	10.0	29.6	57.8	8.9	33.3	63.9	8.6	27.5
1993	58.5	11.3	30.2	53.3	9.1	37.6	65.6	8.5	26.0
1994	56.6	12.5	30.9	48.7	9.3	42.0	67.3	8.3	24.5
1995	54.7	13.7	31.5	44.2	9.4	46.3	68.9	8.1	22.9
1996	52.8	15.0	32.2	39.7	9.6	50.7	70.6	8.0	21.4
1997	51.0	16.2	32.8	35.2	9.8	55.0	72.2	7.8	19.9
1998	49.1	17.5	33.4	30.7	10.0	59.3	73.9	7.7	18.4
1999	47.2	18.7	34.1	26.2	10.1	63.7	75.6	7.5	16.9
2000	47.2	18.7	34.1	26.2	10.1	63.7	75.6	7.5	16.9
2001	51.6	16.8	31.6	35.9	10.4	53.7	72.9	8.4	18.7
2002	56.1	14.9	29.0	45.6	10.6	43.8	70.3	9.3	20.5
2003	60.5	12.9	26.5	55.3	10.8	33.9	67.6	10.1	22.2
2004 2005 2006	65.0	11.0	24.0	65.0	11.0	24.0	65.0	11.0	24.0

Table 134: NFR 1 A 4 b i Type of heatings split.

Year	Fuel Wood (log wood)			Wood chips, pellets and other biomass		
	CH	AH	ST	CH	AH	ST
		[%]			[%]	
1990	61.3	7.3	31.4	61.3	7.3	31.4
1991	62.9	6.1	31.0	62.9	6.1	31.0
1992	63.5	6.4	30.1	66.2	5.8	28.0
1993	64.1	6.6	29.3	69.5	5.4	25.1
1994	64.7	6.8	28.5	72.8	5.1	22.1
1995	65.3	7.1	27.6	76.1	4.7	19.1
1996	65.9	7.3	26.8	79.4	4.4	16.2
1997	66.5	7.5	26.0	82.8	4.0	13.2
1998	67.1	7.8	25.1	86.1	3.7	10.3
1999	67.7	8.0	24.3	89.4	3.3	7.3
2000	67.7	8.0	24.3	89.4	3.3	7.3
2001	66.6	7.6	25.8	87.3	3.3	9.3
2002	65.6	7.1	27.3	85.3	3.3	11.3
2003	64.5	6.7	28.8	83.3	3.3	13.4
2004 2005 2006	63.4	6.3	30.3	81.3	3.3	15.4

Emission factors

Due to the wide variation of technologies, fuel quality and device maintenance the uncertainty of emission factors is rather high for almost all pollutants and technologies.

Country specific main pollutant emission factors from national studies (BMWA 1990), (BMWA 1996) and (UMWELTBUNDESAMT 2001a) are applied. In these studies emission factors are provided for the years 1987, 1995 and 1996.

Emission factors prior to 1996 are taken from (STANZEL et al. 1995) and mainly based on literature research.

Natural gas and heating oil emission factors 1996 are determined by means of test bench measurements of heatings sold in Austria. Solid fuels emission factors 1996 are determined by means of field measurements of Austrian small combustion devices.

NO_x emissions factors of heating oil and natural gas condensing boilers are taken from (LEUTGÖB et al. 2003).

For the years 1990 to 1994 emission factors were interpolated. From 1997 onwards the emission factors from 1996 are applied.

In some cases only VOC emission factors are provided in the studies, NMVOC emission factors are determined assuming that a certain percentage of VOC emissions is released as methane as listed in Table 135. The split follows closely (STANZEL et al. 1995).

Table 135: Share of CH_4 and NMVOC in VOC for small combustion devices.

	CH_4	NMVOC	VOC
Coal	25%	75%	100%
Gas oil; Kerosene	20%	80%	100%
Residual fuel oil	25%	75%	100%
Natural gas; LPG	80%	20%	100%
Biomass	25%	75%	100%

The following Tables show the main pollutant emission factors by type of heating.

Table 136: NFR 1 A 4 NO_x emission factors by type of heating for the year 2006.

	Central heating [kg/TJ]	Apartement heating [kg/TJ]	Stove [kg/TJ]
Coal	78.0	78.0	132.0
Residual fuel oil < 1% S	115.0		
Residual fuel oil ≥ 1% S	235.0		
Heating oil, Kerosene, LPG	42.0 20.0[(2)]	42.0 20.0[(2)]	42.0
Natural gas	42.0 16.0[(2)]	43.0 16.0[(2)]	51.0
Solid biomass	107.0	107.0	106.0
Industrial waste	100.0[(1)]		

(1) *Default values for industrial boilers*

(2) *Condensing boilers (LEUTGÖB et al. 2003)*

Table 137: NFR 1 A 4 NMVOC emission factors by type of heating for the year 2006.

	Central heating [kg/TJ]	Apartement heating [kg/TJ]	Stove [kg/TJ]
Coal	284.4	284.4	333.3
Residual fuel oil < 1% S	0.8		
Residual fuel oil ≥ 1% S	8.0		
Heating oil, Kerosene	0.8	0.8	1.5
LPG	0.5	0.5	
Natural gas	0.2	0.2	0.2
Solid biomass conventional	432.0	432.0	643.0 338.0[(1)]
Wood gasification	325.0[(1)]	312.0[(1)]	
Wood chips	78.0[(1)]		
Pellets	[(3)]35.0 (for all types of heating)		
Industrial waste	38.0[(2)]		

(1) *NMVOC from new biomass heatings (LANG et al. 2003)*

(2) *Default values for industrial boilers*

(3) *Averaged emission factor fro new pellets heatings (LANG et al. 2003)*

Table 138: NFR 1 A 4 CO emission factors by type of heating for the year 2006.

	Central heating [kg/TJ]	Apartement heating [kg/TJ]	Stove [kg/TJ]
Coal	4 206.0	4 206.0	3 705.0
Residual fuel oil < 1% S	45.0		
Residual fuel oil ≥ 1% S	15.0		
Heating oil	67.0	67.0	150.0
Kerosene	15.0		

	Central heating [kg/TJ]	Apartement heating [kg/TJ]	Stove [kg/TJ]
LPG	37.0	37.0	
Natural gas	37.0	37.0	44.0
Solid biomass conventional	4 303.0	4 303.0	4 463.0 2 345.0(2)
Wood gasification	3 237.0(2)	3 107.0(2)	
Industrial waste	200.0(1)		

(1) *Default values for industrial boilers*

(2) *CO from new biomass heatings is calculated by means of ratio of NMVOC from new biomass heatings by NMVOC from conventional heatings*

Table 139: NFR 1 A 4 SO_2 emission factors by type of heating for the year 2006.

	Central heating [kg/TJ]	Apartement heating [kg/TJ]	Stove [kg/TJ]
Coal	543.0	543.0	340.0
Residual fuel oil < 1% S	90.0		
Residual fuel oil ≥ 1% S	398.0		
Heating oil	45.0	45.0	45.0
Kerosene	90.0	90.0	90.0
LPG	6.0(1)	6.0(1)	6.0(1)
Natural gas	NA	NA	NA
Solid biomass	11.0	11.0	11.0
Industrial waste	130.0(2)		

(1) *From (LEUTGÖB et al. 2003)*

(2) *Default value for industrial boilers (BMWA 1990)*

Table 140: NFR 1 A 4 NH_3 emission factors for the year 2006.

	Central heating [kg/TJ]
Coal	0.01
Oil	2.68
Natural gas	1.00
Biomass	5.00
Industrial waste	0.02

Emission factors for heavy metals, POPs and PM used in NFR 1 A 4

In the following the emission factors for heavy metals, POPs and PM which are used in NFR 1 A 3 are described.

Emission factors for heavy metals used in NFR 1 A 4

Fuel Oil

For fuel oil the same emission factors as for 1 A 1 were used.

Coal and Biomass

NFR 1 A 4 c

For deciding on an emission factor for fuel wood results from (OBERNBERGER 1995), (LAUNHARDT et al. 2000) and (FTU 2000) were considered.

The emission factors for coal were derived from (CORINAIR 1995), Table 12, B112.

For mercury the emission factors for 1 A 4 c were also used for the other sub categories.

For lead the emission factors for 1 A 4 c were also used for 1 A 4 b Residential plants: central and apartment heating.

NFR 1 A 4 b

Emission factors for central and apartment heatings base on findings from (HARTMANN, BÖHM & MAIER 2000), (LAUNHARDT, HARTMANN, LINK & SCHMID 2000), (PFEIFFER, STRUSCHKA & BAUMBACH 2000), (STANZEL, JUNGMEIER & SPITZER 1995).

Results of measurements (SPITZER et al. 1998): show that the TSP emission factor for stoves are about 50% higher than the emission factor for central heatings – thus the Cd and Pb emission factor was also assumed to be 50% higher.

Table 141: HM emission factors for Sector 1 A 4 Other Sectors (Commercial and Residential).

	Cadmium EF [mg/GJ]	Mercury EF [mg/GJ]	Lead EF [mg/GJ]
1A4a Commercial/Institutional plants (020103) 1A4c i Plants in Agriculture/Forestry/Fishing (020302)			
102A Hard coal 104A Hard coal briquettes 107A Coke oven coke	5.4	10.7	90
105A Brown coal 106A Brown coal briquettes	3.7	9.2	22
111A Fuel wood 116A Wood waste 113A Peat	7.0	1.9	23
1A4b Residential plants: central and apartment heating (020202)			
102A Hard coal 104A Hard coal briquettes 107A Coke oven coke	4.0	10.7	90
105A Brown coal 106A Brown coal briquettes	2.0	9.2	22
111A Fuel wood 116A Wood waste 113A Peat	3.0	1.9	23

	Cadmium EF [mg/GJ]	Mercury EF [mg/GJ]	Lead EF [mg/GJ]
1A4b Residential plants: stoves (020205)			
102A Hard coal 104A Hard coal briquettes 107A Coke oven coke	6.0	10.7	135
105A Brown coal 106A Brown coal briquettes	3.0	9.2	33
111A Fuel wood 116A Wood waste 113A Peat	4.5	1.9	35

Emission factors for POPs used in NFR 1 A 4

Residential plants

For residential plants the dioxin emission factors for coal and wood were taken from (HÜBNER & BOOS 2000); for heating oil a mean value from (PFEIFFER et al. 2000), (BOOS & HÜBNER 2000) and measurements by FTU (FTU 2000) was used. Combustion of waste in stoves was not considered, as no activity data was available.

For HCB 100 times the EF for dioxin were used.

The PAK emission factors are trimmed mean values from values given in (UBA BERLIN, 1998), (SCHEIDL 1996), (ORTHOFER & VESSELY 1990), (SORGER 1993), (LAUNHARDT et al. 2000), (PFEIFFER et al. 2000) (LAUNHARDT et al. 1998), (STANZEL et al. 1995), (BAAS et al. 1995). However, it was not possible to determine different emission factors for stoves and central heating from the values given in the cited literature. Thus for solid fuels the same proportions given from the dioxin EFs, and for oil the proportions of carbon black given in (HÜBNER et al. 1996), was used. For natural gas it was assumed that the values given in literature are valid for stoves, and that values for central heating are assumed to be five times lower.

Commercial and Institutional plants and Plants in Agriculture/Forestry/Fishing

The same emission factors as used for central heating in the residential sector and for small (and medium) plants of category 1 A 2 were used (the share of the different size classes is based on expert judgement). The values given in the following Table are averaged values per fuel category.

As emission factors for heavy fuel oil and other oil products the same factors as for *1 A 2 Manufacturing and Construction* were used.

Table 142: POP emission factors for 1 A 4.

EF	Dioxin [µg/GJ]	HCB [µg/GJ]	PAK4 [mg/GJ]
1A4a Commercial/Institutional plants (SNAP 020103)			
Coal:102A, 104A, 105A, 106A, 107A	0.24	180 160/190 180	25 24 4.5
203B Light fuel oil 203C Medium fuel oil	0.002	0.19	0.24
203D Heavy fuel oil	0.0009	0.12	0.24
204A Heating oil 206A Petroleum	0.0012	0.12	0.18
224A Other Oil Products	0.0017	0.14	0.011
301A Natural gas	0.0016	0.14	0.01
303A LPG 310A Landfill gas	0.0017	0.14	0.011 0.0032
309A Biogas 309B Sewage sludge gas	0.0006	0.072	0.0032
111A Wood (IEF 2006)	0.193	179	21.8
115A Industrial waste	0.3	250	26
116A Wood wastes (IEF 2006)	0.36	211	24
1A4c i Plants in Agriculture/Forestry/Fishing (SNAP 020302)			
Coal (102A, 104A, 105A, 106A, 107A)	0.24	180 190 180	24 25 4.5
203B Light fuel oil 204A Heating oil	0.0015	0.15	0.24
301A Natural gas 303A LPG	0.0025	0.25	0.04
111A Wood (IEF 2006)	0.221	385	49.3
116A Wood wastes	0.38	600	85
1A4b Residential plants: central and apartment heating (SNAP 020202)			
Coal102A, 105A, 106A, 107A	0.38	600	85 12
203B Light fuel oil 204A Heating oil	0.0015	0.15	
224A Other Oil Products	0.0017	0.14	0.011
301A Natural gas 303A LPG	0.0025	0.25	0.04
111A Wood, 116A Wood wastes Central heating (IEF 2006) Apartment heating	 0.221 0.38	 384 600	 49.3 85
1A4b Residential plants: stoves (SNAP 020205)			
Coal102A, 104A, 105A, 106A, 107A	0.75	600	170 24
204A Heating oil	0.003	0.3	1.7
301A Natural gas	0.006	0.6	0.2
111A Wood 113A Peat 116A Wood wastes	0.75	600	170

Emission factors for PM used in NFR 1 A 4

As already described in Chapter 1.3 the emission inventories of PM for different years were prepared by contractors and incorporated into the inventory system afterwards.

Emission factors were taken from (WINIWARTER et al. 2001) and were used for all years, except for the emission factors from 2000 onwards for wood waste, where the use of pellets (TSP = 30 kg/TJ; PM10 = 27 kg/TJ) was considered (UMWELTBUNDESAMT 2006c).

As for the other pollutants, emission factors were distinguished for three types of heating devices: central heating, apartment heating, and stoves.

The shares of PM10 (90%) and PM2.5 (80%) were also taken from (WINIWARTER et al. 2001).

Table 143: PM emission factors for NFR 1 A 4.

	TSP Emission Factors [g/GJ]		
	Central heating	**Apartment heating**	**Stoves**
Gas			
301A, 303A, 309A, 309B and 310A	0.5	0.5	0.5
Coal			
102A, 104A and 107A	45	94	153
105A and 106A	50	94	153
Oil			
203B, 204A	3	3	3
203D	65	65	65
224A	0.5	0.5	--
Other Fuels			
111A, 113A and 116A	55	90	148

Table 144: PM emission factor for "wood waste and other" used in commercial, institutional or residential plants as well in stationary plants and other equipments in NFR 1 A 4.

	TSP IEF [g/GJ]			
116A	**1990**	**1995**	**2000**	**2006**
Central heating	55.00	55.00	51.95	46.28
Apartment heating	90.00	90.00	82.69	69.06
Stoves	148.00	148.00	133.62	106.82

Other PM sources

For the following sources it is assumed that particle sizes are equal or smaller than PM2.5.

Barbecue

For activity data 11 kt of char coal has been calculated from foreign trade statistics and producton data (Import 11 900 t, Export 1 900 t, Production 1 000 t). An emission factor of 2 237 g TSP/GJ char coal has been selected which is 69 347 g/t char coal assuming a calorific value of 31 GJ/t. This leads to 763 t PM/year for the whole time series.

Bonfire

It is assumed that one bonfire is sparked every year for each 5000 rural inhabitants. This leads to 1000 bonfires each year for all 5 Mio rural inhabitants. The average size of a fire is estimated to have 30 m³ of wood which is 10 m³ of solid wood. Assuming a heating value of 10 GJ/m³ wood and selecting an emission factor of 1500 g/GJ (similar to open fire places, expert guess from literature) this leads to 150 kg PM for each fire and 150 t PM for each year.

Open fire pits

It is assumed that one open fire pit exists for each 2 500 inhabitants. Assuming 20 fires per year and fire pit this leads to 66 400 fires each year. Assuming 0.025 m³ of solid wood per fire which is 0.3 GJ and selecting an emission factor of 800 g/GJ (open fireplace, EPA 1998, Klimont et al. 2002) this leads to 240 g PM/fire and 16 t PM for each year.

NFR 1 A 4 c ii Off-road Vehicles and Other Machinery – soil abrasion

PM emissions from abrasion of offroad machinery in agriculture and forestry are estimated by means of machinery stock, average operating hours and an PM emission factor of 30 [g TSP/machine operating hour]. The share in TSP emissions is 45% for PM10 and 12% for PM2.5. The following Table 99 presents the parameters used for 2006 emission calculation. Emission factors are taken from (WINIWARTER et al. 2007). Activity data is consistent with activity data used for calculation of exhaust emissions.

Table 145: Industry offroad machinery parameters for the year 2006.

Machinery	Stock	Avg. operating hours/year	Off-Site operating hours
Tractors	320 778	234	12%
Trucks	16 100	225	12%
Harvesters	18 120	47	12%
Mowers	141 481	34	12%

4.2.7 QA/QC

Comparison with EPER data

Comparison of emissions with reported 2004/2005 EPER data does not explicitely identify inconsistencies.

1 A 1 a Activity data and GHG emissions are in general of high quality due to the needs of GHG calculation and CO_2-trading. The quality system which is well defined for GHG is basicly also applied to non-GHG but is not always fully documented in the inventory system. The following QA/QC procedures are performed depending on resource availability.

1 A 1 a LPS data gap filling (DKDB)

It has to be noted that emissions from *DKDB* are reported for heating periods from October $year_{(n)}$ to September $year_{(n+1)}$. Due to this and in case of other missing values emissions and fuel consumption for an inventory year are completed by taking the monthly values from the previous inventory year if available. In some cases either activity data or emission data is not complete and gap filling is performed by using other monthly emission ratios of that plant. For boilers with mixed fuel consumption a linear regression model (MS-Excel function "RGP") is sometimes used.

1 A 1 a LPS data validation (DKDB)

An outcome of the methodology as presented in Table 63 are the ratios of measured and calculated emissions by fuel type. Possible reasons for unexplainable ratios:

- Default emission factors are not appropriate because the group includes inhomogen boiler technologies.
- Changed technologies are not reflected.
- Boilers used for default emission factor derivation are not the ident with boilers considered in the inventory aproach.
- Emission declarations are not appropriate (fuel consumption is not consistent with emissions).

Activity data of large boilers and other large plants is checked with the national energy balance. For some fuels (coal, residual fuel oil, waste) and categories total national consumption is limited to a few boilers. In this case LPS consumption may be checked with data from *Statistik Austria* or with the spatial „Bundesländer" energy balance. In some cases published environmental reports which underly a QA/QC system like EMAS are used for validation purpose.

1 A 1 b Petroleum refining

Reported fuel consumption is checked with energy balance. Monthly data from *DKDB* provides emissions by boiler which is cross-checked with reported flue gas concentrations or mandatory limits.

4.2.8 Planned improvements

A project for space heating emission factors update by means of field measurements is currently planned by the Umweltbundesamt GmbH in cooperation with some federal states and the Austrian Federal Ministry of Economics and Labour. Due to the high need on resources it is not clear when data is available for inventory update. It is expected to decrease uncertainty of category 1 A 4 emissions significantly if emission factors are developed which are linked to statistical data more accurate. However, CO, NMVOC and TSP emissions of new residential biomass boilers should be updated according to already existing measurements. The current selected 2006 emission factors do not accurately consider the improved combustion efficiency of modern boilers.

4.3 NFR 1 A Mobile Fuel Combustion Activities

In this Chapter the methodology for estimating emissions of mobile sources in NFR 1 A 3 transport and mobile sources of NFR 1 A 2 f, NFR 1 A 4, NFR 1 A 5, is described.

NFR Category *1 A 3 Transport* comprises emissions from fuel combustion, abrasion of brake and tyre wear, and dust dispersion of dust by road traffic in the sub categories.

Table 146: NFR and SNAP categories of '1 A Mobile Fuel Combustion Activities'.

Activity	NFR Category	SNAP	
NFR 1 A 2 Manufacturing Industry and Combustion			
Industry, Mobile Machinery	**NFR 1 A 2 f 1**		
		0808	Other Mobile Sources and Machinery-Industry
NFR 1 A 3 Transport			
Civil Aviation	**NFR 1 A 3 a**		
• Civil Aviation (Domestic)	NFR 1 A 3 a 2		
• Civil Aviation (Domestic, LTO)	NFR 1 A 3 a 2 a	080501	Domestic airport traffic (LTO cycles – < 1 000 m)
• Civil Aviation (Domestic, Cruise)	NFR 1 A 3 a 2 b	080503	Domestic cruise traffic (> 1 000 m)
Road Transportation	**NFR 1 A 3 b**		
• R.T., Passenger cars	NFR 1 A 3 b 1	0701	Passenger cars
• R.T., Light duty vehicles	NFR 1 A 3 b 2	0702	Light duty vehicles < 3.5 t
• R.T., Heavy duty vehicles	NFR 1 A 3 b 3	0703	Heavy duty vehicles > 3.5 t and buses
• R.T., Mopeds & Motorcycles	NFR 1 A 3 b 4	0704	Mopeds and Motorcycles < 50 cm³ 0705 Motorcycles > 50 cm³
• Gasoline evaporation from vehicles	NFR 1 A 3 b 5	0706	Gasoline evaporation from vehicles
• Automobile tyre and brake wear	NFR 1 A 3 b 6	0707	Automobile tyre and brake wear
Railways	**NFR 1 A 3 c**		
		0802	Other Mobile Sources and Machinery-Railways
Navigation	**NFR 1 A 3 d**		
		0803	Other Mobile Sources and Machinery-Inland waterways
Other mobile sources and machinery	**NFR 1 A 3 e**		
		0810	Other Mobile Sources and Machinery-Other off-road
NFR 1 A 4 Other Sectors			
• Residential	1 A 4 b	0809	Other Mobile Sources and Machinery-Household and gardening
• Agriculture/Forestry/Fisheries	1 A 4 c	0806	Other Mobile Sources and Machinery-Agriculture 0807Other Mobile Sources and Machinery-Forestry

Activity	NFR Category	SNAP	
NFR 1 A 5 Other			
	1 A 5 b	0801	Other Mobile Sources and Machinery-Military
International Aviation			
International Aviation	I B Av 1	080502	International airport traffic (LTO cycles – < 1 000 m)
International cruise			
International cruise	I B Av 2	080504	International cruise traffic (> 1 000 m)

The following table presents the source categories from the NFR 1 A Mobile Fuel Combustion Activities which are key sources of the Austrian inventory with regard to the contribution to national total emissions (for details of the key source analysis see Chapter 1.4).

Table 147: Key Source in NFR 1 A Mobile Fuel Combustion Activities.

	1 A 2 mobile	**1 A 3 b 1**	**1 A 3 b 2**	**1 A 3 b 3**	**1 A 3 b 4**	**1 A 3 b 5**	**1 A 3 b 6**	**1 A 3 b 7**	**1 A 3 c**	**1 A 3 d**	**1 A 3 e**	**1 A 4 mobile**
	Other mobile in industry	**R.T., Passenger cars**	**R.T., Light duty vehicles**	**R.T., Heavy duty vehicles**	**R.T., Mopeds & Motorcycles**	**R.T., Gasoline evaporation**	**R.T., Automobile tyre and break wear**	**R.T., Automobile road abrasion**	**Railways**	**Navigation**	**Other**	**Other Sectors – mobile**
SO_2	**2.04%**	0.24%	0.04%	0.19%					0.20%	**0.05%**		0.2%
NO_x	**5.74%**	**18.52%**	**2.65%**	**36.33%**	0.19%				0.60%	0.20%	0.5%	**7.8%**
NMVOC	**1.14%**	**6.25%**	0.39%	2.61%	1.09%	2.05%			0.10%	0.36%	0.0%	**4.6%**
NH_3	0.01%	**3.45%**	0.08%	0.09%	0.00%				0.00%	0.00%		0.0%
CO	0.86%	**24.21%**	**1.12%**	**1.97%**	**2.73%**				0.05%	0.37%	0.0%	**4.9%**
Cd	3.70%	0.31%	0.04%	0.19%	0.00%		0.00%	**7.59%**	0.01%	0.00%		0.2%
Hg	0.01%	0.12%	0.02%	0.07%	0.00%				0.02%	0.00%		0.0%
Pb	0.00%	0.07%	0.00%	0.02%	0.00%				0.01%	0.00%		0.0%
PAH	1.19%	**7.70%**	**1.76%**	**7.89%**	0.59%				0.17%	0.05%		**1.8%**
Diox	0.21%	**0.96%**	0.23%	**1.38%**	0.01%				0.04%	0.02%	0.0%	0.4%
HCB	0.04%	0.19%	0.05%	0.28%	0.00%				0.01%	0.00%	0.0%	0.1%
TSP	**4.27%**	**2.69%**	0.58%	**2.45%**				**13.53%**	**2.15%**	0.04%	0.0%	**15.9%**
PM10	**6.01%**	**4.65%**	**1.00%**	**4.23%**				**7.78%**	**1.33%**	0.07%	0.0%	**24.9%**
PM2.5	**9.36%**	**8.90%**	**1.92%**	**8.11%**				**4.48%**	0.94%	0.14%	0.0%	**43.4%**

Completeness

Table 148 provides information on the status of emission estimates of all sub categories. A "✓" indicates that emissions from this sub category have been estimated. Table 146 proviedes an overview about NFR categories and the corresponding SNAP codes.

Table 148: Completeness of "1 A Mobile Fuel Combustion Activities".

NFR Category	NO_x	CO	NMVOC	SO_x	NH_3	TSP	PM10	PM2.5	Pb	Cd	Hg	DIOX	PAH	HCB
1 A 2 f Industry, Mobile Machinery	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
1 A 3 a Civil Aviation	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	NE	NE	NE
1 A 3 b Road Trans portation	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
1 A 3 c Railways	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
1 A 3 d National Navi-gation	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
1 A 3 e ii Other mobile sources and machinery	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
1 A 4 b ii Household and gardening (mobile)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
1 A 4 c ii Off-road Vehicles and Other Machinery	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
1A 4 c iii National Fishing	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
1 A 5 b Other, Mobile (Including military)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
International Aviation	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	NE	NE	NE
International maritime Navigation	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
International inland waterways (Included in NEC totals only)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO

The following chapter describes the trend and the methodology of mobile fuel combustion activities.

4.3.1 Emission Trend in NFR 1 A Mobile Fuel Combustion Activities

Total fuel consumption in NFR 1 A Mobile Fule Consumption increased by 95% from166 PJ in 1990 to 325 PJ in 2006 and road performance (miles driven within the Austrian territory) of passenger cars increased by +59% and by +42% for light and heavy duty vehicles. Again it has to be noted that emissions from road transport are calculated on the basis of fuel loaded into vehicles within the Austrian territory.

- a decrease in emission could be noted for
  - SO_2 emissions (93%)
  - NMVOC emissions (63%)
  - CO emissions (61%)
  - Pb emissions (~100%)
  - dioxin/furan emissions (63%)
  - HCB emissions (63%);
- an increase in emissions
  - NO_x emissions (26%)
  - NH_3 emissions (18%)
  - TSP, PM10, PM2.5 emissions (23%, 15%, 9%)
  - Cd, Hg emissions (52%)
  - Hg emissions (29%)
  - PAH emissions (83%).

Another main reason for this strong increase is the so-called 'tank tourism'. At the beginning of the 1990s fuel prices in Austria were higher compared to neighbouring countries, whereas since the middle of the 1990s it has been the other way round.

Table 149: Emissions and trends from Sector NFR 1 A Mobile Fuel Combustion Activities 1990–2006.

Year	SO_2	NO_x	NMVOC	NH_3	CO	TSP	PM10	PM2.5	Cd	Hg	Pb	PAH	Dioxin	HCB
			[Gg]				[Mg]		[kg]	[kg]	[Mg]	[Mg]	[g]	[kg]
1990	5.97	115.33	80.93	3.23	686.48	15 765.99	9 924.43	7 823.52	60.81	2.11	156.99	0.99	3.75	0.75
1991	6.59	124.89	83.22	4.71	746.07	NR	NR	NR	63.88	2.18	126.62	1.04	3.66	0.73
1992	6.88	121.44	81.01	5.59	714.88	NR	NR	NR	65.90	2.21	86.14	1.02	3.14	0.63
1993	7.25	121.41	78.86	6.31	692.82	NR	NR	NR	67.32	2.17	57.63	1.02	2.78	0.56
1994	7.18	118.72	74.87	6.54	647.10	NR	NR	NR	69.86	2.17	35.41	1.01	2.45	0.49
1995	5.76	118.65	69.47	6.34	597.33	17 912.07	11 243.60	8 857.44	71.34	2.22	0.02	1.03	2.16	0.43
1996	3.30	142.14	64.88	5.77	538.24	NR	NR	NR	73.36	2.38	0.02	1.19	2.02	0.40
1997	2.90	128.59	58.95	5.30	488.09	NR	NR	NR	74.77	2.01	0.01	1.11	1.74	0.35
1998	3.14	147.08	56.23	5.34	478.56	NR	NR	NR	77.37	2.16	0.02	1.25	1.72	0.34
1999	2.80	138.06	50.12	4.67	425.36	19 041.52	11 867.02	9 298.71	79.37	2.09	0.01	1.22	1.51	0.30
2000	2.78	146.71	45.46	4.29	392.57	19 093.19	11 808.87	9 205.19	81.74	2.14	0.01	1.31	1.46	0.29
2001	2.88	154.23	42.55	4.04	373.26	19 352.83	11 974.83	9 337.02	83.34	2.26	0.01	1.42	1.44	0.29
2002	2.80	163.42	40.83	4.02	371.81	19 749.92	12 211.19	9 512.66	85.39	2.45	0.02	1.56	1.46	0.29
2003	2.85	172.14	38.71	3.77	358.68	20 053.84	12 336.02	9 568.10	87.91	2.62	0.02	1.69	1.49	0.30
2004	0.46	171.52	35.69	3.30	331.54	20 010.97	12 141.04	9 320.19	89.51	2.68	0.02	1.76	1.46	0.29
2005	0.41	174.53	32.77	2.85	303.30	19 913.45	11 948.31	9 098.71	92.02	2.75	0.02	1.84	1.46	0.29
2006	0.40	161.56	29.66	2.40	270.30	19 417.93	11 368.74	8 489.28	92.60	2.71	0.02	1.82	1.38	0.28
Trend														
1990–2006	*-93.3%*	*40.1%*	*-63.3%*	*-25.7%*	*-60.6%*	*23.2%*	*14.6%*	*8.5%*	*52.3%*	*28.6%*	*-100.0%*	*83.4%*	*-63.2%*	*-63.2%*
2005–2006	*-3.5%*	*-7.4%*	*-9.5%*	*-15.9%*	*-10.9%*	*-2.5%*	*-4.9%*	*-6.7%*	*0.6%*	*-1.4%*	*-1.9%*	*-1.2%*	*-5.7%*	*-5.7%*
National Share														
1990	*8.0%*	*59.9%*	*28.6%*	*4.5%*	*47.5%*	*23.0%*	*23.1%*	*31.1%*	*3.9%*	*0.1%*	*75.7%*	*5.7%*	*2.3%*	*0.8%*
2006	*1.4%*	*71.8%*	*17.3%*	*3.6%*	*34.4%*	*25.9%*	*26.2%*	*37.5%*	*8.2%*	*0.3%*	*0.1%*	*20.8%*	*3.2%*	*0.6%*

4.3.2 NFR 1 A 3 a Civil Aviation

As can be seen in Table 150 emissions from NFR 1 A 3 a Civil Aviation highly increased over the period from 1990–2006 due to an increase of activity by about 605%. NH_3 and NMVOC emission factors decreased over this period.

Table 150: Emissions from 1 A 3 a Civil Aviation 1990–2006.

Year	NO_x		SO_2		NH_3		NMVOC	
	LTO	cruise	LTO	cruise	LTO	cruise	LTO	cruise
	[Mg]	[Mg]	[Mg]	[Mg]	[Mg]	[Mg]	[Mg]	[Mg]
1990	36.13	40.53	4.20	4.51	0.10	0.03	20.63	18.25
1995	47.14	133.20	5.37	11.62	0.10	0.08	17.27	6.50
2000	67.50	199.10	7.73	17.16	0.11	0.12	50.80	21.30
2005	177.15	548.75	20.11	47.30	0.22	0.32	140.01	58.71
2006	185.12	573.89	21.01	49.46	0.22	0.34	146.43	60.40
Trend 1990–2006	*412%*	*1316%*	*400%*	*997%*	*125%*	*990%*	*610%*	*231%*

Methodological Issues

NO_x and SO_2

Emission estimates for NO_x and SO_2 were taken from a study commissioned by the Umweltbundesamt that was finished in 2002 (KALIVODA et al. 2002). Emissions have been calculated using implied emission factors and fuel allocation obtained from the values for the year 2000.

For the air transport class IFR (Instrument Flight Rules) the very detailed methodology from the CORINAIR guidebook in an advanced version (based on the (MEET 1999) model) has been used. It is based on air traffic movement data[93] (flight distance and destination per aircraft type), aircraft/engine performance data and emission factors.

Fuel consumptions for the different transport modes IFR national LTO, IFR international LTO, IFR national cruise and IFR international cruise as obtained from the MEET model were summed up to a total fuel consumption figure. This value was compared by the Umweltbundesamt with the total amount of kerosene sold in Austria of the national energy balance: a difference was observed (lower fuel consumption in the energy balance). Therefore the fuel consumption of IFR international cruise was adjusted so that the total fuel consumption of the calculations according to the MEET model is consistent with national fuel sales figures from the energy balance. The reason for choosing IFR international cruise for this adjustment is that this mode is assumed to hold the highest uncertainty.

Only IFR national LTO and IFR national cruise is considered in 1 A 3 a Civil Aviation, IFR international LTO and IFR international cruise is considered in I B Av International Bunkers Aviation.

For calculation of NO_x and SO_2 emissions VFR flights were considered as well.

Fuel consumption for VFR flights were directly obtained from the energy balance, as total fuel consumption for this flight mode is represented by the total amount of aviation gasoline sold in Austria.

[93] This data is also used for the split national/international aviation.

NMVOC

VOC emissions for IFR have been calculated like NO_x and SO_2. According to the CORINAIR guidebook 90.4% of VOC of the LTO-IFR are assumed to be NMVOC.

NH_3

NH_3 emissions were calculated using the fuel consumptions as obtained in the study.

Emission factors are taken from the ICAO Engine Exhaust Emissions Databank (BALASHOW & SMITH 1995).

Fuel consumptions for 1 A 3 a Civil Aviation as obtained from the MEET model (or from the energy balance for VFR) presented in Table 151.

Table 151: Fuel consumptions 1 A 3 a Civil Aviation 1990–2006.

Year	LTO		cruise
	Kerosene	Gasoline	Kerosene
	[Mg]	[Mg]	[Mg]
1990	3 164	2 487	4 508
1995	4 430	2 241	11 616
2000	6 868	2 039	17 161
2005	18 929	2787	47297
2006	19 796	2 868	49 464
Trend 1990–2006	*526%*	*15%*	*997%*

Table 152: Emission factors and activities for Civil Aviation (LTO + cruise) 1990–2006.

Year	Activity	IEF NO_x	IEF SO_2	IEF NH_3	IEF NMVOC
	[PJ]	[t/PJ]	[t/PJ]	[t/PJ]	[t/PJ]
1990	0.44	175.04	19.90	0.30	88.77
1995	0.79	228.26	21.51	0.23	30.09
2000	1.13	236.53	22.08	0.20	63.97
2005	2.99	243.11	22.57	0.18	66.55
2006	3.12	243.06	22.57	0.18	66.23

Recalculation

No recalculation has been made

Planned improvements

The discrepancy between the development of fuel consumption and number of flights (both national) will be proofed.

For the category 1 A 3 a civil aviation it is planned to develop a new systematic to estimate emissions.

4.3.3 International Bunkers – Aviation

Emissions from aviation assigned to international bunkers include the transport modes international LTO and international cruise for IFR-flights.

Table 153: Emissions for Civil Aviation (LTO+cruise) 1990–2006.

Year	NO_x		SO_2		NH_3		NMVOC	
	LTO	cruise	LTO	cruise	LTO	cruise	LTO	cruise
	[Gg]	[Gg]	[Gg]	[Gg]	[Gg]	[Gg]	[Gg]	[Gg]
1990	0.372	2.399	0.029	0.253	0.000	0.002	0.137	0.163
1995	0.632	3.601	0.049	0.372	0.000	0.003	0.186	0.279
2000	0.817	4.538	0.062	0.470	0.000	0.003	0.271	0.399
2005	0.845	4.690	0.064	0.486	0.000	0.003	0.280	0.412
2006	0.883	4.904	0.067	0.508	0.000	0.003	0.293	0.430
Trend 1990–2006	*138%*	*104%*	*132%*	*101%*	*131%*	*100%*	*114%*	*164%*

Table 154: Activities for Civil Aviation (LTO + cruise) 1990–2006.

Year	Activity	
	LTO	Cruise
	[PJ]	[PJ]
1990	1.25	11.01
1995	2.12	16.13
2000	2.67	20.36
2005	2.76	21.03
2006	2.88	22.00
Trend 1990–2006	*131%*	*100%*

Emissions have been calculated using the methodology and emission factors as described in Chapter 1 A 3 a Civil aviation.

4.3.4 NFR 1 A 3 b Road Transport

Road Transport is the main emission source for NO_x, SO_2, NMVOC and NH_3 emissions of the transport sector. Due to decreasing emission factors SO_2, NMVOC and NH3 emissions were below 1990 levels in 2006.

The sector includes emissions from passenger cars, light duty vehicles, heavy duty vehicles and busses, mopeds and motorcycles as well as gasoline evaporation from vehicles and automobile tyre and brake wear.

Technical improvements and a stricter legislation led to a reduction of emissions per vehicles or per mileage, respectively. On the other hand a steady increase of transport activity is observed.

Emission trend

The road transport sector is one of the main sources of NO_x emissions in Austria. Around 58% of national total NO_x emissions are caused by road transport. NO_x emissions from road transport are dominated by road freight transport with heavy duty vehicles (with a share of about 63% in total road transport emissions) and passenger car transport (about 32% from total road transport emissions).

For SO_2, NMVOC and NH_3 emissions passenger cars are the main source.

SO_2 and NH_3 emissions reached a maximum in 1994 and have steadily decreased since then: SO_2 emissions in 2006 were 96% below 1990 levels and NH_3 emissions were 26% below 1990 levels.

NMVOC emissions have constantly decreased since 1990, in 2006 emissions were 64% below the 1990 level.

Table 155: SO_2 Emissions and trends from Sector NFR 1 A Mobile Fuel Combustion Activities – Road transport – 1990–2006.

NFR	TOTAL	1	1 A Mobile	1 A 3	1 A 3 b	1 A 3 b 1	1 A 3 b 2	1 A 3 b 3	1 A 3 b 4	1 A 3 b 5	1 A 3 b 6
Unit				Gg							
1990	74.33	72.03	5.97	4.07	3.77	1.63	0.65	1.48	0.00	NA	IE
1991	71.42	69.46	6.59	4.77	4.47	1.86	0.71	1.90	0.00	NA	IE
1992	55.03	53.32	6.88	5.02	4.72	1.93	0.77	2.02	0.00	NA	IE
1993	53.38	51.92	7.25	5.40	5.11	2.03	0.81	2.27	0.00	NA	IE
1994	47.61	46.14	7.18	5.54	5.24	2.17	0.87	2.20	0.00	NA	IE
1995	46.85	45.43	5.76	5.17	4.90	2.01	0.77	2.11	0.00	NA	IE
1996	44.61	43.27	3.30	2.69	2.50	0.96	0.30	1.24	0.00	NA	IE
1997	40.16	38.84	2.90	2.26	2.11	0.92	0.29	0.90	0.00	NA	IE
1998	35.57	34.33	3.14	2.52	2.37	0.96	0.29	1.12	0.00	NA	IE
1999	33.79	32.62	2.80	2.24	2.09	0.88	0.28	0.93	0.00	NA	IE
2000	31.62	30.47	2.78	2.24	2.09	0.84	0.27	0.99	0.00	NA	IE
2001	32.70	31.43	2.88	2.32	2.17	0.85	0.26	1.06	0.00	NA	IE
2002	31.64	30.37	2.80	2.23	2.09	0.85	0.22	1.01	0.00	NA	IE
2003	32.44	31.17	2.85	2.26	2.10	0.86	0.21	1.03	0.00	NA	IE
2004	26.93	25.66	0.46	0.34	0.17	0.08	0.02	0.07	NA	NA	IE
2005	26.65	25.37	0.41	0.29	0.15	0.07	0.01	0.07	NA	NA	IE
2006	28.46	27.18	0.40	0.28	0.13	0.07	0.01	0.05	NA	NA	IE
Trend											
1990–2006	*-61.7%*	*0.0%*	*-93.3%*	*-93.2%*	*-96.5%*	*-95.8%*	*-98.3%*	*-96.4%*	*-100%*		
2005–2006	*6.8%*	*0.0%*	*-3.5%*	*-5.7%*	*-13.5%*	*-6.6%*	*-15.4%*	*-20.7%*			
Share in 1 A Mobile											
1990			*100.0%*	*68.2%*	*63.1%*	*27.3%*	*10.9%*	*24.8%*			
2006			*100.0%*	*69.1%*	*33.3%*	*17.1%*	*2.8%*	*13.5%*			
Share in National Total											
1990	*100.0%*	*0.0%*	*8.0%*	*5.5%*	*5.1%*	*2.2%*	*0.9%*	*2.0%*			
2006	*100.0%*	*0.0%*	*1.4%*	*1.0%*	*0.5%*	*0.2%*	*0.0%*	*0.2%*			

Table156: NO_x Emissions and trends from Sector NFR 1 A Mobile Fuel Combustion Activities – Road transport – 1990–2006.

NFR	TOTAL	1	1 A Mobile	1 A 3	1 A 3 b	1 A 3 b 1	1 A 3 b 2	1 A 3 b 3	1 A 3 b 4	1 A 3 b 5	1 A 3 b 6
Unit				**Gg**							
1990	192.41	181.43	115.33	82.29	79.14	43.73	7.78	27.50	0.13	NA	IE
1991	202.65	191.77	124.89	93.16	89.96	46.97	7.75	35.10	0.14	NA	IE
1992	191.89	181.32	121.44	88.98	85.82	41.27	7.71	36.68	0.15	NA	IE
1993	186.24	178.50	121.41	89.28	86.20	37.41	7.60	41.02	0.17	NA	IE
1994	180.70	172.61	118.72	84.45	81.28	35.14	7.54	38.40	0.19	NA	IE
1995	181.40	173.72	118.65	85.85	82.71	33.04	7.32	42.13	0.22	NA	IE
1996	203.81	196.48	142.14	107.69	104.70	31.20	7.10	66.17	0.24	NA	IE
1997	193.03	185.57	128.59	91.91	88.93	30.59	6.93	51.14	0.26	NA	IE
1998	208.09	200.67	147.08	110.65	107.33	33.55	6.82	66.66	0.30	NA	IE
1999	198.89	191.64	138.06	102.82	98.98	32.47	6.76	59.42	0.33	NA	IE
2000	205.35	198.16	146.71	113.60	109.46	33.00	6.71	69.40	0.35	NA	IE
2001	215.03	207.84	154.23	121.04	117.16	34.83	6.54	75.43	0.37	NA	IE
2002	224.58	217.39	163.42	130.62	127.25	39.33	6.34	81.19	0.39	NA	IE
2003	235.54	228.75	172.14	141.02	137.32	42.21	6.22	88.48	0.41	NA	IE
2004	233.29	226.71	171.52	141.23	137.32	43.09	6.14	87.67	0.42	NA	IE
2005	236.97	229.95	174.53	145.78	141.78	42.68	6.27	92.39	0.43	NA	IE
2006	225.16	218.27	161.56	133.71	129.92	41.71	5.97	81.81	0.43	NA	IE
Trend											
1990–2006	*17.0%*	*0.0%*	*40.1%*	*62.5%*	*64.2%*	*-4.6%*	*-23.2%*	*197.5%*	*233.3%*		
2005–2006	*-5.0%*	*0.0%*	*-7.4%*	*-8.3%*	*-8.4%*	*-2.3%*	*-4.8%*	*-11.5%*	*0.0%*		
Share in NFR 1 A Mobile Fuel Combustion Activities											
1990	*0.0%*	*0.0%*	*100.0%*	*71.4%*	*68.6%*	*37.9%*	*6.7%*	*23.8%*	*0.1%*		
2006	*0.0%*	*0.0%*	*100.0%*	*82.8%*	*80.4%*	*25.8%*	*3.7%*	*50.6%*	*0.3%*		
Share in National Total											
1990	*100.0%*	*0.0%*	*59.9%*	*42.8%*	*41.1%*	*22.7%*	*4.0%*	*14.3%*	*0.1%*		
2006	*100.0%*	*0.0%*	*71.8%*	*59.4%*	*57.7%*	*18.5%*	*2.7%*	*36.3%*	*0.2%*		

Table157: NMVOC Emissions and trends from Sector NFR 1 A Mobile Fuel Combustion Activities – Road transport – 1990–2006.

NFR	TOTAL	1	1 A Mobile	1 A 3	1 A 3 b	1 A 3 b 1	1 A 3 b 2	1 A 3 b 3	1 A 3 b 4	1 A 3 b 5	1 A 3 b 6
Unit				Gg							
1990	283.18	153.12	80.93	69.28	68.17	40.03	4.05	2.74	2.23	19.12	IE
1991	275.20	160.54	83.22	72.58	71.48	44.20	3.84	3.16	2.13	18.15	IE
1992	250.43	152.39	81.01	70.05	68.96	43.03	3.61	3.16	2.08	17.08	IE
1993	249.27	149.88	78.86	67.94	66.87	42.20	3.39	3.33	2.03	15.93	IE
1994	231.16	138.58	74.87	63.42	62.34	39.34	3.12	3.17	2.00	14.72	IE
1995	229.35	133.70	69.47	58.67	57.63	36.04	2.79	3.38	2.00	13.43	IE
1996	221.54	131.19	64.88	53.68	52.66	31.52	2.50	4.55	1.99	12.11	IE
1997	206.62	112.62	58.95	47.61	46.59	28.06	2.22	3.53	2.00	10.77	IE
1998	191.80	106.59	56.23	45.38	44.35	26.78	1.97	4.10	2.02	9.48	IE
1999	178.44	100.46	50.12	39.74	38.67	23.06	1.76	3.53	2.06	8.26	IE
2000	177.11	92.52	45.46	35.96	34.91	20.51	1.56	3.84	2.04	6.97	IE
2001	188.25	89.55	42.55	33.26	32.24	18.74	1.37	4.05	2.02	6.05	IE
2002	188.79	85.37	40.83	31.70	30.68	17.91	1.19	4.28	2.00	5.29	IE
2003	183.01	83.37	38.71	29.85	28.77	16.45	1.04	4.63	1.97	4.68	IE
2004	176.02	77.73	35.69	27.24	26.15	14.45	0.90	4.67	1.94	4.20	IE
2005	163.65	75.19	32.77	25.04	23.97	12.52	0.84	4.88	1.92	3.82	IE
2006	171.63	70.12	29.66	22.32	21.25	10.72	0.67	4.48	1.86	3.52	IE
Trend											
1990–2006	*-39.4%*	*0.0%*	*-63.3%*	*-67.8%*	*-68.8%*	*-73.2%*	*-83.4%*	*63.2%*	*-16.4%*	*-81.6%*	
2005–2006	*4.9%*	*0.0%*	*-9.5%*	*-10.9%*	*-11.4%*	*-14.4%*	*-19.7%*	*-8.2%*	*-2.7%*	*-8.0%*	
Share in NFR 1 A Mobile Fuel Combustion Activities											
1990			*100.0%*	*85.6%*	*84.2%*	*49.5%*	*5.0%*	*3.4%*	*2.8%*	*23.6%*	
2006			*100.0%*	*75.2%*	*71.6%*	*36.1%*	*2.3%*	*15.1%*	*6.3%*	*11.9%*	
Share in National Total											
1990			*28.6%*	*24.5%*	*24.1%*	*14.1%*	*1.4%*	*1.0%*	*0.8%*	*6.8%*	
2006			*17.3%*	*13.0%*	*12.4%*	*6.2%*	*0.4%*	*2.6%*	*1.1%*	*2.0%*	

Table158: NH_3 Emissions and trends from Sector NFR 1 A Mobile Fuel Combustion Activities – Road transport – 1990–2006.

NFR	TOTAL	1	1 A Mobile	1 A 3	1 A 3 b	1 A 3 b 1	1 A 3 b 2	1 A 3 b 3	1 A 3 b 4	1 A 3 b 5	1 A 3 b 6
Unit				**Gg**							
1990	71.05	4.28	3.23	3.22	3.21	3.07	0.10	0.04	0.00	NA	IE
1991	73.62	5.85	4.71	4.70	4.70	4.53	0.12	0.04	0.00	NA	IE
1992	72.06	6.67	5.59	5.58	5.58	5.39	0.15	0.04	0.00	NA	IE
1993	72.80	7.45	6.31	6.29	6.29	6.08	0.17	0.04	0.00	NA	IE
1994	73.99	7.66	6.54	6.53	6.53	6.32	0.16	0.04	0.00	NA	IE
1995	75.35	7.49	6.34	6.33	6.32	6.12	0.16	0.04	0.00	NA	IE
1996	73.11	7.01	5.77	5.76	5.75	5.54	0.15	0.06	0.00	NA	IE
1997	72.87	6.52	5.30	5.28	5.28	5.09	0.14	0.05	0.00	NA	IE
1998	72.98	6.55	5.34	5.33	5.32	5.14	0.13	0.05	0.00	NA	IE
1999	71.13	5.92	4.67	4.66	4.65	4.48	0.12	0.05	0.00	NA	IE
2000	69.14	5.42	4.29	4.27	4.26	4.10	0.11	0.05	0.00	NA	IE
2001	68.77	5.28	4.04	4.03	4.02	3.87	0.10	0.05	0.00	NA	IE
2002	67.62	5.23	4.02	4.01	4.00	3.86	0.09	0.06	0.00	NA	IE
2003	67.27	5.05	3.77	3.75	3.75	3.61	0.08	0.06	0.00	NA	IE
2004	66.46	4.55	3.30	3.29	3.28	3.15	0.07	0.06	0.00	NA	IE
2005	65.95	4.17	2.85	2.84	2.83	2.70	0.06	0.06	0.00	NA	IE
2006	65.81	3.76	2.40	2.39	2.38	2.27	0.05	0.06	0.00	NA	IE
Trend											
1990–2006	*-7.4%*	*0.0%*	*-25.7%*	*-25.7%*	*-25.9%*	*-26.1%*	*-51.1%*	*63.1%*	*140.0%*		
2005–2006	*-0.2%*	*0.0%*	*-15.9%*	*-16.0%*	*-16.0%*	*-16.1%*	*-20.9%*	*-8.0%*	*0.0%*		
Share in NFR 1 A Mobile Fuel Combustion Activities											
1990			*100.0%*	*99.6%*	*99.4%*	*95.1%*	*3.2%*	*1.1%*	*0.0%*		
2006			*100.0%*	*99.6%*	*99.2%*	*94.5%*	*2.1%*	*2.4%*	*0.0%*		
Share in National Total											
1990			*4.5%*	*4.5%*	*4.5%*	*4.3%*	*0.1%*	*0.1%*	*0.0%*		
2006			*3.6%*	*3.6%*	*3.6%*	*3.4%*	*0.1%*	*0.1%*	*0.0%*		

Table159: CO Emissions and trends from Sector NFR 1 A Mobile Fuel Combustion Activities – Road transport – 1990–2006.

NFR	TOTAL	1	1 A Mobile	1 A 3	1 A 3 b	1 A 3 b 1	1 A 3 b 2	1 A 3 b 3	1 A 3 b 4	1 A 3 b 5	1 A 3 b 6
Unit				**Gg**							
1990	1 444.11	1 385.17	686.48	649.01	643.17	565.95	59.67	7.34	10.22	NA	IE
1991	1 513.92	1 459.72	746.07	711.19	705.30	629.97	56.12	8.81	10.40	NA	IE
1992	1 481.31	1 424.19	714.88	679.09	673.16	600.83	52.33	9.00	11.00	NA	IE
1993	1 448.57	1 389.45	692.82	657.10	651.16	581.23	48.54	9.75	11.64	NA	IE
1994	1 379.37	1 319.28	647.10	610.22	604.22	537.63	44.85	9.22	12.51	NA	IE
1995	1 267.33	1 211.36	597.33	562.36	556.89	493.02	40.26	9.93	13.68	NA	IE
1996	1 246.13	1 196.34	538.24	502.47	497.14	432.21	36.05	14.10	14.78	NA	IE
1997	1 154.95	1 106.65	488.09	452.21	446.71	387.97	32.00	10.87	15.88	NA	IE
1998	1 109.26	1 064.77	478.56	444.08	438.44	379.58	28.41	13.08	17.37	NA	IE
1999	1 034.38	994.48	425.36	391.87	386.05	330.66	25.14	11.36	18.89	NA	IE
2000	959.09	922.83	392.57	361.16	355.96	301.50	22.20	12.62	19.64	NA	IE
2001	930.36	897.49	373.26	342.22	337.21	283.92	19.35	13.61	20.33	NA	IE
2002	898.57	866.16	371.81	341.00	335.60	283.14	16.72	14.71	21.03	NA	IE
2003	900.10	868.00	358.68	327.99	322.24	270.42	14.36	16.16	21.30	NA	IE
2004	857.50	825.04	331.54	301.21	295.51	245.40	12.23	16.45	21.44	NA	IE
2005	823.41	791.69	303.30	274.38	268.36	217.97	11.37	17.42	21.59	NA	IE
2006	785.35	754.06	270.30	241.93	235.80	190.10	8.81	15.47	21.42	NA	IE
Trend											
1990–2006	*-45.6%*	*0.0%*	*-60.6%*	*-62.7%*	*-63.3%*	*-66.4%*	*-85.2%*	*110.8%*	*109.7%*		
2005–2006	*-4.6%*	*0.0%*	*-10.9%*	*-11.8%*	*-12.1%*	*-12.8%*	*-22.5%*	*-11.2%*	*-0.8%*		
Share in NFR 1 A Mobile Fuel Combustion Activities											
1990			*100.0%*	*94.5%*	*93.7%*	*82.4%*	*8.7%*	*1.1%*	*1.5%*		
2006			*100.0%*	*89.5%*	*87.2%*	*70.3%*	*3.3%*	*5.7%*	*7.9%*		
Share in National Total											
1990			*47.5%*	*44.9%*	*44.5%*	*39.2%*	*4.1%*	*0.5%*	*0.7%*		
2006			*34.4%*	*30.8%*	*30.0%*	*24.2%*	*1.1%*	*2.0%*	*2.7%*		

Table160: Cd Emissions and trends from Sector NFR 1 A Mobile Fuel Combustion Activities – Road transport – 1990–2006.

NFR	TOTAL	1	1 A Mobile	1 A 3	1 A 3 b	1 A 3 b 1	1 A 3 b 2	1 A 3 b 3	1 A 3 b 4	1 A 3 b 5	1 A 3 b 6
Unit				Mg							
1990	1.58	1.06	0.06	0.06	0.06	0.00	0.00	0.00	0.00	NA	-
1991	1.53	1.09	0.06	0.06	0.06	0.00	0.00	0.00	0.00	NA	-
1992	1.25	0.97	0.07	0.07	0.06	0.00	0.00	0.00	0.00	NA	-
1993	1.16	0.94	0.07	0.07	0.07	0.00	0.00	0.00	0.00	NA	-
1994	1.06	0.88	0.07	0.07	0.07	0.00	0.00	0.00	0.00	NA	-
1995	0.97	0.81	0.07	0.07	0.07	0.00	0.00	0.00	0.00	NA	-
1996	0.99	0.84	0.07	0.07	0.07	0.00	0.00	0.00	0.00	NA	-
1997	0.97	0.80	0.07	0.07	0.07	0.00	0.00	0.00	0.00	NA	-
1998	0.90	0.74	0.08	0.08	0.08	0.00	0.00	0.00	0.00	NA	-
1999	0.98	0.80	0.08	0.08	0.08	0.00	0.00	0.00	0.00	NA	-
2000	0.95	0.76	0.08	0.08	0.08	0.00	0.00	0.00	0.00	NA	-
2001	0.98	0.80	0.08	0.08	0.08	0.00	0.00	0.00	0.00	NA	-
2002	1.00	0.80	0.09	0.08	0.08	0.00	0.00	0.00	0.00	NA	-
2003	1.03	0.83	0.09	0.09	0.09	0.00	0.00	0.00	0.00	NA	-
2004	1.03	0.83	0.09	0.09	0.09	0.00	0.00	0.00	0.00	NA	-
2005	1.10	0.88	0.09	0.09	0.09	0.00	0.00	0.00	0.00	NA	-
2006	1.12	0.90	0.09	0.09	0.09	0.00	0.00	0.00	0.00	NA	-
Trend											
1990–2006	*-28.7%*	*0.0%*	*52.3%*	*52.7%*	*53.4%*	*53.9%*	*40.3%*	*320.9%*	*136.0%*		
2005–2006	*1.8%*	*0.0%*	*0.6%*	*0.6%*	*0.6%*	*1.5%*	*-0.4%*	*-6.7%*	*2.2%*		
Share in NFR 1 A Mobile Fuel Combustion Activities											
1990			*100.0%*	*98.9%*	*98.2%*	*3.8%*	*0.6%*	*0.8%*	*0.0%*		*0.0%*
2006			*100.0%*	*99.2%*	*98.9%*	*3.8%*	*0.5%*	*2.3%*	*0.0%*		*0.0%*
Share in National Total											
1990			*3.9%*	*3.8%*	*3.8%*	*0.1%*	*0.0%*	*0.0%*	*0.0%*		*0.0%*
2006			*8.2%*	*8.2%*	*8.1%*	*0.3%*	*0.0%*	*0.2%*	*0.0%*		*0.0%*

Table161: Pb Emissions and trends from Sector NFR 1 A Mobile Fuel Combustion Activities – Road transport – 1990–2006.

NFR	TOTAL	1	1 A Mobile	1 A 3	1 A 3 b	1 A 3 b 1	1 A 3 b 2	1 A 3 b 3	1 A 3 b 4	1 A 3 b 5	1 A 3 b 6
Unit			**Mg**								
1990	207.35	174.17	156.99	155.58	153.59	135.45	14.36	2.37	1.41	NA	IE
1991	171.75	143.81	126.62	125.55	123.55	109.20	11.16	2.02	1.18	NA	IE
1992	119.83	100.67	86.14	85.28	83.28	72.57	8.21	1.52	0.98	NA	IE
1993	86.20	70.61	57.63	56.99	54.98	47.47	5.67	1.07	0.76	NA	IE
1994	59.66	47.31	35.41	35.00	32.97	28.49	3.35	0.62	0.51	NA	IE
1995	16.07	11.33	0.02	0.02	0.01	0.01	0.00	0.00	0.00	NA	IE
1996	15.50	11.18	0.02	0.02	0.01	0.01	0.00	0.00	0.00	NA	IE
1997	14.49	9.64	0.01	0.01	0.01	0.01	0.00	0.00	0.00	NA	IE
1998	12.99	8.23	0.02	0.01	0.01	0.01	0.00	0.00	0.00	NA	IE
1999	12.50	7.53	0.01	0.01	0.01	0.01	0.00	0.00	0.00	NA	IE
2000	11.96	6.42	0.01	0.01	0.01	0.01	0.00	0.00	0.00	NA	IE
2001	12.10	6.70	0.01	0.01	0.01	0.01	0.00	0.00	0.00	NA	IE
2002	12.46	6.76	0.02	0.01	0.01	0.01	0.00	0.00	0.00	NA	IE
2003	12.68	6.95	0.02	0.02	0.01	0.01	0.00	0.00	0.00	NA	IE
2004	13.07	7.12	0.02	0.02	0.01	0.01	0.00	0.00	0.00	NA	IE
2005	13.71	7.16	0.02	0.02	0.01	0.01	0.00	0.00	0.00	NA	IE
2006	14.12	7.49	0.02	0.02	0.01	0.01	0.00	0.00	0.00	NA	IE
Trend											
1990–2006	*-93.2%*	*0.0%*	*-100.0%*	*-100.0%*	*-100.0%*	*-100.0%*	*-100.0%*	*-99.9%*	*-100.0%*		
2005–2006	*3.0%*	*0.0%*	*-1.9%*	*-2.1%*	*-2.0%*	*-0.7%*	*-5.2%*	*-6.8%*	*2.2%*		
Share in NFR 1 A Mobile Fuel Combustion Activities											
1990			*100.0%*	*99.1%*	*97.8%*	*86.3%*	*9.1%*	*1.5%*	*0.9%*		
2006			*100.0%*	*94.9%*	*81.8%*	*63.0%*	*4.0%*	*13.7%*	*1.1%*		
Share in National Total											
1990			*75.7%*	*75.0%*	*74.1%*	*65.3%*	*6.9%*	*1.1%*	*0.7%*		
2006			*0.1%*	*0.1%*	*0.1%*	*0.1%*	*0.0%*	*0.0%*	*0.0%*		

Table162: Hg Emissions and trends from Sector NFR 1 A Mobile Fuel Combustion Activities – Road transport – 1990–2006.

NFR	TOTAL	1	1 A Mobile	1 A 3	1 A 3 b	1 A 3 b 1	1 A 3 b 2	1 A 3 b 3	1 A 3 b 4	1 A 3 b 5	1 A 3 b 6
Unit				**Mg**							
1990	2.14	1.56	0.0021	0.0019	0.0011	0.0008	0.0001	0.0002	0.0000	NA	IE
1991	2.04	1.50	0.0022	0.0020	0.0013	0.0009	0.0001	0.0002	0.0000	NA	IE
1992	1.64	1.18	0.0022	0.0020	0.0013	0.0009	0.0001	0.0002	0.0000	NA	IE
1993	1.39	0.96	0.0022	0.0020	0.0013	0.0009	0.0001	0.0003	0.0000	NA	IE
1994	1.18	0.76	0.0022	0.0019	0.0013	0.0009	0.0001	0.0003	0.0000	NA	IE
1995	1.20	0.71	0.0022	0.0020	0.0013	0.0009	0.0001	0.0003	0.0000	NA	IE
1996	1.16	0.71	0.0024	0.0021	0.0015	0.0009	0.0001	0.0005	0.0000	NA	IE
1997	1.13	0.68	0.0020	0.0018	0.0014	0.0008	0.0001	0.0004	0.0000	NA	IE
1998	0.95	0.60	0.0022	0.0019	0.0016	0.0009	0.0001	0.0005	0.0000	NA	IE
1999	0.94	0.65	0.0021	0.0018	0.0015	0.0009	0.0002	0.0004	0.0000	NA	IE
2000	0.89	0.64	0.0021	0.0019	0.0016	0.0009	0.0002	0.0005	0.0000	NA	IE
2001	0.95	0.70	0.0023	0.0020	0.0017	0.0010	0.0002	0.0006	0.0000	NA	IE
2002	0.94	0.66	0.0024	0.0022	0.0019	0.0011	0.0002	0.0006	0.0000	NA	IE
2003	0.98	0.70	0.0026	0.0024	0.0021	0.0012	0.0002	0.0007	0.0000	NA	IE
2004	0.94	0.65	0.0027	0.0024	0.0021	0.0012	0.0002	0.0007	0.0000	NA	IE
2005	1.00	0.67	0.0028	0.0025	0.0022	0.0012	0.0002	0.0008	0.0000	NA	IE
2006	1.02	0.69	0.0027	0.0024	0.0022	0.0012	0.0002	0.0008	0.0000	NA	IE
Trend											
1990–2006	*-52.1%*	*0.0%*	*28.6%*	*30.2%*	*95.8%*	*53.9%*	*40.3%*	*320.9%*	*136.0%*		
2005–2006	*2.9%*	*0.0%*	*-1.4%*	*-1.7%*	*-1.7%*	*1.5%*	*-0.4%*	*-6.7%*	*2.2%*		
Share in NFR 1 A Mobile Fuel Combustion Activities											
1990			*100.0%*	*89.2%*	*52.7%*	*38.2%*	*5.7%*	*8.5%*	*0.2%*		
2006			*100.0%*	*90.3%*	*80.2%*	*45.7%*	*6.3%*	*27.8%*	*0.4%*		
Share in National Total											
1990			*0.1%*	*0.1%*	*0.1%*	*0.0%*	*0.0%*	*0.0%*	*0.0%*		
2006			*0.3%*	*0.2%*	*0.2%*	*0.1%*	*0.0%*	*0.1%*	*0.0%*		

Table163: PAH Emissions and trends from Sector NFR 1 A Mobile Fuel Combustion Activities – Road transport – 1990–2006.

NFR	TOTAL	1	1 A Mobile	1 A 3	1 A 3 b	1 A 3 b 1	1 A 3 b 2	1 A 3 b 3	1 A 3 b 4	1 A 3 b 5	1 A 3 b 6
Unit				**Mg**							
1990	17.30	9.47	0.99	0.78	0.76	0.47	0.10	0.16	0.02	NA	IE
1991	17.89	10.32	1.04	0.84	0.82	0.48	0.11	0.21	0.02	NA	IE
1992	13.33	9.40	1.02	0.81	0.79	0.43	0.11	0.22	0.02	NA	IE
1993	10.12	9.28	1.02	0.81	0.79	0.40	0.11	0.25	0.02	NA	IE
1994	9.28	8.40	1.01	0.80	0.77	0.39	0.12	0.24	0.03	NA	IE
1995	9.62	8.85	1.03	0.82	0.80	0.38	0.12	0.27	0.03	NA	IE
1996	10.72	9.57	1.19	0.98	0.95	0.37	0.12	0.43	0.03	NA	IE
1997	9.29	8.58	1.11	0.89	0.87	0.37	0.13	0.34	0.03	NA	IE
1998	8.94	8.30	1.25	1.04	1.01	0.40	0.13	0.44	0.04	NA	IE
1999	8.80	8.32	1.22	1.00	0.98	0.40	0.14	0.40	0.04	NA	IE
2000	8.21	7.78	1.31	1.10	1.08	0.42	0.14	0.47	0.04	NA	IE
2001	8.89	8.47	1.42	1.20	1.17	0.46	0.14	0.53	0.04	NA	IE
2002	8.71	8.29	1.56	1.33	1.31	0.53	0.14	0.59	0.05	NA	IE
2003	9.04	8.62	1.69	1.47	1.45	0.58	0.15	0.67	0.05	NA	IE
2004	8.99	8.50	1.76	1.52	1.50	0.62	0.15	0.68	0.05	NA	IE
2005	9.19	8.77	1.84	1.61	1.59	0.65	0.15	0.74	0.05	NA	IE
2006	8.73	8.31	1.82	1.59	1.57	0.67	0.15	0.69	0.05	NA	IE
Trend											
1990–2006	*-49.6%*	*0.0%*	*83.4%*	*102.5%*	*106.5%*	*42.1%*	*48.8%*	*324.0%*	*158.6%*		
2005–2006	*-5.0%*	*0.0%*	*-1.2%*	*-1.5%*	*-1.6%*	*3.6%*	*-0.2%*	*-6.7%*	*2.5%*		
Share in NFR 1 A Mobile Fuel Combustion Activities											
1990			*100.0%*	*78.9%*	*76.4%*	*47.6%*	*10.4%*	*16.4%*	*2.0%*		
2006			*100.0%*	*87.1%*	*86.1%*	*36.9%*	*8.4%*	*37.9%*	*2.8%*		
Share in National Total											
1990			*5.7%*	*4.5%*	*4.4%*	*2.7%*	*0.6%*	*0.9%*	*0.1%*		
2006			*20.8%*	*18.2%*	*17.9%*	*7.7%*	*1.8%*	*7.9%*	*0.6%*		

Table 164: Dioxin Emissions and trends from Sector NFR 1 A Mobile Fuel Combustion Activities – Road transport – 1990–2006.

NFR	TOTAL	1	1 A Mobile	1 A 3	1 A 3 b	1 A 3 b 1	1 A 3 b 2	1 A 3 b 3	1 A 3 b 4	1 A 3 b 5	1 A 3 b 6
Unit			g								
1990	160.27	101.84	3.75	3.55	3.50	2.98	0.33	0.19	0.00	IE	IE
1991	134.99	80.87	3.66	3.46	3.42	2.88	0.31	0.23	0.00	IE	IE
1992	76.47	53.86	3.14	2.94	2.89	2.36	0.29	0.24	0.00	IE	IE
1993	66.77	49.34	2.78	2.58	2.54	2.00	0.28	0.26	0.00	IE	IE
1994	56.06	44.54	2.45	2.24	2.20	1.68	0.27	0.25	0.00	IE	IE
1995	58.27	45.79	2.16	1.96	1.92	1.39	0.25	0.27	0.00	IE	IE
1996	59.64	48.22	2.02	1.82	1.77	1.13	0.23	0.40	0.00	IE	IE
1997	59.33	46.92	1.74	1.53	1.49	0.95	0.22	0.32	0.00	IE	IE
1998	56.15	44.45	1.72	1.51	1.48	0.86	0.20	0.41	0.00	IE	IE
1999	53.59	40.74	1.51	1.30	1.27	0.70	0.19	0.37	0.00	IE	IE
2000	51.99	37.69	1.46	1.25	1.21	0.60	0.17	0.43	0.00	IE	IE
2001	54.35	40.55	1.44	1.22	1.19	0.55	0.16	0.48	0.00	IE	IE
2002	42.57	39.08	1.46	1.24	1.21	0.53	0.14	0.53	0.00	IE	IE
2003	43.31	40.04	1.49	1.27	1.23	0.51	0.13	0.59	0.00	IE	IE
2004	42.75	39.08	1.46	1.23	1.20	0.47	0.12	0.60	0.00	IE	IE
2005	44.65	40.31	1.46	1.24	1.21	0.44	0.12	0.65	0.00	IE	IE
2006	43.69	38.62	1.38	1.16	1.13	0.42	0.10	0.60	0.01	IE	IE
Trend											
1990–2006	*-72.7%*	*0.0%*	*-63.2%*	*-67.5%*	*-67.9%*	*-86.0%*	*-69.6%*	*221.7%*	*131.5%*		
2005–2006	*-2.1%*	*0.0%*	*-5.7%*	*-6.9%*	*-7.0%*	*-5.1%*	*-15.6%*	*-6.9%*	*2.3%*		
Share in NFR 1 A Mobile Fuel Combustion Activities											
1990			*100.0%*	*94.6%*	*93.3%*	*79.5%*	*8.7%*	*5.0%*	*0.1%*		
2006			*100.0%*	*83.6%*	*81.5%*	*30.2%*	*7.2%*	*43.6%*	*0.4%*		
Share in National Total											
1990			*2.3%*	*2.2%*	*2.2%*	*1.9%*	*0.2%*	*0.1%*	*0.0%*		
2006			*3.2%*	*2.6%*	*2.6%*	*1.0%*	*0.2%*	*1.4%*	*0.0%*		

Table 165: HCB Emissions and trends from Sector NFR 1 A Mobile Fuel Combustion Activities – Road transport – 1990–2006.

NFR	TOTAL	1	1 A Mobile	1 A 3	1 A 3 b	1 A 3 b 1	1 A 3 b 2	1 A 3 b 3	1 A 3 b 4	1 A 3 b 5	1 A 3 b 6
Unit				kg							
1990	91.77	72.57	0.75	0.71	0.70	0.60	0.07	0.04	0.00	NA	IE
1991	84.44	69.71	0.73	0.69	0.68	0.58	0.06	0.05	0.00	NA	IE
1992	69.51	56.94	0.63	0.59	0.58	0.47	0.06	0.05	0.00	NA	IE
1993	63.84	53.58	0.56	0.52	0.51	0.40	0.06	0.05	0.00	NA	IE
1994	51.79	48.04	0.49	0.45	0.44	0.34	0.05	0.05	0.00	NA	IE
1995	52.93	50.20	0.43	0.39	0.38	0.28	0.05	0.05	0.00	NA	IE
1996	55.64	53.15	0.40	0.36	0.35	0.23	0.05	0.08	0.00	NA	IE
1997	51.78	49.07	0.35	0.31	0.30	0.19	0.04	0.06	0.00	NA	IE
1998	49.01	46.45	0.34	0.30	0.30	0.17	0.04	0.08	0.00	NA	IE
1999	47.56	44.75	0.30	0.26	0.25	0.14	0.04	0.07	0.00	NA	IE
2000	44.15	41.02	0.29	0.25	0.24	0.12	0.03	0.09	0.00	NA	IE
2001	47.35	44.32	0.29	0.24	0.24	0.11	0.03	0.10	0.00	NA	IE
2002	45.02	41.80	0.29	0.25	0.24	0.11	0.03	0.11	0.00	NA	IE
2003	45.60	42.36	0.30	0.25	0.25	0.10	0.03	0.12	0.00	NA	IE
2004	43.86	40.48	0.29	0.25	0.24	0.09	0.02	0.12	0.00	NA	IE
2005	45.58	41.82	0.29	0.25	0.24	0.09	0.02	0.13	0.00	NA	IE
2006	43.10	39.27	0.28	0.23	0.23	0.08	0.02	0.12	0.00	NA	IE
Trend											
1990–2006	*-53.0%*	*0.0%*	*-63.2%*	*-67.5%*	*-67.9%*	*-86.0%*	*-69.6%*	*221.7%*	*131.5%*		
2005–2006	*-5.5%*	*0.0%*	*-5.7%*	*-6.9%*	*-7.0%*	*-5.1%*	*-15.6%*	*-6.9%*	*2.3%*		
Share in NFR 1 A Mobile Fuel Combustion Activities											
1990			*100.0%*	*94.6%*	*93.3%*	*79.5%*	*8.7%*	*5.0%*	*0.1%*		
2006			*100.0%*	*83.6%*	*81.5%*	*30.2%*	*7.2%*	*43.6%*	*0.4%*		
Share in National Total											
1990			*0.8%*	*0.8%*	*0.8%*	*0.7%*	*0.1%*	*0.0%*	*0.0%*		
2006			*0.6%*	*0.5%*	*0.5%*	*0.2%*	*0.0%*	*0.3%*	*0.0%*		

Table 166: TSP Emissions and trends from Sector NFR 1 A Mobile Fuel Combustion Activities – Road transport – 1990–2006.

NFR	TOTAL	1	1 A Mobile	1 A 3	1 A 3 b	1 A 3 b 1	1 A 3 b 2	1 A 3 b 3	1 A 3 b 4	1 A 3 b 5	1 A 3 b 6
Unit				**Mg**							
1990	68 586.59	31 811.93	15 765.99	10 981.47	9 171.98	710.42	401.00	1 190.79	–	NA	IE
1991	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
1992	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
1993	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
1994	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
1995	71 568.09	32 200.20	17 912.07	13 442.04	11 676.68	1 202.11	544.00	1 795.37	–	NA	IE
1996	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
1997	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
1998	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
1999	70239.98	32 714.34	19 041.52	14 646.09	12 903.72	1 681.28	558.00	1 799.44	–	NA	IE
2000	74 054.61	32 097.98	19 093.19	15 015.72	13 278.55	1 718.59	571.00	1 940.38	–	NA	IE
2001	73 946.03	32 928.52	19 352.83	15 289.02	13 562.01	1 808.06	551.00	2 022.28	–	NA	IE
2002	73 626.21	33 010.37	19 749.92	15 734.74	14 016.56	2 003.66	525.00	2 093.81	–	NA	IE
2003	73 874.86	33 725.61	20 053.84	16 203.92	14 470.27	2 130.02	506.00	2 211.36	–	NA	IE
2004	74 355.32	33 401.68	20 010.97	16 334.17	14 597.43	2 124.29	479.00	2 140.80	–	NA	IE
2005	73 195.56	33 535.63	19 913.45	16 512.64	14 787.25	2 083.28	471.00	2 208.96	–	NA	IE
2006	75 000.51	33 224.22	19 417.93	16 163.74	14 439.41	2 018.35	436.00	1 838.01	–	NA	IE
Trend											
1990–2006	*9.4%*	*0.0%*	*23.2%*	*47.2%*	*57.4%*	*184.1%*	*8.7%*	*54.4%*			
2005–2006	*2.5%*	*0.0%*	*-2.5%*	*-2.1%*	*-2.4%*	*-3.1%*	*-7.4%*	*-16.8%*			
Share in NFR 1 A Mobile Fuel Combustion Activities											
1990			*100.0%*	*69.7%*	*58.2%*	*4.5%*	*2.5%*	*7.6%*	*0.0%*		
2006			*100.0%*	*83.2%*	*74.4%*	*10.4%*	*2.2%*	*9.5%*	*0.0%*		
Share in National Total											
1990			*23.0%*	*16.0%*	*13.4%*	*1.0%*	*0.6%*	*1.7%*	*0.0%*		
2006			*25.9%*	*21.6%*	*19.3%*	*2.7%*	*0.6%*	*2.5%*	*0.0%*		

Table 167: PM10 Emissions and trends from Sector NFR 1 A Mobile Fuel Combustion Activities – Road transport – 1990–2006.

NFR	TOTAL	1	1 A Mobile	1 A 3	1 A 3 b	1 A 3 b 1	1 A 3 b 2	1 A 3 b 3	1 A 3 b 4	1 A 3 b 5	1 A 3 b 6
Unit				**Mg**							
1990	42 962.93	23 962.50	9 924.43	5 364.41	710.42	401.00	1 190.7886	–	NA	IE	2 289.93
1991	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
1992	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
1993	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
1994	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
1995	43 429.77	23 717.21	11 243.60	6 981.37	1 202.11	544.00	1 795.37	–	NA	IE	2 711.73
1996	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
1997	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
1998	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
1999	42 580.91	23 798.23	11 867.02	7 698.70	1 681.28	558.00	1 799.44	–	NA	IE	2 955.00
2000	43 918.28	23 104.92	11 808.87	7 945.84	1 718.59	571.00	1 940.38	–	NA	IE	3 016.19
2001	44 135.61	23 771.24	11 974.83	8 131.16	1 808.06	551.00	2 022.28	–	NA	IE	3 060.23
2002	43 538.95	23 716.91	12 211.19	8 434.76	2 003.66	525.00	2 093.81	–	NA	IE	3 131.36
2003	43 796.85	24 200.40	12 336.02	8 751.33	2 130.02	506.00	2 211.36	–	NA	IE	3 207.63
2004	43 689.52	23 744.38	12 141.04	8 727.88	2 124.29	479.00	2 140.80	–	NA	IE	3 284.45
2005	43 041.57	23 747.95	11 948.31	8 792.48	2 083.28	471.00	2 208.96	–	NA	IE	3 341.34
2006	43 450.49	23 340.23	11 368.74	8 361.63	2 018.35	436.00	1 838.01	–	NA	IE	3 382.35
Trend											
1990–2006	*1.1%*	*0.0%*	*14.6%*	*55.9%*	*184.1%*	*8.7%*	*54.4%*				*47.7%*
2005–2006	*1.0%*	*0.0%*	*-4.9%*	*-4.9%*	*-3.1%*	*-7.4%*	*-16.8%*				*1.2%*
Share in NFR 1 A Mobile Fuel Combustion Activities											
1990			*100.0%*	*54.1%*	*7.2%*	*4.0%*	*12.0%*	*0.0%*			*23.1%*
2006			*100.0%*	*73.5%*	*17.8%*	*3.8%*	*16.2%*	*0.0%*			*29.8%*
Share in National Total											
1990			*23.1%*	*12.5%*	*1.7%*	*0.9%*	*2.8%*	*0.0%*			*5.3%*
2006			*26.2%*	*19.2%*	*4.6%*	*1.0%*	*4.2%*	*0.0%*			*7.8%*

Table 168: PM2.5 Emissions and trends from Sector NFR 1 A Mobile Fuel Combustion Activities – Road transport – 1990–2006.

NFR	TOTAL	1	1 A Mobile	1 A 3	1 A 3 b	1 A 3 b 1	1 A 3 b 2	1 A 3 b 3	1 A 3 b 4	1 A 3 b 5	1 A 3 b 6
Unit				Mg							
1990	25 122.04	19 941.51	7 823.52	3 398.21	710.42	401.00	1 190.79	–	NA	IE	686.98
1991	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
1992	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
1993	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
1994	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
1995	24 354.01	19 661.80	8 857.44	4 719.90	1 202.11	544.00	1 795.37	–	NA	IE	813.52
1996	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
1997	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
1998	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
1999	23 863.53	19 617.63	9 298.71	5 266.66	1 681.28	558.00	1 799.44	–	NA	IE	886.50
2000	23 527.67	18 941.75	9 205.19	5 470.83	1 718.59	571.00	1 940.38	–	NA	IE	904.86
2001	24 030.04	19 510.76	9 337.02	5 625.44	1 808.06	551.00	2 022.28	–	NA	IE	918.07
2002	23 539.85	19 417.76	9 512.66	5 879.49	2 003.66	525.00	2 093.81	–	NA	IE	939.41
2003	23 865.28	19 770.00	9 568.10	6 142.54	2 130.02	506.00	2 211.36	–	NA	IE	962.29
2004	23 387.24	19 281.92	9 320.19	6 065.22	2 124.29	479.00	2 140.80	–	NA	IE	985.33
2005	23 226.93	19 236.67	9 098.71	6 089.86	2 083.28	471.00	2 208.96	–	NA	IE	1 002.40
2006	22 666.55	18 763.85	8 489.28	5 630.42	2 018.35	436.00	1 838.01	–	NA	IE	1 014.71
Trend											
1990–2006	*-9.8%*	*0.0%*	*8.5%*	*65.7%*	*184.1%*	*8.7%*	*54.4%*				*47.7%*
2005–2006	*-2.4%*	*0.0%*	*-6.7%*	*-7.5%*	*-3.1%*	*-7.4%*	*-16.8%*				*1.2%*
Share in NFR 1 A Mobile Fuel Combustion Activities											
1990			*100.0%*	*43.4%*	*9.1%*	*5.1%*	*15.2%*	*0.0%*			*8.8%*
2006			*100.0%*	*66.3%*	*23.8%*	*5.1%*	*21.7%*	*0.0%*			*12.0%*
Share in National Total											
1990			*31.1%*	*13.5%*	*2.8%*	*1.6%*	*4.7%*	*0.0%*			*2.7%*
2006			*37.5%*	*24.8%*	*8.9%*	*1.9%*	*8.1%*	*0.0%*			*4.5%*

Methodological Issues

Mobile combustion is differentiated into the categories passenger cars, light duty vehicles, heavy duty vehicles and buses, mopeds and motorcycles. The emission calculations are based on a combination between a bottom up and a top down method as described by the model GLOBEMI (HAUSBERGER, 1998).

Bottom up Methodology, for fuel consumed

Energy consumption and emissions of the different vehicle categories are calculated by multiplying the yearly road performance per vehicle category (km/vehicle and year) by the specific energy use (g/km) and by the emission factors in g/km (Model: GLOBEMI). Emission factors are based on the "Handbook of Emission Factors" Version 2.1 (HAUSBERGER & KELLER 1998) and on new ARTEMIS measurements (basically for passenger cars, light duty vehicles and motorcycles). The emissions from cold starts are calculated separately – taking into account temperature, interception periods and driving distances.

The annual millage driven for Austria is taken from the national traffic model VMOe (Verkehrs-Mengenmodell-Oesterreich – Austrian National Transport Model, Ministry of Transport, BMVIT).

VMOe is a network-based, multi-modal transport model covering passenger and freight transport. It is mainly used for forecasts and infrastructure assessment. Transport volumes for road are based on official background statistics relevant for travel and freight transport demand. These statistics include traffic counting information as well as average vehicle road performance (supplied by the Austrian automobile clubs throughout the annual vehicle inspection system), population data, motorisation rates, vehicle fleet sizes, economic and income development statistics. VCOe covers traffic movements between "transport zones" (the Austrian communities) and estimates the traffic generated by movements within the zones. This covers the total traffic within Austria driven by Austrian and foreign vehicles. The resulting mileages are used to calculate the total fuel consumption (and emissions based on fuel consumed) of traffic within Austria.

Calculated total fuel consumption of road transport is summed up with total fuel consumption of off road traffic.

Top down Methodology, Fuel sold

The difference between the fuel consumption calculated in the bottom up methodology for traffic and off road transport within Austria and total fuel sales in Austria (obtained from national statistics; STATISTIK AUSTRIA 2007) is allocated to fuel tourism (fuel sold in Austria but consumed abroad).

As in the year 2003, the amount of calculated fuel consumption differed significantly from sold fuel. The Ministry for Agriculture and Forestry, Environment and Water management has commissioned a study about the amount of tank tourism (BMFLUW 2004). In this study two different kinds of 'fuel export' due to low fuel prices in Austria have been identified:

- Increased entrainment of fuel at commercial or private journeys crossing Austria.
- Border crossing journeys to Austria only for buying fuel caused by the low fuel price.

Within the study the following analyses have been made:

Survey of passenger car drivers as well as of truckers concerning fuel consumption (place and amount of fuel bought and amount of fuel in the tank when crossing the border). At the same time fuel price differences between Austria and the neighbouring countries have been compared and the price differences have been linked to the fuel consumption behaviour.

The study showed that the sum of the calculated fuel consumption for Austria by road performance and 'fuel export' matches the national total fuel sold.

Activity data

Calculation of the activity data is based on the model GLOBEMI (HAUSBERGER 1998). Information on the number of new vehicles is published yearly by STATISTIK AUSTRIA. Information on the yearly road performance of the vehicles is supplied by the Austrian automobile clubs throughout the annual vehicle inspection system.

Different road performance for different street categories depending on the engine type, vehicle size and vehicle age is taken into account. The extrapolation of the yearly vehicle stock- and performance share (by vehicle age, motor type and vehicle size) is based on a dynamic, vehicle specific drop out- and road performance function.

Based on the GLOBEMI model total fuel consumption and total emissions for road transport are calculated with a bottom-up approach. Calculated total fuel consumption of road transport is summed up with total fuel consumption of off road traffic and is compared with national total sold fuel: due to uncertainties of the bottom up method the values differ by about 5–20%. To be consistent with the national energy balance, activity data in the bottom-up approach is adjusted so that finally the calculated total fuel consumption equals the figure of fuel sold in the national energy balance.

Table 169: Implied emission factors for NEC gases and CO and activities for 1A3b Road Transport 1990–2006.

Year	Activity	IEF NO_x	IEF SO_2	IEF NH_3	IEF NMVOC	IEF CO
	[PJ]	[t/PJ]				
1990	158.85	498.21	23.73	20.21	308.79	4.05
1991	180.07	499.57	24.85	26.08	296.18	3.92
1992	179.47	478.17	26.27	31.07	289.07	3.75
1993	184.35	467.58	27.72	34.11	276.33	3.53
1994	183.71	442.43	28.51	35.52	259.23	3.29
1995	188.76	438.17	25.95	33.48	234.14	2.95
1996	210.23	498.02	11.89	27.35	192.91	2.36
1997	195.49	454.93	10.80	26.99	183.18	2.29
1998	223.46	480.32	10.62	23.83	156.07	1.96
1999	214.43	461.59	9.73	21.68	141.80	1.80
2000	228.42	479.18	9.16	18.66	122.33	1.56
2001	245.33	477.58	8.85	16.40	106.73	1.37
2002	272.88	466.30	7.64	14.67	93.04	1.23
2003	296.80	462.66	7.07	12.62	81.16	1.09
2004	303.77	452.07	0.56	10.80	72.27	0.97
2005	315.79	448.96	0.49	8.97	63.81	0.85
2006	315.87	411.31	0.42	7.53	56.15	0.75

Table 170: Implied emission factors for PM and activities for 1A3b Road Transport 1990 – 2006.

Year	Activity	IEF PM	IEF TSP Non Exhaust	IEF PM10 Non Exhaust	IEF PM2.5P Non Exhaust
	[PJ]	[t/PJ]			
1990	158.85	14.49	43.25	14.42	4.32
1991	180.07	0.00	0.00	0.00	0.00
1992	179.47	0.00	0.00	0.00	0.00
1993	184.35	0.00	0.00	0.00	0.00
1994	183.71	0.00	0.00	0.00	0.00
1995	188.76	18.76	43.10	14.37	4.31
1996	210.23	0.00	0.00	0.00	0.00
1997	195.49	0.00	0.00	0.00	0.00
1998	223.46	0.00	0.00	0.00	0.00
1999	214.43	18.83	41.34	13.78	4.13
2000	228.42	18.52	39.61	13.20	3.96
2001	245.33	17.86	37.42	12.47	3.74
2002	272.88	16.94	34.43	11.48	3.44
2003	296.80	16.33	32.42	10.81	3.24
2004	303.77	15.62	32.44	10.81	3.24
2005	315.79	15.08	31.74	10.58	3.17
2006	315.87	13.59	32.12	10.71	3.21

Table 171: Implied emission factors for heavy metals and POPs and activities for 1A3b Road Transport 1990–2006.

Year	Activity	IEF Cd	IEF Hg	IEF Pb	IEF PAH	IEF Dioxin	IEF HCB
	[PJ]	[t/PJ]					
1990	158.85	2.0E-05	7.0E-06	0.97	0.0048	2.2E	4.4E
1991	180.07	2.0E-05	7.0E-06	0.69	0.0045	1.9E	3.8E
1992	179.47	2.0E-05	7.0E-06	0.46	0.0044	1.6E	3.2E
1993	184.35	2.0E-05	7.0E-06	0.30	0.0043	1.4E	2.8E
1994	183.71	2.0E-05	7.0E-06	0.18	0.0042	1.2E	2.4E
1995	188.76	2.0E-05	7.0E-06	6E-05	0.0042	1.0E	2.0E
1996	210.23	2.0E-05	7.0E-06	6E-05	0.0045	8.4E	1.7E
1997	195.49	2.0E-05	7.0E-06	6E-05	0.0045	7.6E	1.5E
1998	223.46	2.0E-05	7.0E-06	5E-05	0.0045	6.6E	1.3E
1999	214.43	2.0E-05	7.0E-06	5E-05	0.0046	5.9E	1.2E
2000	228.42	2.0E-05	7.0E-06	5E-05	0.0047	5.3E	1.1E
2001	245.33	2.0E-05	7.0E-06	5E-05	0.0048	4.8E	9.7E
2002	272.88	2.0E-05	7.0E-06	5E-05	0.0048	4.4E	8.9E
2003	296.80	2.0E-05	7.0E-06	4E-05	0.0049	4.2E	8.3E
2004	303.77	2.0E-05	7.0E-06	4E-05	0.0049	3.9E	7.9E
2005	315.79	2.0E-05	7.0E-06	4E-05	0.0050	3.8E	7.7E
2006	315.87	2.0E-05	6.9E-06	4E-05	0.0050	3.6E	7.1E

Recalculations

- Update of statistical energy and vehicle stock data
- Update of EF for PC, LDV and MC for all legislation standards (ARTEMIS, new CADC measurements). Big influence of inventory, mainly for NOx.
- Implementation of a new traffic volume model (vehicle km, passenger km and ton km)

Planned Improvements

- Introduction of a new "Handbook of Emission Factors" Version
- For the category 1 A 3 b passenger cars it is planned to use new EURO 4 emission factors for Minivans ans SUV's which were measured in autumn 2007.

4.3.5 Other mobile sources – Off Road

Methodology

In 2001 a study on off road emissions in Austria was finished (PISCHINGER 2000). The study was prepared to improve the poor data quality in this sector. The following categories were taken into account:

- 1 A 2 f Industry
- 1 A 3 c Railways
- 1 A 3 d Navigation
- 1 A 4 b Household and Gardening
- 1 A 4 c Agriculture and Forestry
- 1 A 5 Other: Military Activities.

Depending on the engine's fuel consumption the ratio power of the engine was calculated, emissions were calculated by multiplying ratio power and emission factors. To improve data quality the influence of the vehicle age on the operating time was taken into account.

With this method all relevant effects on engine emissions could be covered:

- Emissions according to the engine type
- Emissions according to the effective engine performance
- Emissions according to the engine age
- Emissions depending on the engine operating time
- Engine operating time according to the engine age.

Emission factors for NO_x, NMVOC and NH_3 were defined for four categories of engine type depending on the year of construction. They are listed in Table 172 to Table 175. The emission factors present fuel consumption and emissions according to the engine power output. Total emissions are calculated by multiplying emission factors with average motor capacity and activity data. With this bottom-up method national total fuel consumption and total emissions are calculated. Calculated total fuel consumption of off road traffic is summed up with total fuel consumption of road transport and is compared with national total sold fuel; due to uncertainties of the bottom-up method the values differ by about 5–20%. To be consistent with the national energy balance, activity data in the bottom-up approaches for both road transport and off- road traffic is adjusted so that finally the calculated total fuel consumption equals to the figure of fuel sold in the national energy balance.

Table 172: Emission Factors for diesel engines > 80 kW.

Year	Fuel	NO_x	NH_3	NMVOC	PM
			[g/kWh]		
1993	282	13.0	0.00300	1.95	1.50
1997	273	14.4	0.00240	1.56	1.10
2000	265	9.2	0.00195	1.27	0.70

Table 173: Emission Factors for diesel engines < 80 kW.

Year	Fuel	NO_x	NH_3	NMVOC	PM
			[g/kWh]		
1993	296	13.0	0.00600	3.90	1.80
1997	287	14.4	0.00450	2.93	1.50
2000	278	9.2	0.00390	2.54	1.05

Table 174: Emission Factors for 4-stroke-petrol engines.

Year	Fuel	NO_x	NH_3	NMVOC	PM
			[g/kWh]		
1993	550	5.0	0.00194	42.84	0.50
1997	520	5.5	0.00172	38.08	0.50
2000	500	5.5	0.00159	35.22	0.50

Table 175: Emission Factors for 2-stroke-petrol engines.

Year	Fuel	NO_x	NH_3	NMVOC	PM
			[g/kWh]		
1993	700	1.5	0.00168	297.0	8,00
1997	675	1.5	0.00151	267.3	8.00
2000	655	1.5	0.00134	237.6	8.00

Emission factors for SO_2 are based on the "Handbook of Emission Factors" (HAUSBERGER & KELLER 1998). They take into account analysis about the sulphur content of the fuel, which has been part of the inquiry of the yearly fuel quality monitory system.

Activity

Activity data, vehicle stock and specific fuel consumption for vehicles and machinery were taken from:

- Statistik Austria
- questionnaire to vehicle and machinery user
- information from vehicle and machinery manufacturer
- interviews with experts
- expert judgement.

Planned Improvements

For the category 1 A 2 f other mobile sources it is planned to use new emission factors which will be developed in a new study of off road emissions.

4.3.5.1 NFR 1 A 2 f Manufacturing Industries and Construction – Other – mobile sources

Most mobile sources of the industry are among the building industry. Within the industry sector there are different vehicles, which can be summarized to the following groups:

- vehicles with diesel engine > 80 kW
- vehicles with diesel engine < 80 kW
- vehicles with 4-stroke-petrol engine
- vehicles with 2-stroke-petrol engine.

Emissions from this category are presented in the following table.

Table 176: Emissions from off-road – Industry 1990–2006.

Year	NO_x	SO_2	NH_3	NMVOC	PM
			[Gg]		
1990	14.59	0.82	0.004	2.87	1.76
1995	15.36	0.26	0.004	2.83	1.71
2000	14.47	0.23	0.004	2.34	1.28
2005	11.22	0.04	0.003	1.91	0.80
2006	10.74	0.04	0.003	1.85	0.73
Trend 1990–2006	*-26%*	*-95%*	*-26%*	*-36%*	*-58%*

Between 1990 and 2006, emissions from off road industry decreased because of improved technology.

Activity data

Activities as well as the implied emission factors (national total emissions divided by total fuel consumption in GWh) for mobile sources of 1 A 2 f Manufacturing Industries and Construction (off-road transport in industry) are presented in the following table.

Table 177: Implied emission factors and activities for off-road transport in industry (NFR 1 A 2 f Manufacturing Industries and Construction – mobile) 1990–2006.

Year	Activity	IEF NO_x	IEF SO_2	IEF NH_3	IEF NMVOC	IEF PM
	[PJ]			[t/PJ]		
1990	13.79	1 058.21	59.48	0.30	208.26	127.95
1995	14.07	1 091.99	18.60	0.29	201.46	121.69
2000	14.40	1 005.09	16.28	0.25	162.81	89.07
2005	15.79	710.62	2.33	0.20	120.79	50.65
2006	16.41	654.47	2.27	0.19	112.41	44.75

4.3.5.2 NFR 1 A 3 c Railways

Only diesel and coal engines are taken into account, emissions driven by power plants due to production of electricity for electric engines are not included to avoid double counting of emissions.

Table 178: Emissions from railways 1990–2006.

Year	NO_x	SO_2	NH_3	NMVOC	PM	PM non-exhaust
				[Gg]		
1990	1.95	0.26	0.00	0.30	0.20	0.51
1995	1.75	0.22	0.00	0.25	0.15	0.51
2000	1.77	0.10	0.00	0.24	0.11	0.51
2005	1.37	0.06	0.00	0.17	0.06	0.52
2006	1.36	0.06	0.00	0.17	0.06	0.52
Trend 1990–2006	*-30%*	*-78%*	*-42%*	*-42%*	*-70%*	*1.2%*

Emissions from Railways fluctuated over the period from 1990–2006. They reached a maximum in 1992; afterwards the trend was decreasing until 2006. In the year 2006 all emissions were below 1990 levels. The activity of railways also fluctuated over the past years.

Activities used for estimating the emissions and implied emission factors are presented in the following tables.

Table 179: Activities for railways 1990–2006.

Year	Activity [PJ]
1990	2.34
1995	2.22
2000	2.43
2005	2.04
2006	2.11

Table 180: Emission factors for railways 1990–2006.

Year	IEF NO_x	IEF SO_2	IEF NH_3	IEF NMVOC	IEF PM Total
			[t/PJ]		
1990	831.14	111.22	0.93	127.31	302.36
1995	786.40	98.31	0.83	114.49	295.97
2000	731.10	42.23	0.72	99.06	256.65
2005	670.91	28.19	0.62	85.55	283.76
2006	646.28	27.47	0.59	81.66	273.49

4.3.5.3 NFR 1 A 3 d Navigation

Navigation is mainly freight traffic. All emissions from this category decreased between 1990 and 2006.

Table 181: Emissions from navigation 1990–2006.

Year	NO_x	SO_2	NH_3	NMVOC	PM
			[Gg]		
1990	0.52	0.04	0.00	0.72	0.05
1995	0.59	0.04	0.00	0.72	0.05
2000	0.65	0.02	0.00	0.69	0.05
2005	0.44	0.01	0.00	0.62	0.03
2006	0.45	0.01	0.00	0.62	0.03
Trend 1990–2006	*-15%*	*-60%*	*-24%*	*-14%*	*-41%*

Activities used for estimating the emissions and the implied emission factors are presented in the following table.

Table 182: Activities for navigation 1990–2006.

Year	Activity [PJ]
1990	0.70
1995	0.83
2000	0.95
2005	0.71
2006	0.76

Table 183: Emission factors for navigation 1990–2006.

Year	IEF NO_x	IEF SO_2	IEF NH_3	IEF NMVOC	IEF PM
			[t/PJ]		
1990	743.95	50.56	0.12	1 019.51	76.84
1995	718.27	43.01	0.11	864.63	61.44
2000	678.92	20.85	0.10	721.87	48.26
2005	609.78	19.25	0.08	872.10	45.03
2006	588.11	18.93	0.08	810.70	41.82

4.3.5.4 NFR 1 A 4 b Household and gardening – mobile sources

In addition to vehicles used in household and gardening this category contains ski slope machineries and snow vehicles.

Emissions from this category highly decreased over the period from 1990 to 2006, especially SO_2 emissions decreased to a greater extend due to decreasing emission factors.

Table 184: Emissions from off-road – household and gardening 1990–2006.

Year	NO_x	SO_2	NH_3	NMVOC	PM
			[Gg]		
1990	1.07	0.06	0.00	6.27	0.26
1995	1.16	0.02	0.00	6.25	0.25
2000	0.98	0.02	0.00	5.35	0.21
2005	0.80	0.00	0.00	2.86	0.15
2006	0.77	0.00	0.00	2.39	0.15
Trend 1990–2006	*-28%*	*-92%*	*-25%*	*-62%*	*-44%*

Activities used for estimating emissions and the implied emission factors are presented in the following table.

Table 185: Emission factors and activities for off-road – household and gardening 1990–2006.

Year	Activity [PJ]
1990	1.90
1995	1.95
2000	1.90
2005	1.89
2006	1.93

Table 186: Emission factors and activities for off-road – household and gardening 1990–2006.

Year	IEF NO_x	IEF SO_2	IEF NH_3	IEF NMVOC	IEF PM
			[t/PJ]		
1990	565.52	29.97	0.15	3 306.68	135.86
1995	596.53	11.08	0.14	3 205.41	128.72
2000	517.72	9.92	0.13	2 817.82	111.77
2005	422.99	2.34	0.11	1 512.32	81.61
2006	398.17	2.30	0.11	1 235.82	75.20

4.3.5.5 NFR 1 A 4 c Agriculture and forestry – mobile sources

Emissions from this category decreased over the period from 1990 to 2006, especially SO_2 emissions decreased by about 96% due to decreasing emission factors.

NH_3 and NMVOC emissions remained quite constant with only minor fluctuations over this period.

Table 187: Emissions from off-road – agriculture 1990–2006.

Year	NO_x	SO_2	NH_3	NMVOC	PM
	[Gg]				
1990	11.12	0.64	0.01	4.42	1.54
1995	10.55	0.19	0.00	4.14	1.41
2000	11.62	0.19	0.00	3.86	1.48
2005	10.11	0.03	0.00	3.12	1.19
2006	9.85	0.03	0.00	3.00	1.14
Trend 1990–2006	*-11%*	*-96%*	*-21%*	*-32%*	*-26%*

Activities used for estimating the emissions and the implied emission factors are presented in the following tables.

Table 188: Activities for off-road – agriculture 1990–2006.

Year	Activity [PJ]
1990	11.14
1995	10.42
2000	11.64
2005	11.83
2006	12.20

Table 189: Emission factors for off-road – agriculture 1990–2006.

Year	IEF NO_x	IEF SO_2	IEF NH_3	IEF NMVOC	IEF PM
	[t/PJ]				
1990	998.53	57.90	0.45	396.94	138.12
1995	1 012.64	18.15	0.43	397.00	135.51
2000	998.21	15.95	0.39	331.56	126.84
2005	854.19	2.33	0.34	263.82	100.67
2006	807.36	2.27	0.32	246.10	93.33

Table 190: Emissions from off-road – forestry 1990–2006.

Year	NO_x	SO_2	NH_3	NMVOC	PM
	[Gg]				
1990	7.24	0.42	0.00	4.34	1.06
1995	6.82	0.12	0.00	3.81	0.95
2000	6.93	0.11	0.00	3.28	0.91
2005	7.21	0.02	0.00	2.66	0.92
2006	7.05	0.02	0.00	2.45	0.89
Trend 1990–2006	*-3%*	*-96%*	*-16%*	*-44%*	*-16%*

Table 191: Activities for off-road – forestry 1990–2006.

Year	Activity [PJ]
1990	7.27
1995	6.69
2000	6.78
2005	7.93
2006	8.18

Table 192: Emission factors for off-road – forestry 1990–2006.

Year	IEF NO_x	IEF SO_2	IEF NH_3	IEF NMVOC	IEF PM
	[t/PJ]				
1990	996.61	58.20	0.46	597.81	145.68
1995	1 018.27	18.29	0.45	569.94	142.61
2000	1 021.40	16.05	0.40	483.01	134.38
2005	909.41	2.33	0.36	335.17	116.27
2006	861.17	2.27	0.34	299.57	108.49

4.3.6 NFR 1 A 5 Other Military

In this category military off-road transport and military aviation are considered.

4.3.6.1 Military off road transport

Estimates for military activities were taken from (PISCHINGER 2000). Information on the fleet composition was taken from official data presented in the internet as no other data was available. Also no information on the road performance of military vehicles was available, that's why emission estimates only present rough estimations, which were obtained making the following assumptions: for passenger cars and motorcycles the yearly road performance as calculated for civil cars was used. For tanks and other special military vehicles the emission factors for diesel engines > 80 kW was used (for these vehicles a power of 300 kW was assumed). The yearly road performance for such vehicles was estimated to be 30 h/year (as a lot of vehicles are old and many are assumed not to be in actual use anymore).

Table 193: Emissions from military off road transport 1990–2006 [Gg].

Year	NO_x	SO_2	NH_3	NMVOC	PM
			[Gg]		
1990	0.03120	0.00173	0.00001	0.00468	0.00360
1995	0.03170	0.00054	0.00001	0.00455	0.00346
2000	0.03054	0.00046	0.00001	0.00384	0.00267
2005	0.01973	0.00006	–	0.00296	0.00157
2006	0.01810	0.00006	–	0.00282	0.00140
Trend 1990–2006	*-42%*	*-97%*	*-100%*	*-40%*	*-61%*

Activities used and implied emission factors are presented in the following tables.

Table 194: Activities for military off road transport 1990–2006.

Year	Activity [PJ]
1990	0.03
1995	0.03
2000	0.03
2005	0.03
2006	0.03

Table 195: Emission factors for military off road transport 1990–2006.

Year	IEF NO_x	IEF SO_2	IEF NH_3	IEF NMVOC	IEF PM
			[t/PJ]		
1990	1 107.19	61.39	0.35	166.08	127.75
1995	1 106.45	18.85	0.35	158.81	120.77
2000	1 094.42	16.48	0.36	137.61	95.68
2005	741.91	2.26	–	111.30	59.04
2006	672.40	2.23	–	104.76	52.01

4.3.6.2 Military aviation

Emissions of military aviation were calculated following (KALIVODA et al. 2002). Fuel consumption for military flights was reported by the Ministry of Defence. Calculation of emissions from military aviation did not distinguish between LTO and cruise.

Table 196: Emissions and activities military aviation 1990–2006.

Year	NO_x	SO_2	NMVOC	NH_3	Activity
		[Mg]			[PJ]
1990	50.66	10.49	10.16	0.07	0.46
1995	46.93	9.72	9.41	0.07	0.42
2000	66.05	13.68	13.25	0.09	0.59
2005	182.04	37.70	36.51	0.26	1.62
2006	190.38	39.42	38.19	0.27	1.70

4.3.7 Emission factors for heavy metals, POPs and PM used in NFR 1 A 3

In the following the emission factors for heavy metals, POPs and PM which are used in NFR 1 A 3 are described.

Emission factors for heavy metals used in NFR 1 A 3

As can be seen in Table 67, the HM content of lighter oil products in Austria are below the detection limit. For Cd and Hg and for Pb from 1995 onwards 50% of the detection limit was used as emission factor for all years.

For Pb emission factors for gasoline before 1995 were calculated from the legal content limit for the different types of gasoline and the amounts sold of the different types in the respective year. Furthermore it was considered that according to the CORINAIR 1997 Guidebook the emission rate for conventional engines is 75%, and for engines with catalyst 40% (the type of fuel used in the different engine types was also considered).

The same emission factors were also used for mobile combustion in Categories NFR *1 A 2* and NFR *1 A 4*.

For coal fired steam locomotives the emission factor for uncontrolled coal combustion from the CORINAIR 1997 Guidebook were used.

The emission factors for 'automobile tyre and break wear' were taken from (VAN DER MOST & VELDT 1992), where it was considered that only 10% of the emitted particulate matter (PM) were relevant as air pollutants.

Table 197: HM emission factors for Sector 1 A 3 Transport and SNAP 08 Off-Road Machinery.

EF [mg/GJ]	Cd	Hg	Pb
Diesel, kerosine gasoline, aviation gasoline *(see also following Table)*	0.02	0.01	0.02
Coal (railways)	5.4	10.7	89
Automobile tyre and breakwear: passenger cars, motorcyles	0.5	–	–
Automobile tyre and breakwear: LDV and HDV	5.0	–	–

Table 198: Pb emission factors for gasoline for Sector 1 A 3 Transport and SNAP 08 Off-Road Machinery.

Pb EF [mg/GJ]	1985	1990	1995
gasoline (conventional)	2 200	2 060	0.1
gasoline (catalyst)	130	130	0.1
gasoline type jet fuel	23 990	15 915	0.1

Emission factors for POPs used in NFR 1 A 3

In the following the emission factors for POPs used in NFR 1 A 3 are described.[94]

Dioxin emission factors base on findings from (HAGENMAIER et al., 1995).

For estimating PAK emissions trimmed averages from emission factors in (UBA BERLIN 1998), (SCHEIDL 1996), (ORTHOFER & VESSELY, 1990) and (SCHULZE et al., 1988) as well as measurements of emissions of a tractor engine by FTU (FTU, 2000) were applied.

HCB emissions were calculated on the basis of dioxin emissions and assuming a factor of 200.

For coal fired steam locomotives the same emission factor as for 1 A 4 b – stoves were used.

Table 199: POP emission factors for Sector 1 A 3 Transport and SNAP 08 Off-Road Machinery.

	Dioxin EF [µgTE/GJ]	PAK4 [mg/GJ]
Passenger cars, gasoline	0.046	5.3
PC, gasoline, with catalyst	0.0012	0.32
Passenger cars, diesel	0.0007	6.4
LDV	0.0007	6.4
HDV	0.0055	6.4
Motorcycles < 50 ccm	0.0031	21
Motorcycles < 50 ccm with catalyst	0.0012	2.1
Motorcycles > 50 ccm	0.0031	33
Coal fired steam locomotives	0.38	0.085

Emission factors for PM used in NFR 1 A 3

As already described in Chapter 4.3 the emission inventories of PM for different years were prepared by contractors and incorporated into the inventory system afterwards.

[94] Emissions from off-road machinery are reported under 1 A 2 f (machinery in industry), 1 A 4 b (machinery in household and gardening) and 1 A 4 c (machinery in agriculture/forestry/fishing).

4.4 NFR 1 B Fugitive Emissions

Key source: NMVOC

Fugitive Emissions arising from the production, extraction of coal, oil and natural gas; their storage, processing and distribution. These emissions are fugitive emissions and are reported in NFR Category 1 B. Emissions from fuel combustion during these processes are reported in NFR Category 1 A.

4.4.1 Emission trend in NFR Category 1 B Fugitive Emissions

NMVOC emissions from this category are a minor source of NMVOC emissions in Austria: in 1990 the contribution to national total emissions was 4.3%, in the year 2005 it was 1.8%. Fugitive NMVOC emissions decreased: in 2006, they were 74% below 1990 levels.

Table 200: NMVOC emissions and trends from NFR Category 1 B Fugitive Emissions 1990–2006.

NMVOC	1	1 B 2	1 B 2 a	1 B 2 a 1	1 B 2 a 4	1 B 2 a 5	1 B 2 b	1 B 2 c
				[Gg]				
1990	153.12	12.22	12.10	1.09	6.59	4.42	0.11	IE
1991	160.54	13.16	13.04	1.09	7.11	4.84	0.12	IE
1992	152.39	13.12	12.99	1.09	7.27	4.63	0.13	IE
1993	149.88	12.86	12.71	1.08	7.19	4.45	0.14	IE
1994	138.58	10.26	10.10	1.04	4.72	4.35	0.15	IE
1995	133.70	8.83	8.66	1.00	3.70	3.96	0.16	IE
1996	131.19	7.90	7.73	0.98	3.67	3.07	0.17	IE
1997	112.62	7.37	7.19	0.98	3.65	2.55	0.18	IE
1998	106.59	5.85	5.66	0.96	3.75	0.95	0.19	IE
1999	100.46	5.13	4.93	0.95	3.00	0.98	0.20	IE
2000	92.52	5.16	4.95	0.95	2.99	1.01	0.21	IE
2001	89.55	3.31	3.10	0.95	1.13	1.01	0.22	IE
2002	85.37	3.47	3.24	0.94	1.16	1.14	0.23	IE
2003	83.37	3.44	3.20	0.94	1.14	1.12	0.24	IE
2004	77.73	3.27	3.02	0.93	1.06	1.04	0.25	IE
2005	75.19	3.09	2.84	0.91	0.94	0.99	0.26	IE
2006	70.12	3.12	2.86	0.91	0.95	1.00	0.26	IE
Trend								
1990–2006	*-54.2%*	*-74.4%*	*-76.4%*	*-16.6%*	*-85.6%*	*-77.3%*	*132.6%*	
2005–2006	*-6.8%*	*0.9%*	*0.9%*	*0.1%*	*0.7%*	*1.6%*	*1.7%*	
Share in NFR Category 1 Energy								
1990		*8.0%*	*7.9%*	*0.7%*	*4.3%*	*2.9%*	*0.1%*	
2006		*4.5%*	*4.1%*	*1.3%*	*1.3%*	*1.4%*	*0.4%*	
Share in National Total								
1990	*54.1%*	*4.3%*	*4.3%*	*0.4%*	*2.3%*	*1.6%*	*0.0%*	
2006	*40.9%*	*1.8%*	*1.7%*	*0.5%*	*0.6%*	*0.6%*	*0.2%*	

This category is a minor source regarding SO_2 emissions, which originate from the first treatment of sour gas. The contribution in the year 1990 was 2.7%, in 2006 these emissions contributed 0.6% to national total SO_2 emissions. SO_2 emissions from NFR Category 1 B decreased by 92% between 1990 and 2006.

Table 201: SO_2 and NO_x emissions and trends from NFR Category 1 B Fugitive Emissions 1990–2006.

Year	SO_2 [Gg]				NO_x [Gg]	
	1	1 B	1 B 2 b	1 B 2 c	1	1 B
1990	72.03	2.00	2.00	IE	181.43	IE
1991	69.46	1.30	1.30	IE	191.77	IE
1992	53.32	2.00	2.00	IE	181.32	IE
1993	51.92	2.10	2.10	IE	178.50	IE
1994	46.14	1.28	1.28	IE	172.61	IE
1995	45.43	1.53	1.53	IE	173.72	IE
1996	43.27	1.20	1.20	IE	196.48	IE
1997	38.84	0.07	0.07	IE	185.57	IE
1998	34.33	0.04	0.04	IE	200.67	IE
1999	32.62	0.14	0.14	IE	191.64	IE
2000	30.47	0.15	0.15	IE	198.16	IE
2001	31.43	0.16	0.16	IE	207.84	IE
2002	30.37	0.14	0.14	IE	217.39	IE
2003	31.17	0.15	0.15	IE	228.75	IE
2004	25.66	0.14	0.14	IE	226.71	IE
2005	25.37	0.13	0.13	IE	229.95	IE
2006	27.18	0.17	0.17	IE	218.27	IE
Trend						
1990–2006	*-62.3%*	*-91.7%*	*-91.7%*		*20.3%*	
2005–2006	*7.1%*	*25.6%*	*25.6%*		*-5.1%*	
Share in NFR Category 1 Energy						
1990		*2.8%*	*2.8%*			
2005		*0.6%*	*0.6%*			
Share in National Total						
1990	*96.9%*	*2.7%*	*2.7%*		*94.3%*	
2006	*95.5%*	*0.6%*	*0.6%*		*96.9%*	

Fugitive TSP, PM10 and PM2.5 emissions originate from storage of solid fuels (coke oven coke, bituminous coal and anthracite, lignite and brown coal). Emissions from this category contribute less than 1% to national totals and remained stable between 1990 and 2006.

Table 202: TSP, PM10 and PM2.5 emissions and trends from NFR Category 1 B Fugitive Emissions 1990–2006.

[Mg]	TSP		PM10		PM2.5	
	1	1 B	1	1 B	1	1 B
			Mg			
1990	31 811.93	647.03	23 962.50	304.71	19 941.51	94.96
1995	32 200.20	545.04	23 717.21	256.91	19 661.80	80.27
1999	32 714.34	499.64	23 798.23	235.54	19 617.63	73.61
2000	32 097.98	558.15	23 104.92	263.30	18 941.75	82.46
2001	32 928.52	585.17	23 771.24	275.91	19 510.76	86.30
2002	33 010.37	598.73	23 716.91	282.40	19 417.76	88.41
2003	33 725.61	642.04	24 200.40	302.80	19 770.00	94.79
2004	33 401.68	604.82	23 744.38	285.44	19 281.92	89.53
2005	33 535.63	611.97	23 747.95	288.82	19 236.67	90.58
2006	33 224.22	588.88	23 340.23	278.17	18 763.85	87.48
Trend						
1990–2006	*4.4%*	*-9.0%*	*-2.6%*	*-8.7%*	*-7.7%*	*-4.3%*
2005–2006	*-0.9%*	*-3.8%*	*-1.7%*	*-3.7%*	*-0.8%*	*0.8%*
Share in NFR Category 1 Energy						
1990		*2.0%*		*1.3%*		*0.4%*
2006		*1.8%*		*1.2%*		*0.5%*
Share in National Total						
1990	*46.4%*	*0.9%*	*55.8%*	*0.7%*	*73.9%*	*0.3%*
2006	*44.3%*	*0.8%*	*53.7%*	*0.6%*	*74.7%*	*0.3%*

4.4.2 Completeness

Table 203 gives an overview of the NFR categories included in this chapter and presents the transformation matrix from SNAP categories. It also provides information on the status of emission estimates of all sub categories. A "✓" indicates that emissions from this sub category have been estimated.

Table 203: Overview of sub categories of Category 1 B Fugitive Emissions and status of estimation.

NFR Category		Status													
		NEC gas				CO	PM			Heavy metals			POPs		
		NO_x	SO_x	NH_3	NMVOC	CO	TSP	PM10	PM2.5	Cd	Hg	Pb	Dioxin	PAH	HCB
1B1	Fugitive Emissions from Solid Fuels	NA	NA	NA	NA	NA	✓	✓	✓	NA	NA	NA	NA	NA	NA
1 B 1 a	Coal Mining and Handling	NA	NA	NA	NA	NA	✓	✓	✓	NA	NA	NA	NA	NA	NA
1 B 1 b	Solid fuel transfor-mation(1)	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
1 B 1 c	Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
1 B 2	Oil and natural gas	IE	✓	NA	✓	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1 B 2 a	Oil	NA	NA	NA	✓	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1 B 2 a	i Exploration	NA	NA	NA	✓	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	ii Production	NA	NA	NA	✓	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	iii Transport	NA	NA	NA	✓	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	iv Refining/Storage	NA	NA	NA	✓	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	v Distribution of oil products	NA	NA	NA	✓	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	vi Other	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
1 B 2 b	Natural gas	NA	✓	NA	✓	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1 B 2 c	Venting and flaring(2)	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE

(1) *included in 1 A 2 a Iron and Steel*

(2) *included in 1 A 1 b Petroleum Refining*

4.4.3 Methodological issues

1 B 1 Coal mining and handling

In this category TSP, PM10 and PM2.5 emissions from storage of solid fuels, including coke oven coke, bituminous coal and anthracite, lignite and brown coal, are considered.

Emissions are calculated with the simple CORINAIR methodology. Activity data are taken from the national energy balance and are presented in Table 204 together with the national emission factors (WINIWARTER et al. 2001).

Table 204: Emission factors and activity data for fugitive TSP, PM10 and PM2.5 emissions from NFR category 1B 1.

PM	Coke oven coke	Bituminous coal/Anthracite	Lignite/Brown coal
		EF [kg/Gg]	
TSP	96.04	84.67	108.30
PM10	45.36	39.49	51.30
PM2.5	14.28	11.96	16.25
Year		**Activity [Gg]**	
1990	1 822.00	2 502.54	2 402.15
1995	1 483.65	1 743.49	2 353.88
2000	1 847.84	1 381.00	2 435.40
2001	2 039.80	1 629.94	2 319.99
2002	1 942.23	1 556.66	2 589.07
2003	2 410.56	1 629.50	2 516.66
2004	2 426.01	1 193.58	2 500.08
2005	2 139.91	1 270.24	2 759.94
2006	2 337.55	753.51	2 775.40

1 B 2 a Oil

In this category, NMVOC emissions of transport and distribution of oil products as well as from oil refining are considered.

Emissions from refinery dispatch stations, depots and from refuelling of cars decreased remarkably (84%, 82% and 71% respectively) due to installation of gas recovery units.

Emissions were reported directly from „Fachverband Mineralöl" (Austrian association of oil industry). Activity data were taken from national statistics. From emission and activity data an implied emission factor was calculated.

Activity data and implied emission factors are presented in Table 205.

Table 205: Activity data and implied emission factors for fugitive NMVOC emissions from NFR Category 1B 2a.

Year	Refinery dispatch station	Transport and depots	Service stations	Petrol	Oil refining	
	IEF [g/Mg] NMVOC	IEF [g/Mg] NMVOC	IEF [g/Mg] NMVOC	Activity [Gg]	IEF [g/Mg] NMVOC	Crude oil refined [Gg]
1990	1 109	995	736	2 554	472	7 952
1995	916	986	662	2 402	174	8 619
2000	811	241	270	1 980	168	8 240
2001	296	238	269	1 998	62	8 799
2002	281	264	270	2 142	62	8 947
2003	269	233	270	2 223	62	8 819
2004	262	215	270	2 133	59	8 442
2005	204	206	270	2 074	59	8 709
2006	221	233	270	1 992	60	8 433

1 B 2 b Natural Gas

In this category SO_2 and NMVOC emissions from the first treatment of sour gas and NMVOC emissions from gas distribution networks are considered.

SO_2 emissions from the 1st treatment of sour gas are reported directly by the operator of the only sour gas treatment plant in Austria. NMVOC emissions were reported for the years 1992 onwards, for the years before the emission value of 1992 was used.

NMVOC emissions from gas distribution networks were calculated by applying an emission factor of 7 380 g/km distribution main. This emission factor is based on the mean IPCC default EF for CH_4 (615 kg/km) with an average of 1.2% NMVOC in natural gas.

Table 206: Activity data and implied emission factors for fugitive NMVOC and SO_2 emissions from NFR Category 1B 2b.

Year	Gas extraction/first treatment			Gas distribution	
	IEF [g/1000m³] NMVOC	IEF [g/1000 m³] SO_2	Natural gas extracted [1000 m³]	EF [g/km]	Distribution mains [km]
1990	849	1553	1 288 000	7 380	15 200
1991	824	980	1 326 000		16 396
1992	761	1392	1 437 000		17 779
1993	723	1411	1 488 000		19 051
1994	764	945	1 355 000		20 743
1995	676	1032	1 482 000		22 358
1996	659	804	1 492 000		23 391
1997	689	47	1 428 000		24 661
1998	614	27	1 568 000		25 792
1999	547	82	1 741 000		27 300
2000	525	80	1 805 000		28 800
2001	485	81	1 954 000		29 700
2002	468	69	2 014 000		31 500
2003	465	74	2 030 000		32 000
2004	472	73	1 963 000		33 800
2005	557	81	1 637 000		34 750
2006	501	92	1 819 000		35 350

4.4.4 Recalculations

Activity data for 2005 were updated due to updated energy statistics and updated information on the gas distribution network.

5 INDUSTRIAL PROCESSES (NFR SECTOR 2)

5.1 Sector overview

This chapter includes information on the estimation of the emissions of NEC gases, CO, particle matter (PM), heavy metals (HM) and persistent organic pollutant (POP) as well as references for activity data and emission factors reported under NFR Category *2 Industrial Processes* for the period from 1990 to 2006 in the NFR.

Emissions from this category comprise emissions from the following sub categories: *Mineral Products*, *Chemical Industry*, *Metal Production* and *Other Production* (*Chipboard* and *Food and Drink)*.

Only process related emissions are considered in this Sector, emissions due to fuel combustion in manufacturing industries are allocated in NFR Category *1 A 2 Fuel Combustion – Manufacturing Industries and Construction* (see Chapter 4.2.4).

Some categories in this sector are not occurring (NO) in Austria as there is no such production. For some categories emissions have not been estimated (NE) or are included elsewhere (IE). In Chapter 1.7 and Chapter 5.3.4 a general and sector specific, respectively description regarding completeness is given. A summary of these categories is given in Table 224.

The Sector *Industrial Processes* is responsible for PAH emissions: they amount to about 3% of national total emissions; the other POPs Dioxin and HCB make up about 11% and 9% of national total emissions in 2006 (see Table 207 and Table 222).

Furthermore the sector *Industrial Processes* is an important source regarding heavy metal emissions in Austria, they make up about 47% of national total Pb emissions, about 30% of national total Hg emissions, and 20% of national total Cd emissions (see Table 207 and Table 222).

This sector is also an important source regarding particulate matter, where it contributes to about 39%, 33% and 10, respectively to national total TSP, PM10 and PM2.5 emissions.

The Sector *Industrial Processes* contributes 4% to national total SO_2 emissions, 1% to national total NO_x emissions, and 3% to national total NMVOC emissions. Also this sector contributes 3% to national total CO emissions and less than 1% to national total NH_3 emissions.

The following Table presents the source categories from the industrial sector which are key sources of the Austrian inventory with regard to the contribution to national total emissions (for details of the key source analysis see Chapter 1.4).

Table 207: Key Source in NFR sector 2 Industrial Processes.

Pollutant	Source category				
	2 A	2 B	2 C	2 D	2 G
	Mineral Products	Chemical Industry	Metal Production	Other Production	Other
SO_2		**2.69%**	1.60%		
NO_x		0.20%	0.05%	0.48%	
NMVOC		0.77%	0.27%	**1.71%**	
NH_3		0.11%			0.00%
CO	**1.25%**	**1.42%**	0.34%	0.10%	
Cd		0.06%	**19.70%**		
Hg		0.01%	**30.31%**		
Pb		0.01%	**46.81%**		
PAH			**2.09%**	0.42%	
Diox			**10.60%**	0.30%	
HCB			**8.67%**	0.06%	
TSP	**35.05%**	0.64%	**1.89%**	**1.36%**	
PM10	**28.81%**	0.64%	**2.30%**	0.94%	
PM2.5	**6.59%**	0.65%	**1.93%**	0.72%	

Note: grey shaded are key sources

5.2 Emission trend in NFR Category 2 Industrial Processes

In the following the air pollutants are described with respect to annual emissions and their trends for the period 1990 to 2006. In cases where the sub sectors are key source, a more detailed description is given.

5.2.1 NEC gases and CO

SO_2 Emissions (key source)

SO_2 emissions from NFR Category *2 Industrial Processes* decreased over the period from 1990 to 2006. As can be seen in Table 208, in 1990 emissions amounted to 2.2 Gg, in 2006 they were 45% lower (1.2 Gg).

The share of SO_2 emissions from this sector in national total emissions was about 3% in 1990 and about 4% in 2006 because there was a strong reduction of SO_2 emissions from combustion processes whereas emissions from industrial processes remained quite stable.

SO_2 emissions arise from the sub-sectors 2 B *Chemical Industry* and 2 C *Metal Production* with a share of 2.7% (NFR 2 B) and 1.4% (NFR 2C) in National Total; the follwing category is key source:

- SO_2 emissions from sub sector 2 B *Chemical Industry* derived from NFR 2 B 5 *Other* which covers processes in inorganic chemical industries. The SO_2 emissions decreased by 51% in the period 1990–2006 where the emission reduction happened mainly from 1990 to 1993. In the years 1999 and 2000 the SO_2 emission were 62% under 1990 level by since then the emissions increased slightly. Reasons for the emission reduction are on the one hand a decline in production of about 6% and on the other hand abatement techniques such as systems for purification of waste gases and desulphurisation facilities.

Table 208: SO_2 emissions and trends from Sector 2 Industrial Processes and source categories 1990–2006.

SO_2 [Gg]	2	2 B	2 B 5	2 C	2 C 1	2 C 5
1990	2.22	1.56	1.56	0.66	0.25	0.41
1991	1.90	1.29	1.29	0.61	0.20	0.41
1992	1.67	1.02	1.02	0.65	0.24	0.41
1993	1.42	0.75	0.75	0.67	0.27	0.41
1994	1.42	0.73	0.73	0.69	0.28	0.41
1995	1.37	0.71	0.71	0.66	0.26	0.40
1996	1.29	0.70	0.70	0.60	0.19	0.40
1997	1.27	0.68	0.68	0.59	0.19	0.40
1998	1.18	0.61	0.61	0.57	0.17	0.40
1999	1.12	0.59	0.59	0.52	0.12	0.40
2000	1.09	0.59	0.59	0.49	0.09	0.40
2001	1.21	0.77	0.77	0.45	0.05	0.40
2002	1.21	0.77	0.77	0.45	0.05	0.40
2003	1.21	0.77	0.77	0.45	0.05	0.40
2004	1.22	0.77	0.77	0.45	0.05	0.40
2005	1.22	0.77	0.77	0.45	0.05	0.40
2006	1.22	0.77	0.77	0.45	0.05	0.40
Trend						
1990–2006	*-45.1%*	*-51.1%*	*-51.1%*	*-30.9%*	*-79.1%*	*-1.0%*
2005–2006	*0.2%*	*< 0.1%*	*< 0.1%*	*0.4%*	*4.1%*	*0.0%*
Share in Sector 2 Industrial Processes						
1990		*70.4%*	*70.4%*	*29.6%*	*11.3%*	*18.2%*
2006		*62.8%*	*62.8%*	*37.2%*	*4.3%*	*32.9%*
Share in National Total						
1990	*3.0%*	*2.1%*	*2.1%*	*0.9%*	*0.3%*	*0.5%*
2006	*4.3%*	*2.7%*	*2.7%*	*1.7%*	*0.2%*	*1.4%*

NO_x Emissions

The share of NO_x emissions from this sector in national total emissions has was about 2.5% in 1990 and about 0.7% in 2006 (see Table 209) because of the strong reduction of NO_x emissions in this sector but also because the emissions from combustion processes remained quite stable on a high level. There are no key sources within this sector.

As it is shown in Table 209, NO_x emissions from the *industrial processes sector* decreased over the period from 1990 to 2006. In 1990 they amounted to 4.8 Gg, in the year 2006 they were 73% below 1990 levels (1.63 Gg). The main source for NO_x emissions of NFR Category *2 Industrial Processes* with a contribution of 85% in 1990 is *2 B Chemical Products*. However, emissions from this sector were reduced due to use of low-emission fuels and energy-savings; in 2006 category *2 D Other Production* (Chipboard Production) was the main NO_x source from this sector as emissions increased due to increasing production. Category *2 C Metal Production* is only a minor source within this sector.

Table 209: NO_x emissions and trends from Sector 2 Industrial Processes and source categories 1990–2006.

NO_x [Gg]	2	2 B	2 B 1	2 B 2	2 B 5	2 C	2 C 1	2 C 5	2 D	2 D 1
1990	4.80	4.07	IE	IE	4.07	0.17	0.16	0.02	0.55	0.55
1991	4.48	3.76	IE	IE	3.76	0.14	0.13	0.02	0.58	0.58
1992	4.55	3.82	IE	IE	3.82	0.17	0.15	0.02	0.57	0.57
1993	1.98	1.25	0.47	0.69	1.25	0.18	0.16	0.02	0.55	0.55
1994	1.92	1.16	0.45	0.63	1.16	0.19	0.17	0.02	0.57	0.57
1995	1.46	0.69	0.29	0.35	0.69	0.18	0.16	0.01	0.59	0.59
1996	1.42	0.69	0.28	0.36	0.69	0.15	0.13	0.02	0.59	0.59
1997	1.50	0.68	0.29	0.34	0.68	0.15	0.13	0.02	0.67	0.67
1998	1.46	0.66	0.25	0.36	0.66	0.14	0.13	0.02	0.66	0.66
1999	1.44	0.67	0.23	0.37	0.67	0.12	0.10	0.02	0.66	0.66
2000	1.54	0.68	0.21	0.41	0.68	0.12	0.10	0.02	0.74	0.74
2001	1.57	0.66	0.20	0.38	0.66	0.09	0.07	0.02	0.82	0.82
2002	1.63	0.66	0.22	0.37	0.66	0.09	0.07	0.02	0.88	0.88
2003	1.34	0.69	0.23	0.38	0.69	0.09	0.07	0.02	0.56	0.56
2004	1.28	0.56	0.23	0.28	0.56	0.10	0.08	0.02	0.61	0.61
2005	1.75	0.57	0.24	0.24	0.57	0.10	0.08	0.02	1.07	1.07
2006	1.63	0.45	0.22	0.17	0.45	0.11	0.08	0.02	1.07	1.07
Trend										
1990–2006	*-73.1%*	*-88.9%*			*-98.3%*	*-38.5%*	*-45.4%*	*28.4%*	*94.5%*	*94.5%*
2005–2006	*1.0%*	*-21.2%*	*-11.8%*	*-30.6%*	*-21.3%*	*3.5%*	*3.6%*	*2.8%*	*0.0%*	*0.0%*
Share in Sector 2 Industrial Processes										
1990		*84.9%*			*84.9%*	*3.6%*	*3.2%*	*0.3%*	*11.5%*	*11.5%*
2006		*27.7%*	*13.2%*	*10.2%*	*4.3%*	*6.5%*	*5.2%*	*1.3%*	*65.8%*	*65.8%*
Share in National Total										
1990	*2.5%*	*2.1%*			*2.1%*	*0.1%*	*0.1%*	*0.0%*	*0.3%*	*0.3%*
2006	*0.7%*	*0.2%*	*0.1%*	*0.1%*	*< 0.1%*	*< 0.1%*	*< 0.1%*	*0.0%*	*0.5%*	*0.5%*

NMVOC Emissions (key source)

Sector *2 Industrial processes* is the third largest sector regarding NMVOC emissions, in 1990 the contribution to national total emissions was 4% (11.1 Gg) compared to 3% (4.7 Gg) in 2006 due to abetement techniques but also because of decreasing emissions from the other sectors as NFR *3 Solvents* and NFR *1 Energy*.

The trend regarding NMVOC emissions from *2 Industrial Processes* shows decreasing emissions: in the period from 1990 to 2006 emissions decreased by 57%, mainly due to decreasing emissions from *2B Chemical Industry*, which was with a share of 75% in sector NFR 2 the main contributor to NMVOC emissions from industrial processes (see Table 210) in 1990.

The decrease took place primarily from 1993 to 2000 since then the emissions remained quite stable. Other contributors to NMVOC emissions from industrial processes are the sector NFR 2 C *Metal production* and 2 D *Other production*.

With a share of 2% (NFR 2D) of the national NMVOC emissions (2006) this category is key sources:

- NMVOC emissions from sub-sector 2 D *Other Production* derived from NFR 2 D 1 *Pulp and Paper* (17% of NFR 2) and 2 D 2 *Food and Drink* (46% of NFR 2). In both sub-sectors NMVOC emissions increased; in NFR 2 D 1 *Pulp and Paper* by 95%, in 2 D 2 *Food and Drink* by 14% to 2.2 Gg (1990–2006). The reason for this increase is the rise in output in the chipboard industry and food and drink industry.

As can be seen in Table 210 NMVOC emissions of NFR 2 A and NFR 2 B 1 are includes elsewhere (IE):

- NMVOC emissions from NFR 2 A which covers activities form road paving with asphalt are reported in NFR 3.
- NMVOC emissions from NFR 2 B 1 which covers activities form Ammonia Production are reported in NFR 2 B 5.

Table 210: NMVOC emissions and trends from Sector 2 Industrial Processes and source categories 1990–2006.

NMVOC [Gg]	2	2 A	2 B	2 B 1	2 B 5	2 C	2 C 1	2 C 5	2 D	2 D 1	2 D 2
1990	11.10	IE	8.29	IE	8.29	0.52	0.31	0.21	2.29	0.40	1.89
1991	12.58	IE	9.64	IE	9.64	0.51	0.30	0.21	2.43	0.43	2.01
1992	13.78	IE	10.99	IE	10.99	0.50	0.28	0.22	2.30	0.42	1.89
1993	15.05	IE	12.34	IE	12.34	0.46	0.25	0.20	2.26	0.40	1.86
1994	13.57	IE	10.77	IE	10.77	0.50	0.26	0.24	2.31	0.42	1.89
1995	11.95	IE	9.21	IE	9.21	0.38	0.25	0.13	2.36	0.43	1.93
1996	10.37	IE	7.64	IE	7.64	0.37	0.24	0.14	2.35	0.43	1.92
1997	9.06	IE	6.08	IE	6.08	0.39	0.25	0.15	2.59	0.49	2.10
1998	7.71	IE	4.52	IE	4.52	0.43	0.27	0.16	2.76	0.48	2.28
1999	6.04	IE	2.97	IE	2.97	0.43	0.26	0.16	2.65	0.48	2.17
2000	4.96	IE	1.67	IE	1.67	0.47	0.28	0.19	2.83	0.54	2.28
2001	4.38	IE	1.31	IE	1.31	0.42	0.26	0.15	2.65	0.60	2.05
2002	4.57	IE	1.39	IE	1.39	0.41	0.25	0.16	2.78	0.64	2.13
2003	4.26	IE	1.28	IE	1.28	0.41	0.25	0.17	2.57	0.41	2.16
2004	4.40	IE	1.32	IE	1.32	0.45	0.27	0.18	2.62	0.45	2.17
2005	4.71	IE	1.32	IE	1.32	0.45	0.27	0.17	2.94	0.79	2.15
2006	4.73	IE	1.32	IE	1.32	0.47	0.29	0.18	2.94	0.79	2.15
Trend											
1990–2006	*-57.4%*	*-*	*-84.0%*	*-*	*-84.0%*	*-10.5%*	*-7.2%*	*-15.4%*	*28.2%*	*94.5%*	*14.0%*
2005–2006	*0.4%*	*-*	*0.0%*	*-*	*0.0%*	*3.9%*	*5.1%*	*1.9%*	*0.0%*	*0.0%*	*0.0%*
Share in Sector 2 Industrial Processes											
1990		*-*	*74.7%*	*-*	*74.7%*	*4.7%*	*2.8%*	*1.9%*	*20.7%*	*3.6%*	*17.0%*
2006		*-*	*28.0%*	*-*	*28.0%*	*9.8%*	*6.1%*	*3.7%*	*62.1%*	*16.7%*	*45.5%*
Share in National Total											
1990	*3.9%*	*-*	*2.9%*	*-*	*2.9%*	*0.2%*	*0.1%*	*0.1%*			
2006	*2.8%*	*-*	*0.8%*	*-*	*0.8%*	*0.3%*	*0.2%*	*0.1%*	*1.7%*	*0.5%*	*1.3%*

CO Emissions

The share of CO emissions from this sector in national total emissions was about 4% in 1990 and about 3% in 2006 (see Table 211) because of the strong reduction measures for CO emissions in this sector but also because the emissions from combustion processes remained on a high level. The categories NFR 2 A and NFR 2 B with shares of the national total of 1.2% and 1.4% are key sources within this sector.

As it can be seen in Table 211, CO emissions from the *industrial processes sector* decreased over the period from 1990 to 2006. In 1990 they amounted to 46 Gg, in the year 2006 they were 47% below 1990 levels (24 Gg). Whereas 1990 NFR *2 C Metal Production* was with a contribution of 50% main source within NFR 2 *industrial processes,* emissions from this sector were reduced due to abatement techniques; in 2006 NFR *2 C Metal Production* had a share of 10% in NFR 2. In 2006, the main sources for CO emissions of NFR Category *2 Industrial Processes* with a contribution of 45% and 40%, respectively were NFR 2 B *Chemical Products* and NFR 2 A *Mineral Products*. NFR 2 D *Other Production* is a minor source within this sector. Extensive technical abatement techniques as well as energy-saving technology are reasons for the emission reduction.

Table 211: CO emissions and trends from Sector 2 Industrial Processes and source categories 1990–2006.

CO [Gg]	2	2 A	2 A 5	2 B	2 B 1	2 B 5	2 C	2 C 1	2 C 5	2 D	2 D 1
1990	46.37	9.78	9.78	12.67	0.12	12.54	23.52	23.19	0.33	0.40	0.40
1991	41.67	9.80	9.80	12.18	0.13	12.05	19.26	18.93	0.33	0.42	0.42
1992	44.97	10.26	10.26	11.68	0.12	11.56	22.63	22.29	0.34	0.41	0.41
1993	47.15	10.76	10.76	11.20	0.13	11.07	24.80	24.47	0.33	0.40	0.40
1994	48.65	11.11	11.11	11.19	0.12	11.07	25.93	25.57	0.35	0.42	0.42
1995	45.08	10.93	10.93	11.17	0.10	11.07	22.55	22.28	0.28	0.43	0.43
1996	39.44	10.93	10.93	11.14	0.06	11.07	16.95	16.67	0.28	0.43	0.43
1997	38.30	10.49	10.49	11.20	0.13	11.07	16.13	15.84	0.29	0.48	0.48
1998	34.86	9.47	9.47	11.16	0.08	11.07	13.75	13.46	0.30	0.48	0.48
1999	30.58	9.32	9.32	11.11	0.04	11.07	9.68	9.38	0.30	0.48	0.48
2000	27.38	9.11	9.11	11.11	0.04	11.07	6.62	6.31	0.31	0.54	0.54
2001	24.20	10.03	10.03	11.11	0.04	11.07	2.47	2.17	0.30	0.60	0.60
2002	23.87	9.78	9.78	11.10	0.03	11.07	2.35	2.05	0.30	0.64	0.64
2003	23.59	9.78	9.78	11.09	0.03	11.07	2.30	2.00	0.31	0.41	0.41
2004	23.86	9.78	9.78	11.11	0.04	11.07	2.52	2.20	0.32	0.45	0.45
2005	24.23	9.78	9.78	11.12	0.05	11.07	2.54	2.22	0.32	0.78	0.78
2006	24.37	9.78	9.78	11.14	0.08	11.07	2.67	2.35	0.32	0.78	0.78
Trend											
1990–2006	*-47.4%*	*0.0%*	*0.0%*	*-12.0%*	*-38.9%*	*-11.8%*	*-88.7%*	*-89.9%*	*-4.5%*	*94.5%*	*94.5%*
2005–2006	*0.6%*	*0.0%*	*0.0%*	*0.2%*	*43.0%*	*0.0%*	*4.8%*	*5.5%*	*-0.6%*	*0.0%*	*0.0%*
Share in Sector 2 Industrial Processes											
1990		*21.1%*	*21.1%*	*27.3%*	*0.3%*	*27.1%*	*50.7%*	*50.0%*	*0.7%*	*0.9%*	*0.9%*
2006		*40.1%*	*40.1%*	*45.7%*	*0.3%*	*45.4%*	*10.9%*	*9.6%*	*1.3%*	*3.2%*	*3.2%*
Share in National Total											
1990	*3.8%*	*0.8%*	*0.8%*	*1.0%*	*0.0%*	*1.0%*	*1.9%*	*1.9%*	*0.0%*	*0.0%*	*0.0%*
2006	*3.1%*	*1.2%*	*1.2%*	*1.4%*	*0.0%*	*1.4%*	*0.3%*	*0.3%*	*0.0%*	*0.1%*	*0.1%*

NH_3 Emissions

NH_3 emissions from NFR 2 *Industrial Processes* nearly exclusively arise from NFR Category *2 B Chemical Products*, which is only a minor source of NH_3 emissions with a contribution to national total emissions of 0.4% in 1990 and 0.1% in 2006 respectively.

The trend concerning NH_3 emissions from NFR 2 *Industrial Processes* is generally decreasing: in the period from 1990 to 2006 emissions decreased by 72% from 0.27 Gg in 1990 to 0.07 Gg (see Table 212). Extensive abatement techniques are reasons for the emission reduction. As can be seen in Table 212 NH_3 emissions of NFR 2 C are includes in category 1 A 2 a.There are no key sources within this sector.

Table 212: NH_3 emissions and trends from Sector 2 Industrial Processes and source categories 1990–2006.

NH_3 [Gg]	2	2 B	2 B 1	2 B 2	2 B 5	2 C	2 G
1990	0.269	0.267	0.007	0.001	0.258	IE	0.002
1991	0.507	0.505	0.008	0.001	0.496	IE	0.002
1992	0.369	0.367	0.007	0.001	0.359	IE	0.002
1993	0.219	0.217	0.008	0.001	0.208	IE	0.002
1994	0.168	0.166	0.007	0.001	0.158	IE	0.002
1995	0.099	0.097	0.011	0.000	0.086	IE	0.002
1996	0.097	0.095	0.012	0.000	0.082	IE	0.002
1997	0.103	0.101	0.011	0.002	0.088	IE	0.002
1998	0.103	0.101	0.004	0.000	0.097	IE	0.002
1999	0.119	0.117	0.009	0.000	0.108	IE	0.002
2000	0.100	0.098	0.007	0.000	0.091	IE	0.002
2001	0.079	0.077	0.006	0.001	0.071	IE	0.002
2002	0.061	0.059	0.011	0.001	0.047	IE	0.002
2003	0.076	0.074	0.011	0.000	0.062	IE	0.002
2004	0.059	0.057	0.010	0.000	0.047	IE	0.002
2005	0.068	0.066	0.010	0.000	0.056	IE	0.002
2006	0.074	0.072	0.013	0.001	0.058	IE	0.002
Trend							
1990–2006	*-72.4%*	*-73.0%*	*80.3%*	*-41.9%*	*-77.5%*		*0.0%*
2005–2006	*9.4%*	*9.6%*	*34.3%*	*1500.0%*	*3.9%*		*0.0%*
Share in Sector 2 Industrial Processes							
1990		*99.3%*	*2.7%*	*0.5%*	*96.0%*		*0.7%*
2006		*97.3%*	*17.9%*	*1.1%*	*78.3%*		*2.7%*
Share in National Total							
1990	*0.4%*	*0.4%*	*0.0%*	*0.0%*	*0.4%*		*0.0%*
2006	*0.1%*	*0.1%*	*0.0%*	*0.0%*	*0.1%*		*0.0%*

5.2.2 Particle Matter (PM) Emissions (key source)

All three particulate matter sizes of PM are key sources in NFR Category 2 *Industrial Processes*. As shown in Table 213 and Table 215 the period from 1990 to 2006 the

- **TSP** emissions increased by 23% to 29 Gg, which is a share of 39% in total TSP emissions;
- **PM10** emissions increased by 10% to 14 Gg, which is a share of 33% in total PM10 emissions;
- **PM2.5** emissions decrease by 36% to 22 Gg, which is a share of 10% in total PM2.5 emissions.

The main source for PM emissions of NFR Category 2 *Industrial Processes* was the sub sector NFR 2 A *Mineral products* with a contribution of

- 65% in 1990 and 90% in 2006 for **TSP** emissions; emissions increased by 70%;
- 58% in 1990 and 88% in 2006 for **PM10** emissions; the emission trend amount to 69%;
- 28% in 1990 and 67% in 2006 **PM2.5** emissions; emissions increased by 51%.

The sub sector NFR 2 A *Mineral products* covers handling of bulk goods as well as activities of NFR 2 A 7 y *Construction and demolition*. Emissions from this sub sector increased by more than 44% due to increasing activities, whereas in the same time the installation of de-dusting devices, and dust-avoidance devices were promoted. Further measures were roofing and exhaust gas cleaning systems. Other important activities of NFR 2 A *Mineral products* are activities reported under NFR 2 A 1 *Cement Production*, NFR 2 A 2 *Lime Production* and NFR 2 A 3 *Limestone and Dolomite Use.*

Another large source for PM emissions of NFR Category *2 Industrial Processes* was the sub sector NFR *2 C Metal Production* with a contribution of

- 27% in 1990 and 5% in 2006 for **TSP** emissions; emissions decreased by 78%;
- 35% in 1990 and 7% in 2006 for **PM10** emissions; the emission trend amounts to -78%;
- 60% in 1990 and 20% in 2006 **PM2.5** emissions; the emissions decreased by 79%.

The sub-sector NFR *2 C Metal Production* covers activities reported under NFR 2 C 1 *Iron and steel*. Emissions from this sub sector decreased in the period 1990 to 2006 due to the installation of de-dusting- and dust-avoidance devices as well as roofing and exhaust gas cleaning systems. The higher share of PM2.5 is a result of the installed filters of the above mentioned devices, which retain only bigger particles. In spite of the dust emission reducing activities in the same period in this sub sector the activities grew.

Small sources for PM emissions of NFR Category 2 *Industrial Processes* were the sub sectors NFR *2 B Chemical Industry* with a contribution of

- 4% in 1990 and 2% in 2006 for **TSP** emissions; the emission trend amounts to -50%;
- 4% in 1990 and 2% in 2006 for **PM10** emissions; the emission trend amounts to -51%;
- 9% in 1990 and 7% in 2006 **PM2.5** emissions; the emission trend amounts to -51%.

NFR 2 D *Other Production* with a contribution of less than 0.1%.

Also in these sub sectors several de-dusting- and dust-avoidance devices as well as exhaust gas cleaning systems were installed.

Table 213: TSP emissions and trends from Sector 2 Industrial Processes and source categories 1990–2006.

TSP [Mg]	2	2 A	2 A 1	2 A 2	2 A 7	2 A 7 x	2 A 7 y	2 A 7 z	2 B
1990	23 769.21	15 455.29	173.75	62.90	15 218.64	10 178.05	1 758.62	34.66	957.60
1995	26 513.77	20 751.00	160.97	64.16	20 525.86	14 653.76	1 917.94	40.42	448.40
1999	24 874.13	20 147.79	113.39	73.13	19 961.27	17 923.56	1 989.64	48.07	432.10
2000	29 341.13	23 730.08	133.41	80.30	23 516.36	16 652.92	2 044.07	48.44	446.89
2001	28 405.74	22 760.49	94.33	81.80	22 584.37	16 172.06	1 967.83	46.78	419.35
2002	28 008.82	23 887.15	88.87	88.25	23 710.04	16 631.73	1 942.54	49.57	442.86
2003	27 436.15	23 329.79	67.47	92.78	23 169.54	16 206.99	2 092.54	49.79	469.24
2004	28 211.12	24 253.89	70.94	96.78	24 086.16	16 388.60	2 136.12	48.88	476.18
2005	27 069.19	23 323.87	82.73	93.31	23 147.83	15 559.70	2 191.03	51.64	456.08
2006	29 202.10	26 286.03	98.63	95.81	26 091.58	18 875.97	2 537.00	53.35	477.20
Trend									
1990–2006	*22.9%*	*70.1%*	*-43.2%*	*52.3%*	*71.4%*	*85.5%*	*44.3%*	*53.9%*	*-50.2%*
2005–2006	*7.9%*	*12.7%*	*19.2%*	*2.7%*	*12.7%*	*21.3%*	*15.8%*	*3.3%*	*4.6%*
Share in Sector 2 Industrial Processes									
1990		*65.0%*	*0.7%*	*0.3%*	*64.0%*	*42.8%*	*7.4%*	*0.1%*	*4.0%*
2006		*90.0%*	*0.3%*	*0.3%*	*89.3%*	*64.6%*	*8.7%*	*0.2%*	*1.6%*
Share in National Total									
1990	*34.7%*	*22.5%*	*0.3%*	*0.1%*	*22.2%*	*14.8%*	*2.6%*	*0.1%*	*1.4%*
2006	*38.9%*	*35.0%*	*0.1%*	*0.1%*	*34.8%*	*25.2%*	*3.4%*	*0.1%*	*0.6%*

(1) *Quarrying and mining of minerals other than coal*

(2) *Construction and demolition*

(3) *Agricultural bulk materials and wood processing*

TSP [Mg]	2	2 B	2 C	2 D	2 D 1	2 D 2	2 D 4
1990	23769.21	957.60	6434.81	921.52	292.20	2.20	627.12
1995	26513.77	448.40	4389.51	924.86	293.76	2.10	629.00
1999	24874.13	432.10	4219.42	74.82	72.92	1.90	IE
2000	29341.13	446.89	4190.49	973.67	334.58	1.90	637.19
2001	28405.74	419.35	4248.62	977.28	334.00	1.90	641.38
2002	28008.82	442.86	2694.48	984.32	338.08	1.90	644.34
2003	27436.15	469.24	2662.38	974.74	345.33	1.90	627.51
2004	28211.12	476.18	2504.78	976.28	343.98	1.90	630.40
2005	27069.19	456.08	2286.40	1002.84	346.29	1.90	654.65
2006	29202.10	477.20	1418.46	1020.42	354.05	1.90	664.46
Trend							
1990–2006	*22.9%*	*-50.2%*	*-78.0%*	*10.7%*	*21.2%*	*-13.6%*	*6.0%*
2005–2006	*7.9%*	*4.6%*	*-38.0%*	*1.8%*	*2.2%*	*0.0%*	*1.5%*
Share in Sector 2 Industrial Processes							
1990		*4.0%*	*27.1%*	*3.9%*	*1.2%*	*0.0%*	*2.6%*
2006		*1.6%*	*4.9%*	*3.5%*	*1.2%*	*0.0%*	*2.3%*
Share in National Total							
1990	*34.7%*	*1.4%*	*9.4%*	*1.3%*	*0.4%*	*0.0%*	*0.9%*
2006	*38.9%*	*0.6%*	*1.9%*	*1.4%*	*0.5%*	*0.0%*	*0.9%*

Table 214: PM10 emissions and trends from Sector 2 Industrial Processes and source categories 1990–2006.

PM10 [Mg]	2	2 A	2 A 1	2 A 2	2 A 7	2 A 7 x	2 A 7 y	2 A 7 z	2 B
1990	12919.97	7425.12	156.37	56.61	7212.14	4790.19	879.31	16.40	565.22
1995	13692.84	9913.43	144.88	57.75	9710.80	6893.24	958.97	19.13	267.46
1999	12855.15	9614.46	102.05	65.81	9446.60	8429.02	994.82	22.75	253.38
2000	14900.75	11311.77	120.07	72.27	11119.43	7832.12	1022.03	22.93	261.97
2001	14452.62	10837.57	84.89	73.62	10679.06	7606.08	983.91	22.14	245.87
2002	13910.71	11367.05	79.98	79.43	11207.64	7822.40	971.27	23.46	259.61
2003	13635.93	11102.85	60.72	83.50	10958.63	7623.29	1046.27	23.57	275.11
2004	13968.78	11541.03	63.85	87.11	11390.08	7707.98	1068.06	23.14	279.14
2005	13383.43	11109.61	74.46	83.98	10951.17	7318.85	1095.51	24.44	267.38
2006	14206.04	12520.24	88.77	86.23	12345.24	8877.61	1268.50	25.25	279.77
Trend									
1990–2006	*10.0%*	*68.6%*	*-43.2%*	*52.3%*	*71.2%*	*85.3%*	*44.3%*	*54.0%*	*-50.5%*
2004–2006	*6.1%*	*12.7%*	*19.2%*	*2.7%*	*12.7%*	*21.3%*	*15.8%*	*3.3%*	*4.6%*
Share in Sector 2 Industrial Processes									
1990		*57.5%*	*1.2%*	*0.4%*	*55.8%*	*37.1%*	*6.8%*	*0.1%*	*4.4%*
2006		*88.1%*	*0.6%*	*0.6%*	*86.9%*	*62.5%*	*8.9%*	*0.2%*	*2.0%*
Share in National Total									
1990	*30.1%*	*17.3%*	*0.4%*	*0.1%*	*16.8%*	*11.1%*	*2.0%*	*0.0%*	*1.3%*
2006	*32.7%*	*28.8%*	*0.2%*	*0.2%*	*28.4%*	*20.4%*	*2.9%*	*0.1%*	*0.6%*

(1) *Quarrying and mining of minerals other than coal*

(2) *Construction and demolition*

(3) *Agricultural bulk materials and wood processing*

PM10 [Mg]	2	2 B	2 C	2 D	2 D 1	2 D 2	2 D 4
1990	12919.97	565.22	4 560.81	368.83	116.88	1.10	250.85
1995	13692.84	267.46	3 141.84	370.11	117.50	1.00	251.60
1999	12855.15	253.38	2 957.24	30.07	29.17	0.90	IE
2000	14900.75	261.97	2 937.40	389.61	133.83	0.90	254.88
2001	14452.62	245.87	2 978.13	391.05	133.60	0.90	256.55
2002	13910.71	259.61	1 890.17	393.87	135.23	0.90	257.74
2003	13635.93	275.11	1 867.93	390.04	138.13	0.90	251.00
2004	13968.78	279.14	1 757.95	390.65	137.59	0.90	252.16
2005	13383.43	267.38	1 605.16	401.28	138.52	0.90	261.86
2006	14206.04	279.77	997.72	408.31	141.62	0.90	265.78
Trend							
1990–2006	*10.0%*	*-50.5%*	*-78.1%*	*10.7%*	*21.2%*	*-18.2%*	*6.0%*
2005–2006	*6.1%*	*4.6%*	*-37.8%*	*1.8%*	*2.2%*	*0.0%*	*1.5%*
Share in Sector 2 Industrial Processes							
1990		*4.4%*	*35.3%*	*2.9%*	*0.9%*	*0.0%*	*1.9%*
2006		*2.0%*	*7.0%*	*2.9%*	*1.0%*	*0.0%*	*1.9%*
Share in National Total							
1990	*30.1%*	*1.3%*	*10.6%*	*0.9%*	*0.3%*	*0.0%*	*0.6%*
2006	*32.7%*	*0.6%*	*2.3%*	*0.9%*	*0.3%*	*0.0%*	*0.6%*

Table 215: PM2.5 emissions and trends from Sector 2 Industrial Processes and source categories 1990–2006.

PM2.5 [Mg]	2	2 A	2 A 1	2 A 2	2 A 7	2 A 7 x	2 A 7 y	2 A 7 z	2 B
1990	3505.46	989.99	139.00	40.88	810.11	554.65	87.93	5.17	301.97
1995	3019.88	1243.27	128.78	41.71	1072.79	775.17	95.90	6.03	145.78
1999	2596.63	1176.43	90.71	47.53	1038.18	931.53	99.48	7.18	133.66
2000	2937.79	1377.02	106.73	52.19	1218.09	870.11	102.20	7.23	138.11
2001	2870.20	1299.77	75.46	53.17	1171.14	845.88	98.39	6.98	129.66
2002	2470.43	1358.04	71.09	57.36	1229.58	870.75	97.13	7.40	136.86
2003	2430.42	1320.45	53.98	60.31	1206.17	853.10	104.63	7.43	145.07
2004	2432.80	1366.95	56.75	62.91	1247.29	857.56	106.81	7.30	147.15
2005	2329.24	1330.66	66.19	60.65	1203.82	819.29	109.55	7.71	140.98
2006	2240.88	1493.04	78.91	62.28	1351.86	985.78	126.85	7.96	147.53
Trend									
1990–2006	*-36.1%*	*50.8%*	*-43.2%*	*52.3%*	*66.9%*	*77.7%*	*44.3%*	*54.1%*	*-51.1%*
2005–2006	*-3.8%*	*12.2%*	*19.2%*	*2.7%*	*12.3%*	*20.3%*	*15.8%*	*3.3%*	*4.6%*
Share in Sector 2 Industrial Processes									
1990		*28.2%*	*4.0%*	*1.2%*	*23.1%*	*15.8%*	*2.5%*	*0.1%*	*8.6%*
2006		*66.6%*	*3.5%*	*2.8%*	*60.3%*	*44.0%*	*5.7%*	*0.4%*	*6.6%*
Share in National Total									
1990	*14.0%*	*3.9%*	*0.6%*	*0.2%*	*3.2%*	*2.2%*	*0.4%*	*0.0%*	*1.2%*
2006	*9.9%*	*6.6%*	*0.3%*	*0.3%*	*6.0%*	*4.3%*	*0.6%*	*0.0%*	*0.7%*

(1) *Quarrying and mining of minerals other than coal*

(2) *Construction and demolition*

(3) *Agricultural bulk materials and wood processing*

PM2.5 [Mg]	2	2 B	2 C	2 D	2 D 1	2 D 2	2 D 4
1990	3505.46	301.97	2 065.90	147.59	46.75	0.50	100.34
1995	3019.88	145.78	1 482.89	147.94	47.00	0.30	100.64
1999	2596.63	133.66	1 274.57	11.97	11.67	0.30	IE
2000	2937.79	138.11	1 266.88	155.78	53.53	0.30	101.95
2001	2870.20	129.66	1 284.41	156.36	53.44	0.30	102.62
2002	2470.43	136.86	818.03	157.49	54.09	0.30	103.10
2003	2430.42	145.07	808.95	155.96	55.25	0.30	100.40
2004	2432.80	147.15	762.49	156.20	55.04	0.30	100.86
2005	2329.24	140.98	697.16	160.45	55.41	0.30	104.74
2006	2240.88	147.53	437.05	163.26	56.65	0.30	106.31
Trend							
1990–2006	*-36.1%*	*-51.1%*	-78.8%	*10.6%*	*21.2%*	*-40.0%*	*6.0%*
2005–2006	*-3.8%*	*4.6%*	-37.3%	*1.8%*	*2.2%*	*0.0%*	*1.5%*
Share in Sector 2 Industrial Processes							
1990		*8.6%*	58.9%	*4.2%*	*1.3%*	*0.0%*	*2.9%*
2006		*6.6%*	19.5%	*7.3%*	*2.5%*	*0.0%*	*4.7%*
Share in National Total							
1990	*14.0%*	*1.2%*	8.2%	*0.6%*	*0.2%*	*0.0%*	*0.4%*
2006	*9.9%*	*0.7%*	1.9%	*0.7%*	*0.2%*	*0.0%*	*0.5%*

5.2.3 Heavy metal Emissions (key source)

The heavy metals Cd, Pb and Hg are rated as key sources of NFR Category 2 *Industrial Processes*. As shown in Table 216 to Table 218 in the period from 1990 to 2006 the

- **Cd** emissions decreased by 51% to 0.22 Mg, which is a share of 20% to the total Cd emission; emissions increased by 2% from 2005 to 2006;
- **Pb** emissions decreased by 80% to 6.6 Mg, which is a share of 47% to the total Pb emission; emissions increased by 2% from 2005 to 2006;
- **Hg** emissions decreased by 41% to 0.3 Mg, which is a share of 30% to the total Hg emission; emissions increased by 2% from 2005 to 2006.

The main source for heavy metal emissions of NFR Category 2 *Industrial Processes* was the sub sectors NFR 2 C *Metal Production* with a contribution of

- nearly 100% in 1990 and 2006 for **Cd** emissions; the emission trend amount to 51%;
- nearly 100% in 1990 and 2006 for **Pb** emissions; the emission trend amount to -80%;
- 49% in 1990 and about 100% in 2006 for **Hg** emissions; the emission trend amount to 20%.

The sub sectors NFR 2 C *Metal Production* covers activities reported under NFR 2 C 1 *Iron and steel*. However, emissions from this sub sector decreased significantly due to extensive abatement measures but also by production and product substitution.

A small source for heavy metal emissions of NFR Category 2 *Industrial Processes* was the sub sectors NFR 2 B *Chemical Industry,* which covers processes in inorganic chemical industries reported under NFR 2 B 5 *Other*. However, emissions from this sub sector decreased significantly due to abatement measures but also by production and product substitution. Furthermore in 1999 the process of chlorine production was changed from mercury cell to membrane cell.

Table 216: Cd emissions and trends from Sector 2 Industrial Processes and source categories 1990–2006.

Cd [Mg]	2	2 B	2 B 5	2 C	2 C 1
1990	0.4566	0.0009	0.0009	0.4556	0.4556
1991	0.3845	0.0009	0.0009	0.3837	0.3837
1992	0.2639	0.0008	0.0008	0.2631	0.2631
1993	0.2156	0.0008	0.0008	0.2147	0.2147
1994	0.1775	0.0008	0.0008	0.1766	0.1766
1995	0.1597	0.0006	0.0006	0.1590	0.1590
1996	0.1469	0.0006	0.0006	0.1463	0.1463
1997	0.1629	0.0006	0.0006	0.1622	0.1622
1998	0.1604	0.0006	0.0006	0.1598	0.1598
1999	0.1677	0.0006	0.0006	0.1671	0.1671
2000	0.1828	0.0006	0.0006	0.1822	0.1822
2001	0.1795	0.0006	0.0006	0.1789	0.1789
2002	0.1895	0.0006	0.0006	0.1889	0.1889
2003	0.1902	0.0007	0.0007	0.1896	0.1896
2004	0.1979	0.0007	0.0007	0.1972	0.1972
2005	0.2181	0.0007	0.0007	0.2175	0.2175
2006	0.2222	0.0007	0.0007	0.2215	0.2215
Trend					
1990–2006	*-51.3%*	*-27.1%*	*-27.1%*	*-51.4%*	*-51.4%*
2005–2006	*1.9%*	*4.6%*	*4.6%*	*1.9%*	*1.9%*
Share in Sector 2 Industrial Processes					
1990		*0.2%*	*0.2%*	*99.8%*	*99.8%*
2006		*0.3%*	*0.3%*	*99.7%*	*99.7%*
Share in National Total					
1990	*28.9%*	*0.1%*	*0.1%*	*28.9%*	*28.9%*
2006	*19.8%*	*0.1%*	*0.1%*	*19.7%*	*19.7%*

Table 217: Pb emissions and trends from Sector 2 Industrial Processes and source categories 1990–2006.

Pb [Mg]	2	2 B	2 B 5	2 C	2 C 1
1990	32.093	0.0012	0.0012	32.0916	32.0916
1991	27.091	0.0011	0.0011	27.0902	27.0902
1992	18.609	0.0010	0.0010	18.6082	18.6082
1993	15.146	0.0011	0.0011	15.1450	15.1450
1994	12.025	0.0010	0.0010	12.0243	12.0243
1995	4.680	0.0008	0.0008	4.6793	4.6793
1996	4.261	0.0008	0.0008	4.2599	4.2599
1997	4.792	0.0008	0.0008	4.7910	4.7910
1998	4.703	0.0008	0.0008	4.7027	4.7027
1999	4.907	0.0008	0.0008	4.9061	4.9061
2000	5.481	0.0008	0.0008	5.4805	5.4805
2001	5.351	0.0007	0.0007	5.3502	5.3502
2002	5.650	0.0008	0.0008	5.6490	5.6490
2003	5.676	0.0008	0.0008	5.6754	5.6754
2004	5.900	0.0008	0.0008	5.8987	5.8987
2005	6.494	0.0008	0.0008	6.4929	6.4929
2006	6.608	0.0009	0.0009	6.6076	6.6076
Trend					
1990–2006	*-79.4%*	*-27.1%*	*-27.1%*	*-79.4%*	*-79.4%*
2005–2006	*1.8%*	*4.6%*	*4.6%*	*1.8%*	*1.8%*
Share in Sector 2 Industrial Processes					
1990		*0.0%*	*0.0%*	*100.0%*	*100.0%*
2006		*0.0%*	*0.0%*	*100.0%*	*100.0%*
Share in National Total					
1990	*15.5%*	*0.0%*	*0.0%*	*15.5%*	*15.5%*
2006	*46.8%*	*0.0%*	*0.0%*	*46.8%*	*46.8%*

Table 218: Hg emissions and trends from Sector 2 Industrial Processes and source categories 1990–2006.

Hg [Mg]	2	2 B	2 B 5	2 C	2 C 1
1990	0.528	0.270	0.270	0.240	0.240
1991	0.492	0.252	0.252	0.201	0.201
1992	0.435	0.234	0.234	0.196	0.196
1993	0.412	0.216	0.216	0.200	0.200
1994	0.398	0.198	0.198	0.286	0.286
1995	0.466	0.180	0.180	0.251	0.251
1996	0.431	0.180	0.180	0.254	0.254
1997	0.434	0.180	0.180	0.223	0.223
1998	0.333	0.110	0.110	0.231	0.231
1999	0.276	0.045	0.045	0.241	0.241
2000	0.241	0.000	0.000	0.245	0.245
2001	0.245	0.000	0.000	0.261	0.261
2002	0.261	0.000	0.000	0.261	0.261
2003	0.261	0.000	0.000	0.272	0.272
2004	0.272	0.000	0.000	0.305	0.305
2005	0.305	0.000	0.000	0.311	0.311
2006	0.311	0.000	0.000	0.240	0.240
Trend					
1990–2006	*-41.1%*	*-100.0%*	*-100.0%*	*20.6%*	*20.6%*
2005–2006	*2.0%*	*4.6%*	*4.6%*	*2.0%*	*2.0%*
Share in Sector 2 Industrial Processes					
1990		*51.2%*	*51.2%*	*48.8%*	*48.8%*
2006		*0.0%*	*0.0%*	*100.0%*	*100.0%*
Share in National Total					
1990	*24.6%*	*12.6%*	*12.6%*	*12.0%*	*12.0%*
2006	*30.3%*	*0.0%*	*0.0%*	*30.3%*	*30.3%*

5.2.4 Persistent organic pollutants (POPs)

The POP emissions (PAH, dioxin/furan and HCB) are rated as key sources in NFR Category *2 Industrial Processes*. As shown in Table 219 in the period 1990 to 2006 the

- **PAH** emissions decreased by 97% to 0.22 Mg, which is a share of 2.5% to the total PAH emissions. The emission trend from 2005 to 2006 amount to 2%.
- **dioxin/furan** emissions decreased by 88% to 4.8 g, which is a share of 11% to the total dioxin/furan emissions. The emission trend from 2005 to 2006 amount to 20%.
- **HCB** emissions decreased by 61% to 3.8 kg, which is a share of 9% to the total HCB emissions. The emission trend from 2005 to 2006 amount to 2%.

The main source for POP emissions of NFR Category 2 *Industrial Processes* was the sub sectors NFR *2 C Metal Production* with a contribution of

- 87% in 1990 and 83% in 2006 for **PAH** emissions; emissions decreased by 97%;
- 95% in 1990 and 97% in 2006 for **dioxin/furan** emissions; emissions decreased by 87%;
- 83% in 1990 and 99% in 2006 **HCB** emissions; emissions decreased by 54%.

The sub sectors NFR 2 C *Metal Production* covers activities reported under NFR 2 C 1 *Iron and steel* and NFR 2 C 3 Aluminium production. Aluminium production was stopped in 1992, which explains the strong decrease of PAH emissions. Dioxin/furan and HCB emissions decreased significantly due to extensive abatement measures.

Small source for persistent organic pollutant (POPs) emissions of NFR Category *2 Industrial Processes* were the sub sectors

- NFR 2 B *Chemical Industry,* which covers processes in inorganic chemical industries (graphite) reported under NFR 2 B 5 *Other*; also this production process is stopped;
- NFR 2 D *Other Production* which covers activities of NFR 2 D 2 *Food and Drink* (meat and fish smoking).

Table 219: PAH emissions and trends from Sector 2 Industrial Processes and source categories 1990–2006.

PAH [Mg]	2	2 B	2 B 5	2 C	2 C 1	2 C 3	2 D	2 D 2
1990	7.437	0.454	0.454	6.437	0.347	6.090	0.545	0.545
1991	7.175	0.395	0.395	6.371	0.281	6.090	0.409	0.409
1992	3.585	0.611	0.611	2.657	0.235	2.422	0.317	0.317
1993	0.524	0.083	0.083	0.194	0.194	NO	0.247	0.247
1994	0.592	0.246	0.246	0.168	0.168	NO	0.177	0.177
1995	0.492	0.240	0.240	0.145	0.145	NO	0.107	0.107
1996	0.898	0.662	0.662	0.154	0.154	NO	0.081	0.081
1997	0.467	0.252	0.252	0.156	0.156	NO	0.059	0.059
1998	0.410	0.215	0.215	0.158	0.158	NO	0.037	0.037
1999	0.250	0.053	0.053	0.160	0.160	NO	0.037	0.037
2000	0.192	0.013	0.013	0.142	0.142	NO	0.037	0.037
2001	0.183	0.002	0.002	0.144	0.144	NO	0.037	0.037
2002	0.190	NA	NA	0.153	0.153	NO	0.037	0.037
2003	0.191	NA	NA	0.154	0.154	NO	0.037	0.037
2004	0.197	NA	NA	0.160	0.160	NO	0.037	0.037
2005	0.216	NA	NA	0.179	0.179	NO	0.037	0.037

PAH [Mg]	2	2 B	2 B 5	2 C	2 C 1	2 C 3	2 D	2 D 2
2006	0.220			0.183	0.183		0.037	0.037
Trend								
1990–2006	*-97.0%*	*-100.0%*	*-100.0%*	*-97.2%*	*-47.4%*	*-100.0%*	*-93.2%*	*-93.2%*
2005–2006	*1.6%*	*-*	*-*	*2.0%*	*2.0%*	*-*	*0.0%*	*0.0%*
Share in Sector 2 Industrial Processes								
1990		*6,1%*	*6,1%*	*86.6%*	*4.7%*	*81,9%*	*7.3%*	*7.3%*
2006		*-*	*-*	*83.2%*	*83.2%*	*-*	*16.8%*	*16.8%*
Share in National Total								
1990	*43.0%*	*2,6%*	*2,6%*	*37.2%*	*2.0%*	*35,3%*	*3.1%*	*3.1%*
2006	*2.5%*	*-*	*-*	*2.1%*	*2.1%*	*-*	*0.4%*	*0.4%*

Table 220: Dioxin/Furan emissions and trends from Sector 2 Industrial Processes and source categories 1990–2006.

Dioxin/Furan [g]	2	2 C	2 C 1	2 C 3	2 D	2 D 2
1990	39.003	37.214	37.212	0.002	1.789	1.789
1991	35.149	33.802	33.801	0.002	1.347	1.347
1992	21.886	20.839	20.838	0.001	1.047	1.047
1993	17.012	16.194	16.194	NO	0.818	0.818
1994	11.262	10.673	10.673	NO	0.589	0.589
1995	12.227	11.867	11.867	NO	0.360	0.360
1996	11.168	10.895	10.895	NO	0.273	0.273
1997	12.151	11.949	11.949	NO	0.202	0.202
1998	11.452	11.321	11.321	NO	0.131	0.131
1999	12.602	12.471	12.471	NO	0.131	0.131
2000	14.053	13.922	13.922	NO	0.131	0.131
2001	13.555	13.424	13.424	NO	0.131	0.131
2002	3.239	3.108	3.108	NO	0.131	0.131
2003	2.983	2.852	2.852	NO	0.131	0.131
2004	3.302	3.171	3.171	NO	0.131	0.131
2005	4.022	3.891	3.891	NO	0.131	0.131
2006	4.761	4.630	4.630		0.131	0.131
Trend						
1990–2006	*-87.8%*	*-87.6%*	*-87.6%*	*-100.0%*	*-92.7%*	*-92.7%*
2005–2006	*18.4%*	*19.0%*	*19.0%*	*--*	*0.0%*	*0.0%*
Share in Sector 2 Industrial Processes						
1990		*95.4%*	*95.4%*	*0.0%*	*4.6%*	*4.6%*
2006		*97.2%*	*97.2%*	*--*	*2.8%*	*2.8%*
Share in National Total						
1990	*24.3%*	*23.2%*	*23.2%*	*0.0%*	*1.1%*	*1.1%*
2006	*10.9%*	*10.6%*	*10.6%*	*--*	*0.3%*	*0.3%*

Table 221: HCB emissions and trends from Sector 2 Industrial Processes and source categories 1990–2006.

HCB [kg]	2	2 B	2 B 5	2 C	2 C 1	2 C 3	2 C 5	2 D	2 D 2
1990	9.712	1.26	1.26	8.094	8.094	0.000	IE	0.358	0.358
1991	8.032	0.36	0.36	7.402	7.402	0.000	IE	0.269	0.269
1992	4.941	0.18	0.18	4.552	4.552	0.000	IE	0.209	0.209
1993	3.702	NA	NA	3.538	3.538	NA	IE	0.164	0.164
1994	2.453	NA	NA	2.335	2.335	NA	IE	0.118	0.118
1995	2.670	NA	NA	2.598	2.598	NA	IE	0.072	0.072
1996	2.440	NA	NA	2.386	2.386	NA	IE	0.055	0.055
1997	2.655	NA	NA	2.614	2.614	NA	IE	0.040	0.040
1998	2.500	NA	NA	2.473	2.473	NA	IE	0.026	0.026
1999	2.756	NA	NA	2.730	2.730	NA	IE	0.026	0.026
2000	3.074	NA	NA	3.048	3.048	NA	IE	0.026	0.026
2001	2.978	NA	NA	2.952	2.952	NA	IE	0.026	0.026
2002	3.170	NA	NA	3.143	3.143	NA	IE	0.026	0.026
2003	3.178	NA	NA	3.151	3.151	NA	IE	0.026	0.026
2004	3.301	NA	NA	3.274	3.274	NA	IE	0.026	0.026
2005	3.691	NA	NA	3.665	3.665	NA	IE	0.026	0.026
2006	3.762	NA	NA	3.735	3.735	NA	IE	0.026	0.026
Trend									
1990–2006	*-61.3%*	*-100%*	*-100.0%*	*-53.9%*	*-53.9%*	*-100.0%*		*-92.7%*	*-92.7%*
2005–2006	*1.9%*	*-*	*-*	*1.9%*	*1.9%*	*-*		*0.0%*	*0.0%*
Share in Sector 2 Industrial Processes									
1990		*13.0%*	*13.0%*	*83.3%*	*83.3%*	*0.0%*		*3.7%*	*3.7%*
2006		*-*	*-*	*99.3%*	*99.3%*	*-*		*0.7%*	*0.7%*
Share in National Total									
1990	*10.6%*	*1.4%*	*1.4%*	*8.8%*	*8.8%*	*0.0%*		*0.4%*	*0.4%*
2006	*8.7%*	*-*	*-*	*8.7%*	*8.7%*	*-*		*0.1%*	*0.1%*

Table 222: Emissions and trends from Sector 2 Industrial Processes 1990–2006.

Year	SO_2	NO_x	NMVOC	CO	NH_3	TSP	PM10	PM2.5	Cd	Hg	Pb	PAH	Dioxin	HCB
			[Gg]				[Mg]			[Mg]		[Mg]	[g]	[kg]
1990	2.22	4.80	11.10	46.37	0.27	23 769.21	12 919.97	3 505.46	0.46	0.53	32.09	7.44	39.00	9.71
1991	1.90	4.48	12.58	41.67	0.51	NR	NR	NR	0.38	0.49	27.09	7.18	35.15	8.03
1992	1.67	4.55	13.78	44.97	0.37	NR	NR	NR	0.26	0.44	18.61	3.59	21.89	4.94
1993	1.42	1.98	15.05	47.15	0.22	NR	NR	NR	0.22	0.41	15.15	0.52	17.01	3.70
1994	1.42	1.92	13.57	48.65	0.17	NR	NR	NR	0.18	0.40	12.03	0.59	11.26	2.45
1995	1.37	1.46	11.95	45.08	0.10	26 513.77	13 692.84	3 019.88	0.16	0.47	4.68	0.49	12.23	2.67
1996	1.29	1.42	10.37	39.44	0.10	NR	NR	NR	0.15	0.43	4.26	0.90	11.17	2.44
1997	1.27	1.50	9.06	38.30	0.10	NR	NR	NR	0.16	0.43	4.79	0.47	12.15	2.65
1998	1.18	1.46	7.71	34.86	0.10	NR	NR	NR	0.16	0.33	4.70	0.41	11.45	2.50
1999	1.12	1.44	6.04	30.58	0.12	24 874.13	12 855.15	2 596.63	0.17	0.28	4.91	0.25	12.60	2.76
2000	1.09	1.54	4.96	27.38	0.10	29 341.13	14 900.75	2 937.79	0.18	0.24	5.48	0.19	14.05	3.07
2001	1.21	1.57	4.38	24.20	0.08	28 405.74	14 452.62	2 870.20	0.18	0.24	5.35	0.18	13.55	2.98
2002	1.21	1.63	4.57	23.87	0.06	28 008.82	13 910.71	2 470.43	0.19	0.26	5.65	0.19	3.24	3.17
2003	1.21	1.34	4.26	23.59	0.08	27 436.15	13 635.93	2 430.42	0.19	0.26	5.68	0.19	2.98	3.18
2004	1.22	1.28	4.40	23.86	0.06	28 211.12	13 968.78	2 432.80	0.20	0.27	5.90	0.20	3.30	3.30
2005	1.22	1.75	4.71	24.23	0.07	27 069.19	13 383.43	2 329.24	0.22	0.30	6.49	0.22	4.02	3.69
2006	1.22	1.63	4.73	24.37	0.07	29 202.10	14 206.04	2 240.88	0.22	0.31	6.61	0.22	4.76	3.76
Trend														
1990–2006	*-45.1%*	*-66.0%*	*-57.4%*	*-47.4%*	*-72.4%*	*22.9%*	*10.0%*	*-36.1%*	*-51.3%*	*-41.1%*	*-79.4%*	*-97.0%*	*-87.8%*	*-61.3%*
2005–2006	*0.2%*	*-6.7%*	*0.4%*	*0.6%*	*9.4%*	*7.9%*	*6.1%*	*-3.8%*	*1.9%*	*2.0%*	*1.8%*	*1.6%*	*18.4%*	*1.9%*
National Share														
1990	*3.0%*	*2.5%*	*3.9%*	*3.2%*	*0.4%*	*34.7%*	*30.1%*	*14.0%*	*28.9%*	*24.6%*	*15.5%*	*43.0%*	*24.3%*	*10.6%*
2006	*4.3%*	*0.7%*	*2.8%*	*3.1%*	*0.1%*	*38.9%*	*32.7%*	*9.9%*	*19.8%*	*30.3%*	*46.8%*	*2.5%*	*10.9%*	*8.73%*

5.3 General description

5.3.1 Methodology

The general method for estimating emissions for the industrial processes sector involves multiplying production data for each process by an emission factor per unit of production (CORINAIR simple methodology).

In some categories emission and production data were reported directly by industry or associations of industries and thus represent plant specific data.

5.3.2 Quality Assurance and Quality Control (QA/QC)

For the Austrian Inventory there is an internal quality management system, for further information see Chapter 1.6.

Concerning measurement and documentation of emission data there are also specific regulations in the Austrian legislation as presented in Table 223. This legislation also addresses verification. Some plants that are reporting emission data have quality management systems implemented according to the ISO 9000–series or to similar systems.

Table 223: Austrian legislation with specific regulations concerning measurement and documentation of emission data.

IPCC Source Category	Austrian legislation
2 A 1	BGBl 1993/63 Verordnung für Anlagen zur Zementerzeugung
2 A 7	BGBl 1994/498 Verordnung für Anlagen zur Glaserzeugung
2 C 1	BGBl 1994/447 Verordnung für Gießereien
2 C 1	BGBl II 1997/160 Verordnung für Anlagen zur Erzeugung von Eisen und Stahl
2 C 1	BGBl II 1997/163 Verordnung für Anlagen zum Sintern von Eisenerzen
2 A/2 B/2 C/2 D	BGBl II 1997/331 Feuerungsanlagen-Verordnung
2 C 2/2 C 3/2 C 5	BGBl II 1998/1 Verordnung zur Erzeugung von Nichteisenmetallen
2 A/2 B/2 C/2 D	BGBl 1988/380 Luftreinhaltegesetz für Kesselanlagen
2 A/2 B/2 C/2 D	BGBl 1989/19 Luftreinhalteverordnung für Kesselanlagen

Extracts of the applicable paragraphs are provided in Annex 3.

5.3.3 Recalculations

Information on changes made with respect to last year's submission is provided in Chapter 3 *Methodological Changes,* details are provided in the corresponding sub chapters of this chapter.

Update of activity data

2 D 1 Other Production – Pulp and Paper (chipboard production):

Activity data for 2005 has been updated.

2 D 2 Other Production – Food and Drink (Bread, Wine, Beer and Spirits):

Activity data for 2005 has been updated.

Improvements of methodologies and emission factors

2 Industrial Processes

Updating methodology and emission factors for handling bulk materials according VDI guidelines 3790

2 A 1 Cement Production and *2 A 2 Lime Production*

PM emissions from cement and limestone kilns from 1 A 2 f Other Industry are now included under 2 A 1 and 2 A 2

2 A 7 *Construction and demolition*

Updating methodology and emission factors for handling bulk materials according CEIPMEIP (2002)

5.3.4 Completeness

Table 224 gives an overview of the NFR categories included in this chapter. It also provides information on the status of emission estimates of all sub categories. A "✓" indicates that emissions from this sub category have been estimated.

Table 224: Overview of sub categories of Category 2 Industrial Processes.

NFR Category		Status													
		NEC gas				CO	PM			Heavy metals			POPs		
		NO_x	SO_2	NH_3	NMVOC	CO	TSP	PM10	PM2.5	Cd	Hg	Pb	Dioxin	PAH	HCB
2 A	MINERAL PRODUCT	NA	NA	NA	IE(1)	✓	✓	✓	✓	NA	NA	NA	NA	NA	NA
2 A 1	Cement Production	NA	NA	NA	NA	NA	✓	✓	✓	NA	NA	NA	NA	NA	NA
2 A 2	Lime Production	NA	NA	NA	NA	NA	✓	✓	✓	NA	NA	NA	NA	NA	NA
2 A 3	Limestone and Dolomite Use	NA	NA	NA	NA	NA	✓	✓	✓	NA	NA	NA	NA	NA	NA
2 A 4	Soda Ash Production and use	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2 A 5	Asphalt Roofing	NA	NA	NA	IE(1)	✓	NA	NA	NA	NA	NA	NA	NA	NA	NA
2 A 6	Road Paving with Asphalt	NA	NA	NA	IE(1)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2 A 7	Other including Non Fuel Mining & Construction	NA	NA	NA	NA	NA	✓	✓	✓	NA	NA	NA	NA	NA	NA
2 B	CHEMICAL INDUSTRY	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	NA	✓(3)	✓ (4)
2 B 1	Ammonia Production	✓	NA	✓	IE(2)	✓	NA	NA	NA	NA	NA	NA	NA	NA	NA
2 B 2	Nitric Acid Production	✓	NA	✓	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2 B 3	Adipic Acid Production	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2 B 4	Carbide Production	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

NFR Category		Status													
		NEC gas				CO	PM			Heavy metals			POPs		
		NO_x	SO_2	NH_3	NMVOC	CO	TSP	PM10	PM2.5	Cd	Hg	Pb	Dioxin	PAH	HCB
2 B 5	Other	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	NA	✓ (3)	✓ (4)
2 C	METAL PRODUCTION	✓	✓	IE	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
2 D	OTHER PRODUCTION	✓	NA	NA	✓	✓	✓	✓	✓	NA	NA	NA	✓	✓	✓
2 D 1	Pulp and Paper	✓	NA	NA	✓	✓	NA	NA	NA	NA	NA	NA	NA	NA	NA
2 D 2	Food and Drink	NA	NA	NA	✓	NA	✓	✓	✓	NA	NA	NA	✓	✓	✓
2 G	OTHER	NA	NA	✓	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

(1) *included in 3 Solvent and other Product use*

(2) *included in 2 B 5 Other*

(3) *until 2001 from Graphite Production; later NO*

(4) *until 1992 from Tri-, Perchlorethylene Production; later NO*

5.4 NFR 2 A Mineral Products

Key source: TSP, PM10, PM2.5, CO

5.4.1 Fugitive Particular Matter emissions

Source Category Description

In this category fugitive PM emissions from bulk material handling are reported. These include emissions from quarrying and mining of minerals other than coal, construction and demolition and agricultural bulk materials. Most of these emissions are reported in NFR category 2 A 7, except emissions from cement that are reported in NFR category 2 A 1, and from lime that are reported in NFR category 2 A 2. Emissions from Cement and Lime include point source emissions from kilns.

Methodological Issues

The general method for estimating fugitive particular matter emissions involves multiplying the amount of bulk material by an emission factor (CORINAIR simple methodology). All emission factors were taken from a national study (WINIWARTER et al. 2001) and partly updated or amended by (WINIWARTER et al. 2008) and are presented in Table 225. Activity data are mainly taken from national statistics and presented in Table 226.

Table 225: Emission factors (EF) for diffuse PM emissions from bulk material handling.

Bulk material	**EF TSP [g/t]**	**EF PM10 [g/t]**	**EF PM2.5 [g/t]**
Magnesite [(1)]	216.20	101.61	10.81
Sand [(1)]	525.00	246.75	26.25
Gravel [(1)]	135.00	63.45	6.75
Silicates [(1)]	191.00	89.77	9.55
Dolomite [(1)]	400.00	188.00	20.00
Limestone [(1)]	500.00	235.00	25.00
Basaltic rocks [(1)]	172.00	80.84	8.60
Iron ore	216.78	104.70	30.43
Tungsten ore	25.12	11.86	3.75
Gypsum, Anhydride [(1)]	85.60	40.23	4.28
Lime [(1)]	122.70	110.43	79.76
Cement [(1) (2)]	21.80 (41.90)	19.62 (37.71)	17.44 (33.52)
Cement & Lime milling	7.75	6.98	6.20
Rye flour	43.59	20.62	6.50
Wheat flour	43.59	20.62	6.50
Sunflower and rapeseed grist	24.76	11.85	3.79
Wheat bran and grist	10.90	5.16	1.63
Rye bran and grist	10.90	5.16	1.63
Concentrated feedingstuffs	30.28	14.32	4.51
Bulk material	**EF TSP [g/m^2]**	**EF PM10 [g/m^2]**	**EF PM2.5 [g/m^2]**
Construction and demolition [(1)]	173.40	86.70	8.67

(1) *Source: WINIWARTER et al. 2008*

(2) *decreasing EF; values given for 2006 (1990)*

Table 226: Activity data for diffuse PM emissions from bulk material handling.

Activity data [t]	**1990**	**1995**	**2000**	**2004**	**2005**	**2006**
Magnesite	1 179 162	783 497	725 832	715 459	693 754	769 188
Sand	2 517 296	3 033 907	3 692 910	4 073 746	3 660 228	2 145 933
Gravel	14 264 676	17 192 140	20 978 974	24 991 464	25 361 797	25 915 932
Silicates	1 484 527	810 520	1 991 018	2 034 752	2 580 295	2 677 274
Dolomite	1 879 837	8 789 688	7 152 245	5 906 701	6 291 413	6 330 822
Limestone	15 371 451	19 079 581	23 823 529	24 157 975	22 643 754	28 816 662
Basaltic rocks	3 673 535	4 202 244	4 933 202	5 197 125	3 166 281	4 150 967
Iron ore	2 310 710	2 116 099	1 859 449	1 889 419	2 047 950	2 091 995
Tungsten ore	191 306	411 417	416 456	447 982	472 964	400 182
Gypsum, Anhydride	751 645	958 430	946 044	1 038 127	911 162	936 072
Lime, quick, slacked	512 610	522 934	654 437	788 790	760 464	780 873
Cement	3 693 539	2 929 973	3 052 974	3 222 802	3 221 167	3 653 477
Cement & Lime milling	2 450 000	2 450 000	2 450 000	2 450 000	2 450 000	2 450 000
Rye flour	61 427	55 846	48 054	53 025	62 387	67 835
Wheat flour	259 123	287 461	291 482	289 107	324 160	339 948

Activity data [t]	1990	1995	2000	2004	2005	2006
Sunflower and rapeseed grist	19 900	108 600	121 200	121 200	121 200	121 200
Wheat bran and grist	64 781	71 865	73 303	73 303	73 303	73 303
Rye bran and grist	15 357	13 962	13 139	13 139	13 139	13 139
Concentrated feeding stuff	638 014	720 972	980 808	991 621	1 018 649	1 044 706
Constructed floor space [m^2]	**1990**	**1995**	**2000**	**2004**	**2005**	**2006**
Construction and demolition	10 142 004	11 060 799	11 788 151	12 319 019	12 635 694	14 630 903

5.4.2 NFR 2 A 5 Asphalt Roofing

Source Category Description

In this category CO emissions from the production of asphalt roofing are considered. CO emissions of this category are an important CO source from NFR Category *2 Industry*: in 2006 40% of all industrial process CO emissions originated from this category.

NMVOC emissions previously reported under this category resulted from the production and laying of asphalt roofing. However, these emissions are already accounted for in the solvents sector, that's why emissions are now reported as "IE".

Methodological Issues

CO emissions from asphalt roofing were calculated by multiplying an emission factor of 350 g CO/m² produced asphalt roofing (BUWAL 1995) with activity data (roofing paper produced). The consumption of bitumen was assumed to be 1.2 kg/m² of asphalt roofing. Activity data were taken from national statistics (STATISTIK AUSTRIA).

Table 227: Activity data for CO emissions from asphalt roofing.

	1990	1995	2000	2004	2005	2006
Asphalt roofing [m^2]	27 945 000	31 229 000	26 020 734	27 952 613	27 952 613	27 952 613

5.4.3 NFR 2 A 6 Road Paving with Asphalt

NMVOC emissions previously reported under this category resulted from road paving with asphalt. However, these emissions are already accounted for in the solvents sector, that's why emissions are now reported as "IE".

5.4.4 Recalculations

Particluar matter emissions have been partly updated with information from WINIWARTER et al. (2008). This information includes new emission factors for handling bulk materials and updated methodology according VDI guidelines 3790; the inclusion of PM emissions from cement and limestone kilns from 1 A 2 f Other Industry under 2 A 1 and 2 A 2; and updated methodology and emission factors for Construction and demolition based on CEPMEIP (2002)[95].

[95] http://www.air.sk/tno/cepmeip/em_factors_results.php?

5.5 NFR 2 B Chemical Products

Key source: SO_2, CO

5.5.1 NFR 2 B 1 and 2 B 2 Ammonia and Nitric Acid Production

Source Category Description

Ammonia (NH_3) is produced by catalytic steam reforming of natural gas or other light hydrocarbons (e.g. liquefied petroleum gas, naphtha). Nitric acid (HNO_3) is manufactured via the reaction of ammonia (NH_3) whereas in a first step NH_3 reacts with air to NO and NO_2 and is then transformed with water to HNO_3. Both processes are minor sources of NH_3 and NO_x emissions. During ammonia production also small amounts of CO are emitted.

In Austria there is only one producer of ammonia and nitric acid.

Methodological Issues

Activity data since 1990 and emission data from 1994 onwards were reported directly to the UMWELTBUNDESAMT by the only producer in Austria and thus represent plant specific data. From emission and activity data an implied emission factor was calculated (see Table 228 and Table 229). The implied emission factor that was calculated from activity and emission data from 1994 was applied to calculate emissions of the year 1993 for NO_x emissions and for the years 1990 to 1993 for NH_3 and CO emissions, as no emission data was available for these years.

NO_x emissions from 1990 to 1992 are reported in category *2 B 5 Other processes in organic chemical industries*.

Table 228: Emissions and implied emission factors for NO_x, NH_3 and CO from Ammonia Production (NFR Category 2 B 1).

Year	NO_x emission [Mg]	NO_x IEF [g/Mg]	NH_3 emission [Mg]	NH_3 IEF [g/Mg]	CO emission [Mg]	CO IEF [g/Mg]
1990	IE	NA	7.4	16.0	123	267
1991	IE	NA	7.6	16.0	127	267
1992	IE	NA	6.9	16.0	115	267
1993	471	1 004	7.5	16.0	125	267
1994	446	1 004	7.1	16.0	119	267
1995	286	604	10.7	22.6	95	201
1996	285	587	12.3	25.4	63	129
1997	292	609	10.9	22.7	128	268
1998	251	517	4.2	8.7	84	174
1999	232	473	8.5	17.3	41	84
2000	207	428	7.0	14.5	43	89
2001	204	455	6.0	13.4	41	91
2002	225	484	11.1	23.9	31	66
2003	227	444	11.3	22.1	26	51
2004	231	453	9.6	18.8	43	83
2005	244	510	9.9	20.7	53	110
2006	215	428	13.3	26.5	75	150

Table 229: Emissions and implied emission factors for NO_x and NH_3 from Nitric Acid Production (NFR Category 2 B 2).

Year	NO_x emission [Mg]	NO_x IEF [g/Mg]	NH_3 emission [Mg]	NH_3 IEF [g/Mg]
1990	IE	NA	1.38	2.60
1991	IE	NA	1.39	2.60
1992	IE	NA	1.26	2.60
1993	691	1 346	1.33	2.60
1994	629	1 346	1.30	2.78
1995	346	715	0.10	0.21
1996	359	724	0.20	0.40
1997	343	701	1.90	3.88
1998	363	719	0.30	0.59
1999	370	722	0.20	0.39
2000	407	762	0.40	0.75
2001	379	742	0.50	0.98
2002	366	700	0.60	1.15
2003	383	686	0.40	0.72
2004	282	492	0.10	0.17
2005	239	429	0.05	0.09
2006	166	286	0.80	1.38

NH_3 emission factors vary depending on the plant utilization and on how often the production process was interrupted, e.g. because of change of the catalyst.

5.5.2 NFR 2 B 5 Chemical Products – Other

Source Category Description

This category includes NH_3 emissions from the production of ammonium nitrate, fertilizers and urea as well as NO_x emissions from fertilizers. NO_x emissions from inorganic chemical processes for the years 1990 to 1992 are reported as a sum under this category.

This category furthermore includes SO_2 and CO emissions from inorganic chemical processes and NMVOC emissions from organic chemical processes, which were not further splitted in sub categories.

Emissions of minor importance are Heavy Metals and Particular Matter from fertilizers; PAH emissions from graphite production (2002 cessation of production); Hg emissions from Chlorine production (1999 changeover from mercury cell to membrane cell, thus nor more emissions); HCB emissions from the production of Per- and Trichloroethylene (1992 cessation of production); and particular matter emissions from the production of ammonium nitrate.

Methodological Issues

Ammonium nitrate and Urea production

For ammonium nitrate and urea production activity data since 1990 and emission data from 1994 onwards were reported directly to the Umweltbundesamt by the only producer in Austria and thus represent plant specific data.

The implied emission factors for NH_3 and CO that were calculated from activity and emission data of 1994 were applied to calculate emissions of the years 1990 to 1993 as no emission data was available for these years.

TSP emissions are reported directly to the Umweltbundesamt by the only producer in Austria and thus represent plant specific data. The shares of PM10 and PM2.5 are according to UMWELTBUNDESAMT (2001c) until 1996 90% and 80% (conventional plant) and from 1997 onwards 95% and 90% (modern plant).

Table 230: TSP, PM10, PM2.5 emissions and emissions and implied emission factors for and NH_3 from Ammonia nitrate.

Year	NH_3 emission [Mg]	NH_3 IEF [g/Mg]	TSP emission [Mg]	PM10 emission [Mg]	PM2.5 emission [Mg]
1990	0.71	72	12.80	11.52	10.24
1991	1.05	72	NE	NE	NE
1992	0.78	72	NE	NE	NE
1993	0.84	72	NE	NE	NE
1994	0.30	24	12.80	11.52	10.24
1995	0.90	72	14.90	13.41	11.92
1996	0.40	28	9.80	8.82	7.84
1997	0.30	22	0.40	0.38	0.36
1998	0.30	21	0.30	0.28	0.27
1999	0.30	21	0.40	0.38	0.36
2000	0.20	13	0.20	0.19	0.18
2001	0.30	20	0.30	0.28	0.27
2002	0.48	29	0.20	0.19	0.18
2003	0.43	24	0.30	0.29	0.27
2004	0.40	21	0.20	0.19	0.18
2005	0.33	17	0.26	0.24	0.23
2006	0.43	22	0.30	0.28	0.27

Table 231: Emissions and implied emission factors for NH_3 and CO from Urea production.

Year	NH_3 emission [Mg]	NH_3 IEF [g/Mg]	CO emission [Mg]	CO IEF [g/Mg]
1990	39	137	7	25
1991	40	137	7	25
1992	35	137	6	25
1993	42	137	8	25
1994	49	137	9	25
1995	48	121	10	25

Year	NH_3 emission [Mg]	NH_3 IEF [g/Mg]	CO emission [Mg]	CO IEF [g/Mg]
1996	30	73	10	23
1997	28	71	9	23
1998	39	98	10	24
1999	33	81	7	16
2000	17	45	4	9
2001	14	39	4	10
2002	25	63	4	9
2003	36	80	4	9
2004	26	59	4	8
2005	30	72	4	9
2006	25	59	4	9

Fertilizer production

For fertilizer production activity data from 1990 to 1994 were taken from national production statistics[96] (STATISTIK AUSTRIA); NO_x and NH_3 emissions and activity data from 1995 onwards were reported by the main producer in Austria. For the years 1990 to 1993 NH_3 emissions were estimated with information on emissions of the main producer and extrapolation to total production. The emission estimate for 1994 was obtained by applying the average emission factor of 1995–1999. NO_x emissions from 1990 to 1992 are included in *Other processes in organic chemical industries*.

Cd, Hg and Pb emissions were calculated by multiplying the above mentioned activity data with national emission factors (HÜBNER 2001a), that derive from analysis of particular matter fractions as described in (MA LINZ 1995). Particular matter emissions (fugitive and non-fugitive) were estimated for the whole fertilizer production in Austria (WINIWARTER et al. 2007) for the years 1990, 1995 and 1999. Implied emission factors were calculated from emission and activity data that were used to calculate emissions from 2000 to 2005. The shares of PM10 and PM2.5 are 58.6% and 30.9% for the whole time-series.

Table 232: NO_x and NH_3 emissions from Fertilizer Production.

Year	NO_x emission [Mg]	NH_3 emission [Mg]
1990	IE	219
1991	IE	455
1992	IE	323
1993	88	165
1994	86	108
1995	60	37
1996	47	52
1997	49	60
1998	47	57
1999	63	74

[96] This results in an inconsistency of the time series, as activity data taken from national statistics represent total production in Austria, whereas the data obtained from the largest Austrian producer covers only the production of this producer. It is planned to prepare a consistent time series.

Year	NO_x emission [Mg]	NH_3 emission [Mg]
2000	71	73
2001	75	56
2002	74	22
2003	77	26
2004	47	20
2005	89	25
2006	70	32

Table 233: Heavy metal emission factors and Particular matter emissions from Fertilizer Production.

Year	Cd EF [mg/Mg]	Hg EF [mg/Mg]	Pb EF [mg/Mg]	TSP emission [Mg]	PM10 emission [Mg]	PM2.5 emission [Mg]
1990	0.67	0.08	0.84	945	554	291
1995	0.67	0.08	0.84	434	254	134
2000	0.62	0.08	0.78	447	262	138
2004	0.62	0.08	0.78	476	279	147
2005	0.62	0.08	0.78	456	267	141
2006	0.62	0.08	0.78	477	279	147

Other processes in organic and inorganic chemical industries

All SO_2, NO_x and NMVOC process emissions from chemical industries (both organic and inorganic) are reported together as a total in category *2 B 5 Other*. For NO_x emissions from 1993 onwards emission data has been split and allocated to the respective emitting processes (ammonia production, fertilizer production and nitric acid production).

Activity data until 1992 were taken from Statistik Austria. In the year 1997 a study commissioned by associations of industries was published (WINDSPERGER & TURI 1997). The activity Figures for the year 1993 included in this study was used for all years afterwards, as no more up to date activity data is available.

Emission data for NO_x and CO were taken from the same study (WINDSPERGER & TURI 1997); they were obtained from direct inquiries in industry. SO_2 emissions were re-evaluated by direct inquiries in industry in 2004. NMVOC emissions were re-evaluated from 1994 onwards with data reported by the Austrian Association of Chemical Industry.

Activity data and emissions for NO_x, NMVOC, CO and SO_2 from other organic and inorganic chemical industries are presented in Table 234.

Table 234: NMVOC, NO_x, SO_2 and CO emissions and activity data from other processes in organic and inorganic chemical industries.

Year	Processes in organic chemical industries		Processes in inorganic chemical industries			
	NMVOC emissions	Activity	NO_x emissions	SO_2 emissions	CO emissions	Activity
	[Mg]		[Mg]			
1990	8 285	1 130 265	4 072	1 565	12 537	963 824
1995	9 207	1 066 788	IE	712	11 064	908 640
2000	1 665	1 066 788	IE	595	11 064	908 640
2004	1 325	1 066 788	IE	766	11 064	908 640
2005	1 325	1 066 788	IE	766	11 064	908 640
2006	1 325	1 066 788	IE	766	11 064	908 640

Chlorine, Graphite and Per- and Trichloroethylene production

Hg emissions from chlorine production are calculated by multiplying production figures from industry with national emission factors (WINDSPERGER et al. 1999) that are based on (WINIWARTER & SCHNEIDER 1995). In 1999 the chlorine producing company changed the production process from mercury cell to membrane cell. Therefore, for 1999 the EF was assumed to be half of the years before and since 2000 no Hg emissions result from chlorine production.

PAH emissions from graphite production are calculated by multiplying a national emission factor (HÜBNER 2001b) that is based on the study (UBA BERLIN 1998) with production figures from national statistics. Since 2002 there is no production of graphite in Austria.

HCB emissions and production figures from Per- and Trichloroethylene production were evaluated in a national study (HÜBNER 2001b). The emission factor used is 60 mg/Mg Product and is based on the study (UBA BERLIN 1998). Since 1993 there is no production of Per- and Trichloroethylene in Austria.

Table 235: Hg and PAH emission factors and HCB emissions from other processes in organic and inorganic chemical industries.

Year	Chlorine production	Graphite production	Per- Trichloroethylene production
	Hg EF [mg/Mg]	PAH EF [mg/Mg]	HCB emissions [g]
1990	270	20 000	1 260
1995	180	20 000	NO
2000	0	20 000	NO
2005	0	NO	NO

5.5.3 Recalculations

PM10 and PM2.5 from fertilizer production were updated for 1990–1995 in order to achieve consistent shares of TSP throughout the whole time-series.

TSP, PM10 and PM2.5 emissions from ammonium nitrate production were included.

5.6 NFR 2 C Metal Production

Key source: Cd, Hg, Pb, PAH, Dioxine, HCB, TSP, PM10, PM2.5

In this category emissions from iron and steel production and casting as well as process emissions from non-ferrous metal production and casting are considered.

5.6.1 NFR 2 C 1 Iron and Steel

In this category, emissions from blast furnace charging, basic oxygen furnace steel plants, electric furnace steel plants in Austria, from rolling mills and from iron casting are considered.

Blast Furnace Charging

In this category PM, POP and heavy metal emissions are considered. SO_2, NO_x, NMVOC, and CO emissions are included in category 1 A 2 a.

Heavy metal and POP emissions 1990–2000 were calculated by multiplying activity data with emission factors from unpublished national studies (HÜBNER 2001a[97]), (HÜBNER 2001b[98]) for each of the processes (sinter, coke oven, blast furnace cowpers) separately and summing up emissions. For the years 2001–2005 emissions were calculated by multiplying iron production with the implied emission factors for 2000, except dioxine emissions that were reported directly from plant operators since 2002.

Particular matter emissions for the years 1990 to 2001 were taken from a national study (WINIWARTER et al. 2001[99]). Fugitive emissions 1990–2001 were considered for the first time in this submission. The sources for these emissions are environmental declarations from the companies. For the years 2002–2006 total particular matter emissions are reported directly by the operator.

Pig iron production figures were taken from national statistics. Activity data, POP, HM and PM emissions are presented in Table 236.

Table 236: Activity data and emissions from blast furnace charging.

Year	Activity [Mg]	Emissions [kg]			Emissions [g]			Emissions [Mg]		
	Iron	Cd	Hg	Pb	PAH	DIOX	HCB	TSP	PM10	PM2.5
1990	3 444 000	342	218	26 307	341	33	7 241	6 209	4 346	1 863
1995	3 888 000	86	281	2 118	142	10	2 261	4 113	2 879	1 234
2000	4 320 000	98	236	2 557	139	12	2 657	4 174	2 922	1 252
2004	4 860 630	111	265	2 877	156	2	2 990	2 486	1 740	746
2005	5 457 755	124	298	3 230	176	2	3 357	2 268	1 587	680
2006	5 565 089	127	303	3 294	179	3	3 423	1 399	979	420

[97] according to EUROPEAN COMMISSION IPPC BUREAU (2000); MA LINZ (1995)

[98] according to HÜBNER, C. et al. (2000); EUROPEAN COMMISSION IPPC BUREAU (2000); UBA Berlin (1998)

[99] according to VOEST (2000)

Basic Oxygen Furnace Steel Plant

In this category POP and heavy metal emissions are considered. SO_2, NO_x, NMVOC and CO emissions are included in category 1 A 2a. PM emissions are reported together with emissions from blast furnace charging.

Emission factors for heavy metal emissions were taken from national studies, 1990–1994 (WINDSPERGER et al. 1999[100]), 1995–2000 (HÜBNER 2001a[97]), the latest were also used for 2001–2006, and multiplied with steel production to calculate HM emissions. POP emissions were calculated by multiplying steel production with national emission factors (HÜBNER 2001b[98]).

Steel production data was taken from national production statistics, the amount of electric steel was subtracted. Activity data, POP and HM emission factors are presented in Table 237; particular matter emissions are reported together with emissions from blast furnace charging.

Table 237: Activity data, HM and POP emission factors and PM emissions from basic oxygen furnace steel plants.

Year	Activity [Mg]	EF [mg/Mg]				EF [µg/Mg]		Emissions [Mg]		
	Steel	Cd	Hg	Pb	PAH	DIOX	HCB	TSP	PM10	PM2.5
1990	3 921 341	19	3	984	0.04	0.69	138	IE	IE	IE
1995	4 538 355									
2000	5 183 461									
2004	5 900 810	13	1	470	0.01	0.23	46	IE	IE	IE
2005	6 407 738									
2006	6 487 155									

Electric Furnace Steel Plant

Estimation of emissions from electric furnace steel plants was carried out by multiplying an emission factor with production data. Activity data were obtained from the *Association of Mining and Steel Industries* and thus represent plant specific data. The used emission factors and their sources are summarized in Table 238 together with electric steel production figures.

Table 238: Activity data and emission factors for emissions from Electric Steel Production 1990–2006.

	1990	1995	2000	2004	2005	2006
Electric steel production [Mg]						
Activity	370 107	453 645	540 539	614 362	624 262	639 845
Emission factor [g/Mg Electric steel production]						
SO_2	590(1)	511(3)	119(3)	40 (2)	40(2)	40(2)
NO_x	330(1)	295(3)	119(3)	84 (2)	84(2)	84(2)
NMVOC	60(1)	60(1)	60(1)	60 (1)	60(1)	60(1)
CO	52 000(1)	44 594(3)	7 565(3)	159 (2)	159(2)	159(2)
Emission factor [mg/Mg Electric steel produced]						
Cd	80.0(4)	13.0(5)	13.0(5)	0.4 (2)	0.4(2)	0.4(2)
Hg	75.0(4)	1.0(5)	1.0(5)	1.0 (5)	1.0(5)	1.0(5)
Pb	4 125.0(4)	470.0(5)	470.0(5)	19.3 (2)	19.3(2)	19.3(2)
PAH	4.6(6)	4.6(6)	4.6(6)	4.6 (6)	4.6(6)	4.6(6)

[100] according to CORINAIR (1995), VAN DER MOST et.al. (1992), WINIWARTER & SCHNEIDER (1995)

	1990	1995	2000	2004	2005	2006
	Emission factor [µg/Mg Electric steel produced]					
DIOX	4.2(6)	1.4(6)	1.4(6)	0.1 (2)	0.1(2)	0.1(2)
HCB	840.0(6)	280.0(6)	280.0(6)	20.0 (2)	20.0(2)	20.0(2)
	Emission factor [g/Mg Electric steel produced]					
TSP	610.0(7)	610.0(7)	30.0(7)	30.0(7)	30.0(7)	30.0(7)
PM10	579.5(8)	579.5(8)	28.5(8)	28.5(8)	28.5(8)	28.5(8)
PM2.5	549.0(9)	549.0(9)	27.0(9)	27.0(9)	27.0(9)	27.0(9)

Emission factor sources:

(1) *(WINDSPERGER & TURI 1997), study published by the Austrian chamber of commerce, section industry. For NMVOC emissions it was assumed that total VOC emissions as presented in the study are composed of 10% CH_4 and 90% NMVOC (expert judgement UMWELTBUNDESAMT).*

(2) *Mean values as reported from industry (Association of Mining and Steel Industries).*

(3) *Interpolated values (expert judgement UMWELTBUNDESAMT).*

(4) *(WINDSPERGER et. al. 1999[100])*

(5) *(HÜBNER 2001a[97])*

(6) *(HÜBNER 2001b[98])*

(7) *(EMEP/CORINAIR EMISSION INVENTORY GUIDEBOOK 2006)*

(8) *Expert judgement: 95% TSP*

(9) *Expert judgement: 90% TSP*

Rolling Mills

The emission factor for VOC emissions from rolling mills was reported directly by industry and thus represents plant specific data. It was assumed that VOC emissions are composed of 10% CH_4 and 90% NMVOC (expert judgement UMWELTBUNDESAMT) resulting in an emission factor of 0.9 g NMVOC/Mg steel produced.

Steel production data was taken from national production statistics, the amount of electric steel was subtracted.

Iron Cast

SO_2, NO_x, NMVOC and CO emissions were calculated by multiplying iron cast (sum of grey cast iron, cast iron and cast steel) with national emission factors. Activity data were obtained from „Fachverband der Gießereiindustrie Österreichs" (association of the Austrian foundry industry). The applied emission factors were taken from a study commissioned by the same association (FACHVERBAND DER GIESSEREIINDUSTRIE) and from direct information from this association.

Table 239: Emission factors and activity data for cast iron 1990–2006.

Year	Emission factors [g/Mg]				Activity [Mg]
	SO_2	NO_x	NMVOC	CO	Iron cast
1990	170	170	1 450	20 020	196 844
1995	140	160	1 260	11 590	176 486
2000	140	160	1 260	11 590	191 420
2004	130	151	1 180	10 843	194 114
2005	130	151	1 180	10 843	196 017
2006	130	151	1 180	10 843	207 134

Steel Cast

Emission factors for POP emissions were taken from a national study (HÜBNER 2001b). The emission factors used are 4.6 mg PAH/Mg cast iron 0.03 µg Dioxine/Mg cast iron and 6.4 µg HCB/Mg cast iron. Heavy metal emissions were calculated by multiplying national emission factors 1990–1994 (WINDSPERGER et. al. 1999), 1995–2004 (HÜBNER 2001a) with the same activity data used for POP emissions. The emission factors used are 1 mg Hg/Mg cast iron, 80 mg Cd (1990: 110 mg)/Mg cast iron and 2 g Pb (1990: 4.6 g)/Mg cast iron. Activity data until 1995 is taken from a national study (HÜBNER 2001b). From 1996 onwards data published by the Association of the Austrian foundry industry (FACHVERBAND der GIESSEREIINDUSTRIE) has been used.

Table 240: Activity data for cast steel 1990–2006.

Year	Activity [Mg]
1990	86 844
1995	107 486
2000	116 766
2004	118 410
2005	119 570
2006	126 352

Recalculations

Dioxine emissions from blast furnace charging in 2005 were updated according to information provided by the operator.

5.6.2 Non-ferrous Metals

In this category process emissions from non-ferrous metal production as well as from non-ferrous metal cast (light metal cast and heavy metal cast) are considered.

Non-ferrous Metals Production

Emission estimates for Non-ferrous Metal Production were taken from a study (WINDSPERGER & TURI 1997) and used for all years: 0.4 Gg SO_2, 0.01 Gg NMVOC and 0.2 Gg CO.

POP emissions from Aluminium Production were estimated in a national study (HÜBNER 2001b[101]) and were 6 090 kg PAH and 0.002 g Dioxine in 1990. Primary Aluminium production in Austria was terminated in 1992.

Non-ferrous Metals Casting

Activity data were obtained from „Fachverband der Gießereiindustrie Österreichs" (association of the Austrian foundry industry). The applied emission factors as presented below were taken from a study commissioned by the same association (FACHVERBAND der GIESSEREIINDUSTRIE) and from direct information from this association.

[101] according to WURST, F. & C.HÜBNER (1997); UBA data base; EUROPEAN COMMISSION IPPC BUREAU (2000); NEUBACHER, F. et al. (1993)

Table 241: Emission factors and activity data for light metal cast 1990–2005.

Year	Emission factors [g/Mg]				Activity [Mg]
	SO_2	NO_x	NMVOC	CO	Light metal cast
1990	120	330	4 040	2 340	46 316
1995	10	230	1 740	880	59 834
2000	10	230	1 740	880	92 695
2004	10	170	1 289	660	115 292
2005	10	170	1 289	660	109 927
2006	10	170	1 289	660	114 110

Table 242: Emission factors and activity data for heavy metal cast 1990–2005.

Year	Emission factors [g/Mg]				Activity [Mg]
	SO_2	NO_x	NMVOC	CO	Heavy metal cast
1990	100	100	1 390	3 290	8 525
1995	80	80	1 180	2 770	10 384
2000	80	80	1 180	2 770	13 214
2004	80	80	1 180	2 770	15 799
2005	80	80	1 180	2 770	18 456
2006	80	80	1 180	2 770	16 722

5.7 NFR 2 D Other Production

Key source: NMVOC, TSP

5.7.1 NFR 2 D 1 Pulp and Paper

Source Category Description

As emissions from pulp and paper production mainly arise from combustion activities, they are included in *1 A 2 Combustion in Manufacturing Industries*.

In this category NO_x, NMVOC and CO emissions from chipboard production and TSP, PM10 and PM2.5 emissions from wood-chips industry are considered.

Methodological Issues

NO_x, NMVOC and CO emissions were calculated by applying national emission factors on production data (activity data). Activity data were taken from Statistik Austria. The values of 1995, 1998 and 2005 were also used for the year after because no data is available for these years. The applied emission factors were taken from a study (WURST et al. 1994), the values of 492 g NO_x/Mg, 361 g NMVOC/Mg and 357 g CO/Mg chipboard produced is a mean value of values obtained by inquiries of different companies producing chipboards.

Table 243: Activity data for chipboard production 1990–2006.

Year	Activity [Mg]
1990	1 121 786
1995	1 194 262
2000	1 509 673
2004	1 248 028
2005	2 182 251
2006	2 182 251

The wood-chips industry includes PM emissions from supply (production) and handling of wood-chips and sawmill-by-products for the use in chipboard and paper industry and for the use in combustion plants.

Particular matter emissions were estimated in a national study (WINIWARTER et al. 2007) for the year 2001. For supply and handling for the use in industry the same values were taken for the whole time-series due to a lack of available activity data. For supply and handling for the use in combustion plants an implied emission factor was calculated with the cross consumption of wood waste in the national energy balance (ref) that was applied to the whole time-series.

Table 244: Activity data and emission factors for supply (production) and handling of wood-chips and sawmill-by-products for the use in chipboard and paper industry.

		Supply (production)	Handling
Activity [Mg]	logs	5 600 000	
	Wood-chips and sawmill-by-products		4 800 000
Emission factor [g/Mg]	TSP	30.0	20.0
	PM10	12.0	8.0
	PM2.5	4.8	3.2

Table 245: Activity data and emissions for supply (production) and handling of wood-chips and sawmill-by-products for the use in combustion plants.

Year	Wood waste – cross consumption [TJ]	Emissions [Mg]		
		TSP	PM10	PM2.5
1990	12 099	28.20	11.28	4.51
1995	12 770	29.76	11.90	4.76
2000	30 285	70.58	28.23	11.29
2001	30 036	70.00	28.00	11.20
2002	31 786	74.08	29.63	11.85
2003	34 899	81.33	32.53	13.01
2004	34 318	79.98	31.99	12.80
2005	35 311	82.29	32.92	13.17
2006	38 641	90.05	36.02	14.41

Planned Improvements

In chipboard production gas and wood dust are used as fuels. As wood dust accumulates as waste material during chipboard production it is not reported as a fuel in the energy balance, where fuel gas is reported and included in the fuel input of SNAP Category 03 *Combustion in Production Processes*.

As the used emission factor from SNAP Category 040601 Chipboard Production refers to all emissions from chipboard production but emissions due combustion of fuel gas in chipboard production are also included in SNAP 03, these emissions are counted double. However, it is not possible to separate emissions due to combustion of wood dust from gas as no detailed fuel input figures for chipboard production are available. Further investigation of this subject is planned and if possible the double count will be eliminated.

Recalculation

Activity data for the year 2005 was updated using statistical data, for the last submission this value was not available. Particular matter emissions from wood-chips industry were included for the whole time-series.

5.7.2 NFR 2 D 2 Food and Drink

Source Category Description

This category includes NMVOC emissions from the production of bread, wine, spirits and beer and PM emissions from the production of beer. Furthermore this category includes POP emissions from smokehouses.

Methodological Issues

NMVOC emissions were calculated by multiplying the annual production with an emission factor.

The following emission factors were applied:

- Bread ......4 200 kg_{NMVOC}/Mg_{bread}
- Wine ....65 kg_{NMVOC}/hl_{wine}
- Beer ....20 kg_{NMVOC}/hl_{beer}
- Spirits......2 000 kg_{NMVOC}/hl_{spirit}

All emission factors were taken from (BUWAL 1995) because of the very similar structures and standards of industry in Austria and Switzerland. Activity data was taken from national statistics (STATISTIK AUSTRIA), for the year 2005 no activity data was available, that's why the values of 2004 were also used for 2005.

PM emissions from beer production correspond to fugitive emissions from barley used for the production of malt. Emissions were estimated in a national study (WINIWARTER et al. 2001) and are:

- TSP.........1990: 2.2 Mg, 1995: 2.1 Mg, 1999–2005: 1.9 Mg
- PM10 ......1990: 1.1 Mg, 1995: 1.0 Mg, 1999–2005: 0.9 Mg
- PM2.5 .....1990: 0.5 Mg, 1995: 0.3 Mg, 1999–2005: 0.3 Mg

POP emissions from smokehouses were estimated in an unpublished study (HÜBNER 2001b[102]) that evaluates POP emissions in Austria from 1985 to 1999. The authors of this study calculated POP emissions using technical information on smokehouses and the number of smokehouses from literature (WURST & HÜBNER 1997), (MEISTERHOFER 1986). The amount on smoked meat was also investigated by the authors of this study. From 1999 onwards the emission values from 1999 have been used as no updated emissions have been available. Activity data and emissions are presented in Table 246.

Table 246: POP emissions and activity data from smokehouses 1990–2006.

Year	Emissions			Activity [Mg]
	PAH [kg]	Diox [g]	HCB [g]	Smoked meat
1990	545	1.8	358	15 318
1995	107	0.4	72	19 533
2000	37	0.1	26	19 533
2004				
2005				
2006				

Recalculations

Activity data (bread, wine, beer, spirits) for the year 2005 were updated using statistical data, for the last submission these values were not available.

5.7.3 NFR 2 D 4 Wood Processing

Source Category Description

This category includes TSP, PM10 and PM2.5 emissions from wood processing.

Methodological Issues

The methodology for emission calculation was developed in a national study (WINIWARTER et al. 2008) and emissions were calculated for 2001 applying emission factors of a swiss study (EMPA 2004) to Austrian activities. Two major sources are identified: the sawmill industry including wood-processing and the chipboard industry.

For sawmills and wood-processing this resulted to the following combined emission factors TSP: 149.5 g/scm; PM10: 59.8 g/scm; PM2.5: 23.92 g/scm; applied to an activity of 4 Mio solid cubic metres (scm). Due to lack of activity data these values were used for the whole time-series.

For chipboard industry emissions of 43.4 Mg TSP, 17.4 Mg PM10 and 6.9 Mg PM2.5 in the year 2001 were calculated applying the previously mentioned method. With these emissions an implied emission factor was calculated with the chipboard production from national statistics (STATISTIK AUSTRIA 2007) that was applied to the whole time-series of chipboard production.

[102]according to MEISTERHOFER (1986)

Table 247: Activity data and emissions for supply (production) and handling of wood-chips and sawmill-by-products for combustion plants.

Year	Chipboard production [Mg]	Emissions [Mg]		
		TSP	PM10	PM2.5
1990	1 121 786	29.12	11.65	4.66
1995	1 194 262	31.00	12.40	4.96
2000	1 509 673	39.19	15.68	6.27
2001	1 248 028	43.38	17.35	6.94
2002	2 182 251	46.34	18.54	7.42
2003	2 182 251	29.51	11.80	4.72
2004	1 121 786	32.40	12.96	5.18
2005	1 194 262	56.65	22.66	9.06
2006	1 509 673	66.46	26.58	10.63

Recalculations

The method for the calculation of PM emissions from sawmills and wood-processing was updated according to a new national study (WINIWARTER et al. 2008) and allocated from NFR category 2 A 7 to 2 D 4. PM emissions from chipboard production were included.

6 SOLVENT AND OTHER PRODUCT USE (NFR SECTOR 3)

6.1 Sector Overview

This chapter describes the methodology used for calculating NMVOC emissions from solvent use in Austria, which is also basis for calculating GHG emissions from Solvent use. Solvents are chemical compounds, which are used to dissolve substances as paint, glues, ink, rubber, plastic, pesticides or for cleaning purposes (degreasing). The following activities are covered by NFR sector 3:

NFR	Description
3 A	PAINT APPLICATION
3 A 1	*Decorative paint application*
3 A 2	*Industrial paint application*
3 A 3	*Other paint application*
3 B	DEGREASING AND DRY CLEANING
3 B 1	*Degreasing*
3 B 2	*Dry cleaning*
3 B 3	*Other (please specify)*
3 C	CHEMICAL PRODUCTS, MANUFACTURE AND PROCESSING
3 D	OTHER including products containing HMs and POPs
3 D 1	*Printing*
3 D 2	*Preservation of wood*
3 D 3	*Domestic solvent use*
3 D 4	*Other including products containing HMs and POPs*

After application of these substances or other procedures of solvent use most of the solvents are released into air. Because solvents consist mainly of NMVOC, solvent use is a major source for anthropogenic NMVOC emissions in Austria. Once released into the atmosphere NMVOCs react with reactive molecules (mainly HO-radicals) or high energetic light to finally form CO_2.

Besides NMVOC further air pollutants from solvent use are relevant:

- Cd and Pb from NFR Sector 3 C Chemical products, manufacture and processing as well as
- PAH, dioxins and HCB from NFR Sector 3 D 2 Preservation of wood.

In the year 2006 this category had a contribution of 55% to NMVOC emissions (94 Gg NMVOC). There has been a decrease of 19% in NMVOC emissions from 1990 to 2006 (see Table 252) due to the positive impact of various enforced laws and regulations in Austria:

- Solvent Ordinance: for limitation of emission of volatile organic compounds due to the use of organic solvents in certain paints and varnishes and vehicle refinishing products in order to combat acidification and ground-level ozone

  Federal Law Gazette II No. 398/2005[103]*, amendment of Federal Law Gazette 872/1995*[104]*; amendment of Federal Law Gazette 492/1991*[105] *(implementation of Council Directive 2004/42/CE)*

- Ordinance for paint finishing system (surface technology systems): for limitation of emission of volatile organic compounds due to the use of organic solvents by activities such as surface coating, painting or varnishing of different materials and products along the entire chain in the painting process in order to combat acidification and ground-level ozone

  Federal Law Gazette 873/1995[106]*, amendment of Federal Law Gazette 27/1990*[107]

- Federal Ozone Law: establishes by various measures a reduction in emissions of ozone precursors NO_x and NMVOC

  Federal Law Gazette 309/1994; amendment of Federal Law Gazette 210/1992[108]

- Ordinance for industrial facilities and installations applying chlorinated hydrocarbon: for limitation of emission of chlorinated organic solvents from industrial facilities and installations applying chlorinated hydrocarbon

  Federal Law Gazette 865/1994[109]

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[103] Verordnung des Bundesministers für Land- und Forstwirtschaft, Umwelt und Wasserwirtschaft über die Begrenzung der Emissionen flüchtiger organischer Verbindungen durch Beschränkung des Inverkehrsetzens und der Verwendung organischer Lösungsmittel in bestimmten Farben und Lacken (Lösungsmittelverordnung 2005 – LMV 2005), BGBl. II Nr. 398/2005; Umsetzung der Richtlinie 2004/42/EG

[104] Verordnung des Bundesministers für Umwelt über Verbote und Beschränkungen von organischen Lösungsmitteln (Lösungsmittelverordnung 1995 – LMVO 1995), BGBl. 872/1995

[105] Verordnung des Bundesministers für Umwelt, Jugend und Familie über Verbote und Beschränkungen von organischen Lösungsmitteln (Lösungsmittelverordnung), BGBl. Nr. 492/1991

[106] Verordnung des Bundesministers für wirtschaftliche Angelegenheiten über die Begrenzung der Emission von luftverunreinigenden Stoffen aus Lackieranlagen in gewerblichen Betriebsanlagen (Lackieranlagen-Verordnung), BGBl. Nr. 873/1995

[107] Verordnung des Bundesministers für wirtschaftliche Angelegenheiten vom 26. April 1989 über die Begrenzung der Emission von chlorierten organischen Lösemitteln aus CKW-Anlagen in gewerblichen Betriebsanlagen (CKW-Anlagen-Verordnung), BGBl. Nr. 27/1990

[108] Bundesgesetz über Maßnahmen zur Abwehr der Ozonbelastung und die Information der Bevölkerung über hohe Ozonbelastungen, mit dem das Smogalarmgesetz, BGBl. Nr. 38/1989, geändert wird (Ozongesetz)

[109] Verordnung des Bundesministers für wirtschaftliche Angelegenheiten über die Begrenzung der Emission von chlorierten organischen Lösemitteln aus CKW-Anlagen in gewerblichen Betriebsanlagen (CKW-Anlagen-Verordnung 1994), BGBl. Nr. 865/1994

- Convention on Long-range Transboundary Air Pollution (LRTAP)[110], extended by eight protocols from which the following have relevance
  - The 1988 Protocol concerning the Control of Nitrogen Oxides or their Transboundary Fluxes[111]
  - The 1991 Protocol concerning the Control of Emissions of Volatile Organic Compounds or their Transboundary Fluxes[112]
  - The 1998 Protocol on Persistent Organic Pollutants (POPs)[113]
  - The 1999 Protocol to Abate Acidification, Eutrophication and Ground-level Ozone; 21 Parties.[114]
- Ordinance for volatile organic compounds (VOC) due to the use of organic solvents in certain activities and installations;

  Federal Law Gazette II No. 301/2002[115], amended by Federal Law Gazette[116]
- Council Directive 1999/13/EC[117] of March 1999 on the limitation of emissions of volatile organic compounds due to the use of organic solvents in certain activities and installations
- Council Directive 2004/42/CE[118] of the European Parliament and of the Council of 21 April 2004 on the limitation of emissions of volatile organic compounds due to the use of organic solvents in certain paints and varnishes and vehicle refinishing products and amending Directive 1999/13/EC
- Ordinance on the limitation of emission during the use of solvents containing lightly volatile halogenated hydrocarbons in industrial facilities and installations

  Federal Law Gazette II No. 411/2005[119]

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[110] Entered into force 14 February 1991; ratified by Austria 16 December 1982

[111] Entered into force 14 February 1991; ratified by Austria 15 January 1990; BGBl. Nr. 273/1991

[112] Entered into force 29 September 1997; ratified by Austria 23 August 1994; Bekämpfung von Emissionen flüchtiger organischer Verbindungen oder ihres grenzüberschreitenden Flusses samt Anhängen und Erklärung, BGBl. III Nr. 164/1997

[113] Entered into force on 23 October 2003; ratified by Austria 27 August 2002

[114] Entered into force on 17 May 2005; signed by Austria 1 December 2000

[115] Verordnung des Bundesministers für Wirtschaft und Arbeit zur Umsetzung der Richtlinie 1999/13/EG über die Begrenzung der Emissionen bei der Verwendung organischer Lösungsmittel in gewerblichen Betriebsanlagen (VOC-Anlagen-Verordnung – VAV), BGBl. II Nr. 301/2002

[116] Änderung der VOC-Anlagen-Verordnung – VAV, BGBl. II Nr. 42/2005

[117] Richtlinie 1999/13/EG des Rates vom 11. März 1999 über die Begrenzung von Emissionen flüchtiger organischer Verbindungen, die bei bestimmten Tätigkeiten und in bestimmten Anlagen bei der Verwendung organischer Lösungsmittel entstehen

[118] Richtlinie 2004/42/EG des Europäischen Rates vom 21. April 2004 über die Begrenzung von Emissionen flüchtiger organischer Verbindungen aufgrund der Verwendung organischer Lösemittel in bestimmten Farben und Lacken und in Produkten der Fahrzeugreparaturlackierung sowie zur Änderung der Richtlinie 1999/13/EG

[119] Verordnung des Bundesministers für Wirtschaft und Arbeit über die Begrenzung der Emissionen bei der Verwendung halogenierter organischer Lösungsmittel in gewerblichen Betriebsanlagen (HKW-Anlagen-Verordnung – HAV) BGBl. II Nr. 411/2005

In emission intensive activity areas such as coating, painting, and printing as well as in the pharmaceutical industry several measures were implemented:

- Primary measures
  - complete substitution of certain solvents
  - reduction of the solvent content by changing the composition of solvent containing products
  - technological change from solvent emitting processes to low or non-solvent emitting processes
  - implementation of resources saving procedures and techniques
  - installation of new equipments and facilities and shutdown of old equipments and facilities
  - avoidance of fugitive emissions
- Secondary measures
  - waste gas collection and waste gas purification, whereas the solvents in the exhaust air are precipitated and either recycled if applicable or destructed.
  - raising of environmental awareness
  - compliance with emission limit values for exhaust gas
  - compilation of solvent balance
  - compilation of solvent reduction plan

6.1.1 Key categories

The methodology and results of the key source category analysis is presented in Chapter 1.4. Table 248 summerize the key categories in the NFR Sector 3 Solvent and Other Product Use. NMVOC, PM10 and PM2.5 emissions of this source have been identified as key category.

Table 248: Key Source in NFR sector 3 Solvent and Other Product Use.

	3 Solvent and Other Product Use		3 Solvent and Other Product Use
SO_2		PAH	
NO_x		Diox	
NMVOC	**55.31**	HCB	
NH_3		TSP	0.59
CO		PM10	**1.01**
Cd		PM2.5	**1.94**
Hg			
Pb			

Note: grey shaded are key sources

6.1.2 Emission Trends

In the NFR Sector 3 *Solvent and Other Product Use* there are no emissions of SO_2, NH_3, CO and NO_x as well as no Pb.

NEC gases and CO

NMVOC Emissions (key source)

Sector 3 *Solvent and Other Product Use* is the largest Sector regarding NMVOC emissions and thus also a key source; in 1990 the contribution to national total emissions was 41% (117 Gg) compared to 55% (96 Gg) in 2006 due to decreasing emissions from other sectors such as NFR 2 *Industrial Processes* and NFR 1 *Energy*.

The trend regarding NMVOC emissions from NFR 3 *Solvent and Other Product Use* shows decreasing emissions: in the period from 1990 to 2005 emissions increased by 16%, mainly due to increasing emissions from NFR 3 *A Paint Application*, whose share in sector NFR 3 was 40% in 1990 and 29% in 2006, respectively (see Table 249). This reduction was primarily achieved from 1990 to 1992 due to different enforced laws and regulations.

Other contributors to NMVOC emissions from NFR 3 are the sub sectors NFR 3 B *Degreasing and Dry Cleaning,* NFR 3 C *Degreasing and Dry Cleaning and NFR 3 D Other*, with a share of 7% (NFR 3 B), 7% (NFR 3 C) and 26% (NFR 3 D) of the National NMVOC emissions in 2006 (see Table 249):

- NMVOC emissions from NFR *3 A Paint Applications* arose from the following sub categories
  - NFR 3 A 1 *Decorative Paint Application* which covers the use of paint in the area of construction and buildings (SNAP 060103) and for domestic use (except do-it-yourself)(SNAP 060104). NMVOC emissions decreased by 16% to 6.4 Gg in the period 1990–2006 due to a reduction of solvents in paint as well as due to substitution solvents based paint for paint with less or without solvents. The quantity of used solvents is reduced by about 14% within this period.
  - NFR 3 A 2 *Industrial Paint Application* which covers processes such as car repairing (SNAP 060102), coil coating (SNAP 060105), wood conditioning (SNAP 060107) and other industrial paint application (SNAP 060108). The NMVOC emissions decreased by 46% to 20.8 Gg in the period 1990–2006 but the reduction in emission happened mainly from 1990 to 1995 due to different enforced laws and regulations; since then the emissions remained stable. The quantity of used solvents is reduced by about 14% within this period.
    NFR 3 A 2 (I) *Manufacture of automobiles* (SNAP 060101) which covers the use of paint in the automobile industry. NMVOC emissions decreased by 29% to 1.2 Gg in the period 1990–2006 due to a reduction of solvents in paint as well as due to substitution solvents based paint for paint with less or without solvents. The quantity of used solvents is reduced by about 16% within this period.
- NMVOC emissions from sub sector *3 B Degreasing and Dry Cleaning,* which had a share of 12% in NFR 3, arose in 2006 from the following sub categories
  - NFR 3 B 1 *Met*al Degreasing, where the emissions decreased by 50% to about 4.4 Gg;
  - NFR 3 B 2 Dry Cleaning, where the emissions increased by 13% to 0.5 Gg;
  - NFR 3 B 3 Other, where the emissions increased by 48% to 6.9 Gg.

The emission reduction in this sub sector could be achieved due to technical abatement measures such as closed loop processes, waste gas purification and recycling. The quantity of used solvents is increased by about 29% within the period 1990 – 2006, which compansates the reduction due to technical abetement measures.

- The share of NMVOC emissions from sub sector NFR 3 C *Chemical Products, Manufacture and Processing* in national total emissions was about 7% in 1990 and also 2006 whereas an emission reduction of 7% could be achieved due to technical abatement measures such as closed loop processes, waste gas purification and recycling but also due to product substitution. The NFR 3 C covers activities such as rubber processing, asphalt blowing, textile finishing and leather tanning as well as the manufacturing of pharmaceutical products, paints, inks and glues.
- The share of NMVOC emissions from sub sector NFR 3 D *Other* in sector NFR 3 is about 33% in 1990 and about 47% in 2006 whereas an emission reduction of 17% could be achieved. Sub sector *3 D* causes the following emission sources
  - NFR *3 D 1 Printing* with a share of 10% in NFR 3 and an emissions reduction of 27% (9.4 Gg);
  - *NFR 3 D 2 Preservation of wood* with a share of about 1% in NFR 3 and an emissions increas of 8% (0.7 Gg);
  - *NFR 3 D 3 Domestic Solvent Use* with a share of 32% in NFR 3 and an emissions increased by 84% (30.5 Gg);
  - *NFR* 3 D 4 *Other* with a share of 4% in NFR 3 and a decrease in emissions of 51% (3.9 Gg).

The emission reduction could be achieved due to technical abatement measures such as closed loop processes, waste gas purification and recycling. The high increase of the NMVOC emissions in category 3 D 3 is due to a considerable increase of do-it-yourself activities.

Table 249: NMVOC emissions and trends from Sector 3 A Paint Application and 3 B Degreasing and Dry Clean 1990–2006.

NMVOC [Gg]	3	3 A	3 A 1	3 A 2	3 B	3 B 1	3 B 2	3 B 3
1990	116.95	46.31	7.64	38.67	13.90	8.78	0.44	4.67
1991	100.08	38.21	6.44	31.77	11.40	6.85	0.39	4.16
1992	82.33	29.89	5.16	24.73	8.93	5.06	0.32	3.55
1993	82.43	29.17	5.19	23.98	8.82	4.66	0.34	3.82
1994	77.06	26.04	4.82	21.23	8.07	3.91	0.33	3.82
1995	81.75	26.57	5.15	21.42	8.57	3.76	0.38	4.44
1996	78.07	24.54	4.94	19.60	8.40	3.57	0.37	4.47
1997	82.93	25.56	5.35	20.21	9.28	3.81	0.40	5.06
1998	75.54	22.33	4.86	17.47	8.59	3.42	0.37	4.81
1999	69.96	19.84	4.50	15.34	8.10	3.11	0.35	4.64
2000	77.74	21.66	5.12	16.54	9.38	3.47	0.40	5.51
2001	92.36	26.31	6.21	20.09	11.39	4.21	0.48	6.69
2002	96.90	27.81	6.57	21.24	12.04	4.45	0.51	7.07
2003	93.55	26.82	6.34	20.49	11.61	4.30	0.49	6.82
2004	91.83	26.27	6.21	20.07	11.37	4.21	0.48	6.68
2005	81.80	23.20	5.48	17.72	10.05	3.72	0.43	5.90
2006	94.92	27.25	6.44	20.81	11.80	4.36	0.50	6.93

NMVOC [Gg]	3	3 A	3 A 1	3 A 2	3 B	3 B 1	3 B 2	3 B 3
Trend								
1990–2006	*-18.8%*	*-41.2%*	*-15.8%*	*-46.2%*	*-15.1%*	*-50.3%*	*13.0%*	*48.3%*
2005–2006	*16.0%*	*17.4%*	*17.4%*	*17.4%*	*17.4%*	*17.4%*	*17.4%*	*17.4%*
Share in Sector Solvent and Other Product Use								
1990		*39.6%*	*6.5%*	*33.1%*	*11.9%*	*7.5%*	*0.4%*	*4.0%*
2006		*28.7%*	*6.8%*	*21.9%*	*12.4%*	*4.6%*	*0.5%*	*7.3%*
Share in National Total								
1990	*41.3%*	*16.4%*	*2.7%*	*13.7%*	*4.9%*	*3.1%*	*0.2%*	*1.7%*
2006	*55.3%*	*15.9%*	*3.7%*	*12.1%*	*6.9%*	*2.5%*	*0.3%*	*4.0%*

Table 250: NMVOC emissions and trends from Sector 3 C Chemical Products, Manufacture and Processing and 3 D Other 1990–2006.

NMVOC [Gg]	3	3 C	3 D	3 D 1	3 D 2	3 D 3	3 D 4
1990	116.95	18.76	37.99	12.84	0.68	16.53	7.95
1991	100.08	16.91	33.56	10.90	0.60	15.65	6.41
1992	82.33	15.16	28.35	8.83	0.51	14.12	4.88
1993	82.43	14.24	30.20	9.01	0.55	16.02	4.62
1994	77.06	13.15	29.81	8.50	0.54	16.80	3.97
1995	81.75	12.42	34.18	9.29	0.62	20.42	3.85
1996	78.07	12.11	33.02	8.56	0.59	20.31	3.55
1997	82.93	12.08	36.02	8.90	0.63	22.80	3.70
1998	75.54	11.62	33.00	7.75	0.57	21.46	3.22
1999	69.96	11.22	30.81	6.86	0.52	20.57	2.85
2000	77.74	11.33	35.38	7.46	0.58	24.23	3.11
2001	92.36	11.69	42.98	9.07	0.71	29.43	3.77
2002	96.90	11.62	45.43	9.58	0.75	31.11	3.99
2003	93.55	11.29	43.82	9.24	0.72	30.01	3.85
2004	91.83	11.26	42.92	9.05	0.70	29.40	3.77
2005	81.80	10.64	37.91	8.00	0.62	25.96	3.33
2006	94.92	11.37	44.51	9.39	0.73	30.48	3.91
Trend							
1990–2006	*-18.8%*	*-39.4%*	*17.2%*	*-26.8%*	*7.5%*	*84.4%*	*-50.8%*
2005–2006	*16.0%*	*6.9%*	*17.4%*	*17.4%*	*17.4%*	*17.4%*	*17.4%*
Share in Sector Solvent and Other Product Use							
1990		*16.0%*	*32.5%*	*11.0%*	*0.6%*	*14.1%*	*6.8%*
2006		*12.0%*	*46.9%*	*9.9%*	*0.8%*	*32.1%*	*4.1%*
Share in National Total							
1990	*41.3%*	*6.6%*	*13.4%*	*4.5%*	*0.2%*	*5.8%*	*2.8%*
2006	*55.3%*	*6.6%*	*25.9%*	*5.5%*	*0.4%*	*17.8%*	*2.3%*

Emissions of Particulate Matter (key source)

PM emissions of NFR Category 3 *Solvent and Other Product Use* includes emissions from tabacoo consumption and fireworks. These emissions are estimated the first time. As shown in Table 252 in the period from 1990 to 2006

- **PM10 and PM2.5** emissions increased by 8% to 439 Mg respectively, which is a share of about 1.0% of national total PM10 emission;
- **TSP** emissions increased by 8% to 439 Mg, which is a share of about 0.6% of national total TSP emission;

Heavy metal Emissions

NFR Category 3 *Solvent and Other Product Use* is also a minor source for emissions of the heavy metals Cd and Pb. As shown in Table 252 in the period from 1990 to 2005[120]

- **Cd** emissions decreased by 58% to 0.25 kg, which is a share of less than 0.1% of national total Cd emission;
- **Pb** emissions decrease by 58% to 28.7 kg, which is a share of about 0.2% of national total Pb emission.

Emissions exclusively arise from sub-sector NFR 3 C, which covers activities such as asphalt blowing, and leather tanning as well as the manufacturing of pharmaceutical products, paints, inks and glues. The emission reduction could be achieved due to technical abatement measures such as closed loop processes, waste gas purification and recycling but also due to product substitution.

Persistent organic pollutants (POPs)

POP emissions from NFR Category 3 *Solvent and Other Product Use* arose from 3 B and 3 D 2, where emissions of **PAH** stopped in 1997, emissions of **dioxin/furan** stopped in 1993 and emissions of **HCB** stopped in 2001.

Especially in case of HCB emission an enormous reduction could be realized: the production and use of HCB for preservation of wood is forbidden since 1992.

[120] Value for 2005; value for 2006 are NR because of a transcription error; will be corrected with the next submission

Table 251: HCB emissions and trends from Sector 3 Solvent and Other Product Use and source categories 1990–2006.

HCB [g]	3	3 B	3 B 1	3 B 2	3 B 3	3 D 2
	Solvent and Other Product Use	**Degreasing and Dry Cleaning**	**Degreasing**	**Dry Cleaning**	**Other**	**Preservation of Wood(1)**
1990	9053.29	3.29	1.88	0.09	1.32	9050.00
1991	6391.88	2.88	1.59	0.08	1.20	6389.00
1992	7491.16	2.41	1.29	0.07	1.05	7488.75
1993	6473.29	2.54	1.31	0.08	1.15	6470.75
1994	1252.48	2.48	1.23	0.07	1.17	1250.00
1995	2.81	2.81	1.34	0.09	1.38	NA
1996	2.80	2.80	1.33	0.08	1.39	NA
1997	3.16	3.16	1.48	0.09	1.58	NA
1998	2.98	2.98	1.39	0.09	1.51	NA
1999	2.87	2.87	1.32	0.08	1.46	NA
2000	3.38	3.38	1.55	0.09	1.74	NA
2001	4.11	4.11	1.89	0.11	2.11	NA
2002–2006	NA	NA	NA	NA	NA	NA
Trend						
1990–2006	*-100%*	*-100%*	*-100%*	*-100%*	*-100%*	*-100%*
Share in Sector Solvent and Other Product Use						
1990		*< 0.1%*	*< 0.1%*	*< 0.1%*	*< 0.1%*	*> 99.9%*
2006		-	-	-	-	-
Share in National Total						
1990	*9.9%*	*< 0.1%*	*< 0.1%*	*< 0.1%*	*< 0.1%*	*9.9%*
2006	-	-	-	-	-	-

Table 252: Emissions and trends from NFR Category 3 Solvent and Other Product Use 1990–2006.

Year	SO_2	NO_x	NMVOC	CO	NH_3	TSP	PM10	PM2.5	Cd	Hg	Pb	PAH	Dioxin	HCB
			[Gg]				[Mg]			[kg]		[kg]	[g]	[g]
1990	NA	NA	116.95	NA	NA	406.93	406.93	406.93	0.60	NA	68.35	151.73	1.06	9053.29
1991	NA	NA	100.08	NA	NA	NR	NR	NR	0.55	NA	62.67	151.73	1.04	6391.88
1992	NA	NA	82.33	NA	NA	NR	NR	NR	0.50	NA	56.99	109.48	0.02	7491.16
1993	NA	NA	82.43	NA	NA	NR	NR	NR	0.45	NA	51.31	73.90	0.02	6473.29
1994	NA	NA	77.06	NA	NA	NR	NR	NR	0.40	NA	45.63	55.80	NA	1252.48
1995	NA	NA	81.75	NA	NA	421.26	421.26	421.26	0.35	NA	39.95	35.91	NA	2.81
1996	NA	NA	78.07	NA	NA	NR	NR	NR	0.34	NA	39.31	15.00	NA	2.80
1997	NA	NA	82.93	NA	NA	NR	NR	NR	0.34	NA	38.67	6.80	NA	3.16
1998	NA	NA	75.54	NA	NA	NR	NR	NR	0.33	NA	38.03	NA	NA	2.98
1999	NA	NA	69.96	NA	NA	423.59	423.59	423.59	0.33	NA	37.39	NA	NA	2.87
2000	NA	NA	77.74	NA	NA	424.61	424.61	424.61	0.32	NA	36.75	NA	NA	3.38
2001	NA	NA	92.36	NA	NA	426.28	426.28	426.28	0.30	NA	34.63	NA	NA	4.11
2002	NA	NA	96.90	NA	NA	428.44	428.44	428.44	0.26	NA	29.83	NA	NA	NA
2003	NA	NA	93.55	NA	NA	430.24	430.24	430.24	0.24	NA	27.34	NA	NA	NA
2004	NA	NA	91.83	NA	NA	433.26	433.26	433.26	0.26	NA	29.41	NA	NA	NA
2005	NA	NA	81.80	NA	NA	436.37	436.37	436.37	0.25	NA	28.65	NA	NA	NA
2006	NA	NA	94.92	NA	NA	438.94	438.94	438.94	NR**	NR**	NR**	NA	NA	NA
Trend														
1990–2006	-	-	*-18.8%*	-	-	*7.9%*	*7.9%*	*7.9%*	*-58.1%*	-	*-58.1%*	*-100%*	*-100%*	*-100%*
2005–2006	-	-	*16.0%*	-	-	*0.6%*	*0.6%*	*0.6%*	*-2.6%*	-	*-2.6%*	-	-	-
National Share														
1990	-	-	*41.3%*	-	-	*0.6%*	*0.9%*	*0.9%*	*< 0.1%**	-	*< 0.1%**	*0.9%*	*0.7%*	*10.0%*
2006	-	-	*55.3%*	-	-	*0.6%*	*1.0%*	*1.0%*	*< 0.1%**	-	*0.2%**	-	-	-

* *Value for 2005*

** *NR because of a transcription error; will be corrected with the next submission*

6.2 Completeness

Table 253 gives an overview of the NFR categories included in this chapter and presents the transformation matrix from SNAP categories. It also provides information on the status of emission estimates of all sub categories. A "✓" indicates that emissions from this sub category have been estimated.

Table 253: Overview of sub categories of NFR Category Solvent and Other Product Use: transformation into SNAP Codes and status of estimation.

NFR Category		Status													
		NEC gas				CO	PM			Heavy metals			POPs		
		NO_x	SO_2	NH_3	NMVOC	CO	TSP	PM10	PM2.5	Cd	Hg	Pb	dioxin	PAK	HCB
3 A	Paint application	NA	NA	NA	✓	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3 B	Degreasing and Dry Cleaning	NA	NA	NA	✓	NA	NA	NA	NA	NA	NA	NA	✓	✓	✓
3 C	Chemical Products, Manufacture and Processing	NA	NA	NA	✓	NA	NA	NA	NA	✓	NA	✓	NA	NA	NA
3 D	Other	NA	NA	NA	✓	NA	NA	NA	NA	NA	NA	NA	NA	NA	✓

6.3 NMVOC Emissions from Solvent and Other Product Use (NFR Sector 3)

6.3.1 Methodology Overview

Calculation NMVOC emissions from solvent use were done in several steps. As a first step the quantity of solvents used and the solvent emissions were calculated.

To determine the quantity of solvents used in Austria in the various applications, a bottom up and a top down approach were combined. Figure 11 to Figure 13 present an overview of the methodology.

The top down approach provided total quantities of solvents used in Austria. The share of the solvents used for the different applications and the solvent emission factors have been calculated on the basis of the bottom up approach. By linking the results of bottom up and top down approach, quantities of solvents annually used and solvent emissions for the different applications were obtained.

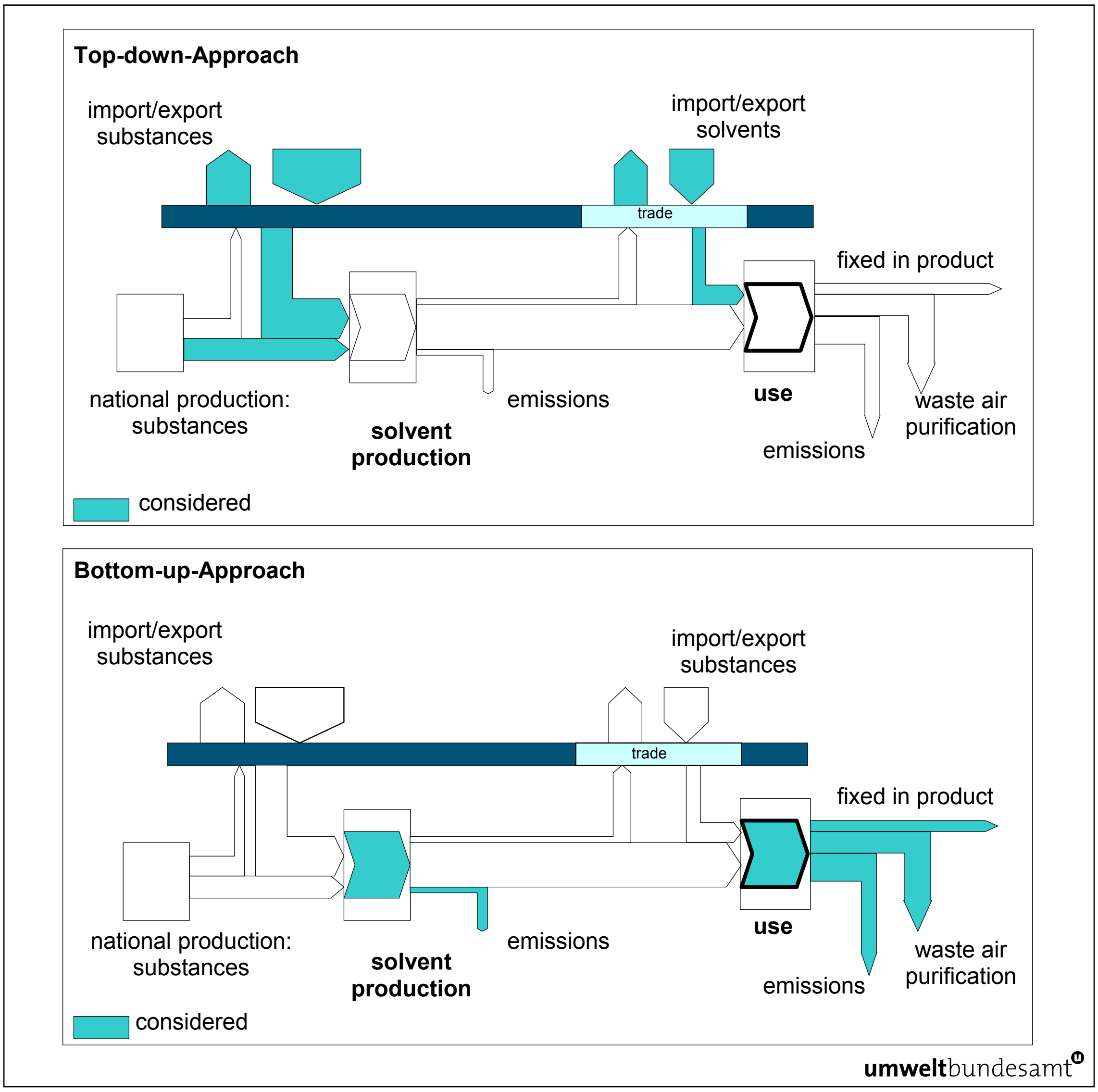

Figure 11: Top-down-Approach compared to Bottom-up-Approach.

Solvent Share CRF Sector 3	Solvent Share CRF Sector 3A-3D	SNAP Level 3		Solvent Emissions CRF Sector 3	Solvent Emissions CRF Sector 3A-3D	Solvent Emissions SNAP Level 3	Solvent Emission Factor CRF Sector 3	Solvent Emission Factor CRF Sector 3A-3D	Solvent Emission Factor SNAP Level 3	Solvent Activity CRF Sector 3	Solvent Activity CRF Sector 3A-3D	Solvent Activity SNAP Level 3
	3 A, Paint application	060101	manufacture of automobiles						57%			1.2%
		060102	car repairing						89%			0.7%
		060103	construction and buildings						88%			3.0%
		060104	domestic use					45%	89%		35.7%	1.4%
		060105	coil coating						53%			3.5%
		060107	wood coating						67%			3.4%
		060108	Other industrial paint application						30%			22.5%
	3 B, Degreasing and Dry Cleaning	060201	Metal degreasing						45%			5.8%
		060202	Dry cleaning						85%			0.3%
		060203	Electronic components manufacturing					55%	44%		12.6%	1.2%
		060204	Other industrial cleaning						68%			5.2%
	3 C, Chemical Products, Manufacture and Processing	060305	Rubber processing						94%			0.4%
		060306	Pharmaceutical products manufacturing						26%			6.2%
		060307	Paints manufacturing						4%			
		060308	Inks manufacturing						5%			
		060309	Glues manufacturing				58%	13%	20%	100%	15.8%	
		060310	Asphalt blowing						1%			0.5%
		060311	Adhesive, magnetic tapes, films and photographs						94%			0.0%
		060312	Textile finishing						88%			0.0%
		060314	Other						16%			8.5%
	3 D, Other	060403	Printing industry						66%			8.4%
		060404	Fat, edible and non edible oil extraction						20%			0.2%
		060405	Application of glues and adhesives						64%			0.4%
		060406	Preservation of wood						99%			0.4%
		060407	Under seal treatment and conservation of vehicles					73%	85%		36.0%	0.1%
		060408	Domestic solvent use (other than paint application)						84%			16.6%
		060411	Domestic use of pharmaceutical products (k)						94%			4.3%
		060412	Other (preservation of seeds,...)						35%			5.5%

Figure 12: Combination of Top-down-Approach compared to Bottom-up-Approach for 2006.

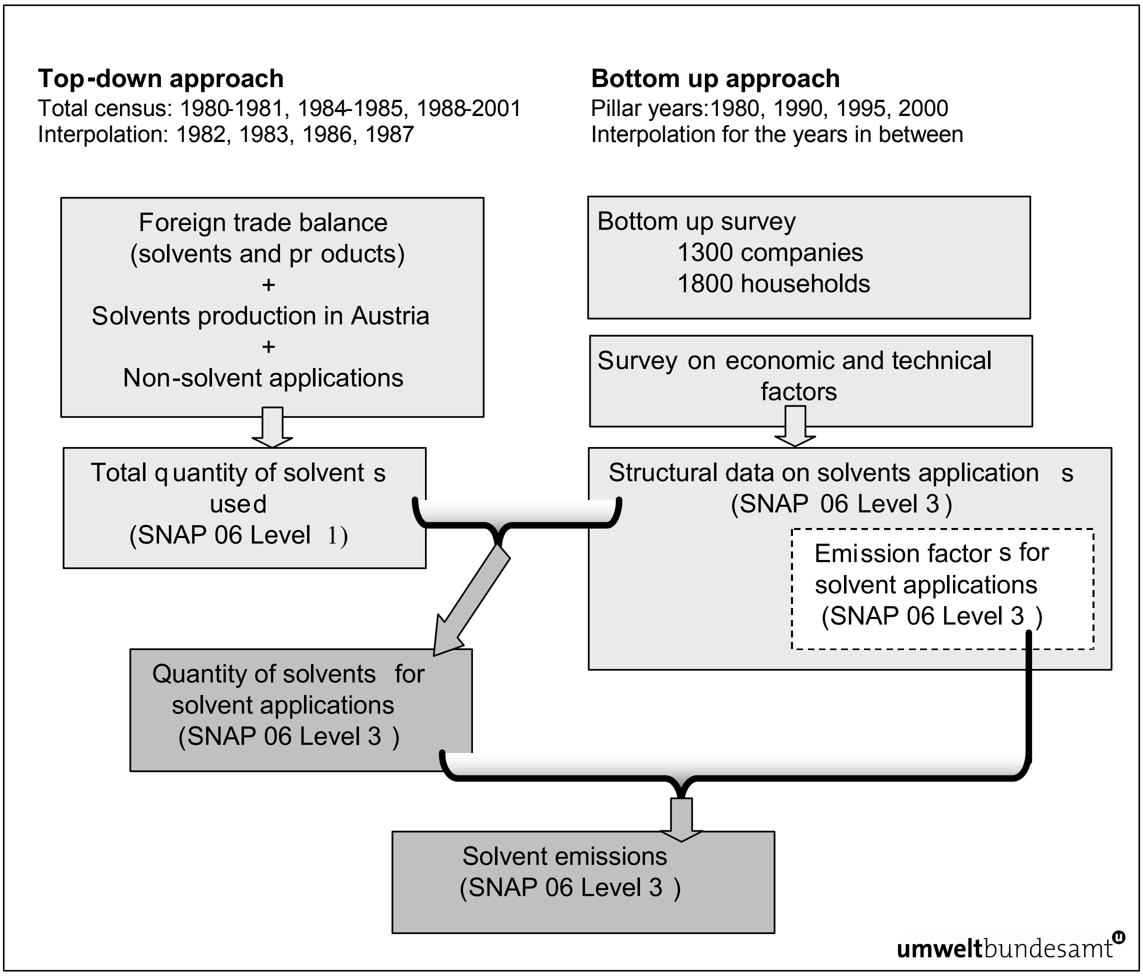

Figure 13: Overview of the methodology for solvent emissions.

A study (WINDSPERGER et al. 2002a) showed that emission estimates only based on the top down approach overestimate emissions because a large amount of solvent substances is used for "non-solvent-applications". "Non-solvent application" are applications where substances usually are used as feed stock in chemical, pharmaceutical or petrochemical industry (e.g. production of MTBE, formaldehyde, polyester, biodiesel, pharmaceuticals etc.) and where therefore no emissions from "solvent use" arise. However, there might be emissions from the use of the produced products, such as MTBE which is used as fuel additive and finally combusted, these emissions for example are considered in the transport sector.

Additionally the comparison of the top-down and the bottom-up approach helped to identify several quantitatively important applications like windscreens wiper fluids, antifreeze, moonlighting, hospitals, deicing agents of aeroplanes, tourism, cement- respectively pulp industry, which were not considered in the top-down approach.

6.3.2 Top down Approach

The top-down approach is based on

(1) import-export statistics (foreign trade balance);

(2) production statistics on solvents in Austria;

(3) a survey on non-solvent-applications in companies (WINDSPERGER et al. 2004a);

(4) survey on the solvent content in products and preparations at producers and retailers (WINDSPERGER et al. 2002a).

ad (1) and (2): Total quantity of solvents used in Austria were obtained from import-export statistics and production statistics provided by STATISTIK AUSTRIA.

Nearly a full top down investigation of substances of the import-export statistics from 1980 to 2002 was carried out (data in the years 1982, 1983, 1986 and 1987 were linearly interpolated). A main problem was that the methodology of the import-export statistics changed over the years. In earlier years products and substances had been pooled to groups and whereas the current foreign trade balance is more detailed with regard to products and substances. It was necessary to harmonise the time series in case of deviations.

There are only a few facilities producing solvents in Austria. Therefore due to confidentiality the Statistic Austria provided the data in an aggregated form. The solvents production fluctuated especially in the last years considerably.

ad (3): In the study on the comparison of top down and bottom up approach (WINDSPERGER et al. 2002a) the amount of solvent substances used in "non-solvent-applications" was identified. The 20 most important companies in this context were identified and asked to report the quantities of solvents they used over the considered time period in „non-solvent-applications".

ad (4): Relevant producers and retailers provided data on solvent content in products and preparations. As the most important substance groups alcohols and esters were identified.

6.3.3 Bottom up Approach

In a first step an extensive survey on the use of solvents in the year 2000 was carried out in 1 300 Austrian companies (WINDSPERGER et al. 2002b). In this survey data about the solvent content of paints, cleaning agents etc. and on solvents used (both substances and substance categories) like acetone or alcohols were collected.

Information about the type of application of the solvents was gathered, divided into the three categories "final application", "cleaner" and "product preparation" as well as the actual type of waste gas treatment, which was divided into the categories "open application", "waste gas collection" and "waste gas treatment".

For every category of application and waste gas treatment an emission factor was estimated to calculate solvent emissions in the year 2000 (see Table 254).

Table 254: Emission factors for NMVOC emissions from Solvent Use.

Category	Factor
final application	1.00
cleaner	0.85
product preparation	0.05
open application	1.00
waste gas collection	0.50
waste gas treatment	0.20

In a second step a survey in 1 800 households was made (WINDSPERGER et al. 2002a) for estimating the domestic solvent use (37 categories in 5 main groups: cosmetic, do-it-yourself, household cleaning, car, fauna and flora). Also, solvent use in the context of moonlighting besides commercial work and do-it-yourself was calculated.

The comparison of top down and bottom up approach helped to identify several additional applications, which make an important contribution to the total amount of solvents used. Thus in a third step the quantities of solvents used in these applications such as windscreens wiper fluids, antifreeze, hospitals, de-icing agents of aeroplanes, tourism, cement- respectively pulp industry, were estimated in surveys.

The outcome of these three steps was the total stock of solvents used for each application in the year 2000 (at SNAP level 3) (WINDSPERGER et al. 2002a).

To achieve a time series the development of the economic and technical situation in relation to the year 2000 was considered. It was distinguished between "general aspects" and "specific aspects" (see tables below). The information about these defined aspects were collected for three pillar years (1980, 1990, 1995) and were taken from several studies (SCHMIDT et al. 1998, BARNERT 1998) and expert judgements from associations of industries (chemical industry, printing industry, paper industry) and other stakeholders. On the basis of this information calculation factors were estimated. With these factors and the data for solvent use and emission of 2000 data for the three pillar years was estimated. For the years in between data was linearly interpolated.

Table 255: General aspects and their development.

General aspects	1980	1990	1995	2000
efficiency factor solvent cleaning	250%	150%	130%	100%
efficiency factor application	150%	110%	105%	100%
solvent content of water-based paints	15%	12%	10%	8%
solvent content of solvent-based paints	60%	58%	55%	55%
efficiency of waste gas purification	70%	75%	78%	80%

Table 256: Specific aspects and their development: distribution of the used paints (water based-paints – solvent-based paints) and part of waste gas purification (application – purification).

SNAP category	description	year	Distribution of used paints		Part of waste gas treatment	
			Solvent based paints	Water based paints	application	purification
060101	manufacture of automobiles	2000	73%	27%	10%	0%
		1995	80%	20%	8%	0%
		1990	90%	10%	5%	0%
		1980	100%	0%	0%	0%
060102	car repairing	2000	51%	49%	62%	1%
		1995	55%	45%	60%	0%
		1990	75%	25%	10%	0%
		1980	85%	15%	5%	0%

SNAP category	description	year	Distribution of used paints		Part of waste gas treatment	
			Solvent based paints	Water based paints	application	purification
060107	wood coating	2000	46%	54%	46%	3%
		1995	60%	40%	45%	2%
		1990	85%	15%	10%	0%
		1980	100%	0%	0%	0%
060108	Other industrial paint application	2000	97%	3%	90%	46%
		1995	99%	1%	87%	45%
		1990	100%	0%	26%	20%
		1980	100%	0%	0%	0%
060201	Metal degreasing	2000	92%	8%	75%	0%
		1995	95%	5%	65%	0%
		1990	100%	0%	10%	0%
		1980	100%	0%	0%	0%
060403	Printing industry	2000			44%	17%
		1995			29%	10%
		1990			10%	5%
		1980			0%	0%
060405	Application of glues and adhesives	2000			58%	0%
		1995			53%	0%
		1990			15%	0%
		1980			0%	0%
060103	Paint application : construction and buildings	2000	91%	9%	19%	4%
		1995	93%	7%	15%	2%
		1990	100%	0%	5%	0%
		1980	100%	0%	0%	0%
060105	Paint application : coil coating	2000	100%	0%	63%	0%
		1995	100%	0%	60%	0%
		1990	100%	0%	25%	0%
		1980	100%	0%	0%	0%
060406	Preservation of wood	2000	83%	17%	0%	0%
		1995	85%	15%	0%	0%
		1990	95%	5%	0%	0%
		1980	100%	0%	0%	0%
060412	Other (preservation of seeds, …)	2000	100%	0%	90%	0%
		1995	100%	0%	80%	0%
		1990	100%	0%	10%	0%
		1980	100%	0%	0%	0%

Table 257: Specific aspects and their development: changes in the number of employees compared to the year 2000.

SNAP		Changes in the number of employees compared to the year 2000			
		1980	1990	1995	2000
0601	Paint application				
060101	manufacture of automobiles	88%	82%	72%	100%
060102	car repairing	94%	98%	96%	100%
060103	construction and buildings	96%	90%	102%	100%
060104	domestic use	separate analysed			
060105	coil coating	99%	113%	107%	100%
060107	wood coating	107%	109%	112%	100%
060108	industrial paint application	122%	112%	106%	100%
0602	Degreasing, dry cleaning and electronics				
060201	Metal degreasing	151%	113%	83%	100%
060202	Dry cleaning	63%	75%	88%	100%
060203	Electronic components manufacturing	143%	122%	104%	100%
060204	Other industrial cleaning	33%	77%	56%	100%
0603	Chemical products manufacturing and processing				
060305	Rubber processing	110%	101%	102%	100%
060306	Pharmaceutical products manufacturing	118%	112%	97%	100%
060307	Paints manufacturing	118%	112%	97%	100%
060308	Inks manufacturing	118%	112%	97%	100%
060309	Glues manufacturing	118%	112%	98%	100%
060310	Asphalt blowing	124%	120%	120%	100%
060311	Adhesive, magnetic tapes, films and photographs	33%	57%	76%	100%
060312	Textile finishing	241%	171%	132%	100%
060314	Other	117%	112%	98%	100%
0604	Other use of solvents and related activities				
060403	Printing industry	129%	125%	111%	100%
060404	Fat, edible and non edible oil extraction	129%	116%	112%	100%
060405	Application of glues and adhesives	239%	156%	104%	100%
060406	Preservation of wood	108%	105%	100%	100%
060407	Under seal treatment and conservation of vehicles	97%	102%	103%	100%
060408	Domestic solvent use (other than paint application	separate analysed			
060411	Domestic use of pharmaceutical products (k)				
060412	Other (preservation of seeds, …)	108%	105%	101%	100%

A comprehensive summary on the methodology for the year 2000 can also be found in the Austrian Informative Inventory Report (UMWELTBUNDESAMT 2007).

6.3.4 Combination Top down – Bottom up approach and updating

To verify and adjust the data the solvents given in the top down approach and the results of the bottom up approach were differentiated by 15 defined categories of solvent groups (see below Table 258). The differences between the quantities of solvents from the top down approach and bottom up approach respectively are lower than 10%. Table 258 shows the range of the differences in the considered pillar years broken down to the 15 substance categories.

Table 258: Differences between the results of the bottom up and the top down approach.

	Acetone	Methanol	Propanol	Solvent naphta	Paraffins	Alcohols	Glycols	Ester	Aromates	Ether	org. acids	Ketones	Aldehydes	Amines	cycl. Hydrocarb.	Others	Sum of Differences [kt/a]
2000																	-14
1995																	-2
1990																	14
1980																	-18

	difference less than 2 kt/a
	difference 2–10 kt/a
	difference greater than 10 kt/a

As the data of the top down approach were obtained from national statistics, they are assumed to be more reliable than the data of the bottom up approach. That's why the annual quantities of solvents used were taken from the top down approach while the share of the solvents for the different applications (on SNAP level 3) and the solvent emission factors have been calculated on the basis of the bottom up approach. The following tables (Table 259 and Table 263) present activity data and implied emission factors.

The inventory has been updated with data from (WINDSPERGER et al. 2004b) since the study (WINDSPERGER et al. 2002) has been published. The data of the Austrian air emission inventory 2007 is based upon a current estimation, which is generally higher than the data of the year 2000, because in the year 2000 the use of wind screen washing fluid in housholds was not included.

Table 259: Activity data of Category 3 A Paint Application.

NFR	**3.A**	**3.A**	**3.A**	**3.A**	**3.A**	**3.A**	**3.A**	**3.A**
SNAP		**060101**	**060102**	**060103**	**060104**	**060105**	**060107**	**060108**
Unit	**Mg Solvent**							
1990	55 450	1 811	1 009	3 882	4 600	5 706	7 103	31 339
1991	49 437	1 535	900	3 585	3 607	5 124	6 217	28 469
1992	42 141	1 240	768	3 162	2 654	4 398	5 200	24 719
1993	45 302	1 260	827	3 514	2 399	4 761	5 484	27 057
1994	45 124	1 182	824	3 614	1 938	4 775	5 356	27 435
1995	52 220	1 283	955	4 315	1 718	5 564	6 075	32 310
1996	49 331	1 304	905	4 080	1 668	5 186	5 548	30 640

NFR	3.A	3.A	3.A	3.A	3.A	3.A	3.A	3.A
SNAP		060101	060102	060103	060104	060105	060107	060108
Unit	Mg Solvent							
1997	52 586	1 493	968	4 353	1 829	5 450	5 701	32 792
1998	47 044	1 432	869	3 897	1 683	4 803	4 902	29 458
1999	42 851	1 396	794	3 554	1 578	4 305	4 275	26 949
2000	47 985	1 671	893	3 983	1 820	4 739	4 565	30 314
2001	58 286	2 030	1 085	4 838	2 211	5 756	5 545	36 822
2002	61 610	2 145	1 147	5 114	2 337	6 085	5 861	38 921
2003	59 431	2 070	1 106	4 933	2 254	5 869	5 654	37 545
2004	58 210	2 027	1 083	4 832	2 208	5 749	5 538	36 774
2005	51 410	1 790	957	4 267	1 950	5 077	4 891	32 478
2006	60 365	2 102	1 123	5 011	2 290	5 962	5 743	38 135

Table 260: Activity data of Category 3 B Degreasing and Dry Appplication.

NFR	3.B	3.B	3.B	3.B	3.B
SNAP		060201	060202	060203	060204
Unit	Mg Solvent				
1990	16 472	9 391	466	2 540	4 075
1991	14 406	7 969	413	2 153	3 871
1992	12 041	6 448	350	1 740	3 503
1993	12 685	6 560	375	1 767	3 983
1994	12 378	6 164	371	1 657	4 186
1995	14 027	6 704	427	1 799	5 097
1996	14 008	6 635	418	1 697	5 258
1997	15 775	7 408	461	1 807	6 099
1998	14 902	6 941	427	1 615	5 919
1999	14 326	6 622	403	1 469	5 832
2000	16 924	7 766	468	1 643	7 047
2001	20 557	9 433	568	1 996	8 560
2002	21 729	9 971	601	2 110	9 048
2003	20 961	9 618	580	2 035	8 728
2004	20 530	9 421	568	1 993	8 549
2005	18 132	8 320	501	1 760	7 550
2006	21 291	9 770	589	2 067	8 865

Table 261: Activity data of Category 3 C Chemical Production, Manufacturing and Processing.

NFR	3.C	3.C	3.C	3.C	3.C	3.C	3.C	3.C	3.C	3.C
SNAP		060305	060306	060307	060308	060309	060310	060311	060312	060314
Unit	Mg Solvent									
1990	123 768	991	8 391	59 952	7 173	4 203	1 348	3	159	41 548
1991	115 918	864	6 978	54 971	6 930	4 168	1 173	3	133	40 698
1992	107 979	720	5 519	49 990	6 687	4 133	975	3	105	39 847
1993	101 904	755	5 470	45 010	6 444	4 098	1 022	3	105	38 997
1994	95 251	734	4 987	40 029	6 201	4 063	991	3	96	38 147
1995	89 617	828	5 237	35 048	5 958	4 028	1 116	4	102	37 296
1996	89 460	750	5 619	34 486	5 795	4 126	989	4	89	37 602
1997	90 263	764	6 739	33 924	5 632	4 225	980	4	87	37 908
1998	89 630	650	6 729	33 362	5 469	4 323	808	4	71	38 214
1999	89 135	560	6 797	32 799	5 306	4 421	671	4	57	38 520
2000	90 444	589	8 394	32 237	5 143	4 520	674	5	56	38 826
2001	91 353	715	10 196	30 375	6 335	1 551	819	6	68	41 288
2002	87 208	756	10 777	26 171	6 031	446	865	6	72	42 082
2003	83 221	729	10 396	23 982	5 201	441	835	6	69	41 562
2004	85 114	715	10 183	25 802	5 868	385	818	6	68	41 270
2005	82 455	631	8 993	25 128	6 854	417	722	5	60	39 645
2006	83 408	741	10 560	23 998	4 957	443	848	6	70	41 785

Table 262: Activity data of Category 3 D Other.

NFR	3.D.5	3.D.5	3.D.5	3.D.5	3.D.5	3.D.5	3.D.5	3.D.5	3.D.5
SNAP		060403	060404	060405	060406	060407	060408	060411	060412
Unit	Mg Solvent								
1990	43 887	14 941	541	824	687	221	14 041	5 055	7 577
1991	40 081	13 214	464	709	609	199	13 460	4 633	6 793
1992	34 983	11 174	380	582	516	172	12 279	4 058	5 822
1993	38 483	11 914	392	602	552	187	14 065	4 478	6 293
1994	39 207	11 770	374	576	546	188	14 874	4 576	6 303
1995	46 388	13 509	413	639	629	221	18 214	5 430	7 333
1996	44 909	12 564	369	602	595	203	18 262	5 273	7 041
1997	49 082	13 172	370	640	636	211	20 642	5 780	7 631
1998	45 042	11 578	309	570	571	183	19 567	5 320	6 944
1999	42 108	10 350	261	518	522	162	18 871	4 987	6 437
2000	48 417	11 359	267	578	586	175	22 361	5 752	7 339
2001	58 811	13 797	324	702	712	213	27 161	6 987	8 914
2002	62 164	14 584	343	742	752	225	28 710	7 385	9 423
2003	59 966	14 068	331	716	726	217	27 695	7 124	9 090
2004	58 734	13 779	324	701	711	212	27 126	6 978	8 903
2005	51 873	12 170	286	619	628	187	23 957	6 163	7 863
2006	60 909	14 290	336	727	737	220	28 130	7 236	9 233

Table 263: Implied NMVOC emission factors for Category 3 A Paint application 1990–2006.

NFR	**3.A**	**3.A**	**3.A**	**3.A**	**3.A**	**3.A**	**3.A**
SNAP	**060101**	**060102**	**060103**	**060104**	**060105**	**060107**	**060108**
Unit	**kg/Mg Solvent**						
1990	940.36	976.21	920.40	884.57	841.40	937.21	782.41
1991	880.78	973.33	904.60	885.50	789.62	892.55	700.76
1992	821.77	970.05	888.68	885.83	738.06	848.08	619.16
1993	762.70	967.35	872.51	886.62	686.20	803.43	537.53
1994	703.89	964.81	856.67	887.00	634.55	758.78	455.91
1995	644.58	961.26	840.56	887.66	582.85	714.07	374.28
1996	630.37	948.07	848.28	887.89	572.31	705.66	360.18
1997	616.21	934.92	855.96	887.37	561.47	697.25	346.09
1998	601.96	921.75	863.74	887.70	550.91	688.70	332.00
1999	588.11	908.06	871.13	887.83	540.07	680.23	317.90
2000	573.31	894.74	878.99	887.36	529.44	671.63	303.82
2001	573.31	894.74	878.99	887.36	529.44	671.63	303.82
2002	573.31	894.74	878.99	887.36	529.44	671.63	303.82
2003	573.31	894.74	878.99	887.36	529.44	671.63	303.82
2004	573.31	894.74	878.99	887.36	529.44	671.63	303.82
2005	573.31	894.74	878.99	887.36	529.44	671.63	303.82
2006	573.31	894.74	878.99	887.36	529.44	671.63	303.82

Table 264: Implied NMVOC emission factors for Category 3 B Degreasing and Dry Application 1990–2006.

NFR	**3.B**	**3.B**	**3.B**	**3.B**
SNAP	**060201**	**060202**	**060203**	**060204**
Unit	**kg/Mg Solvent**			
1990	934.83	950.64	680.31	722.70
1991	859.83	937.05	642.82	717.64
1992	784.89	922.86	605.75	712.53
1993	710.06	906.67	568.19	707.51
1994	634.98	894.88	531.08	702.34
1995	560.11	880.56	493.61	697.27
1996	537.30	873.21	483.21	693.80
1997	514.71	867.68	472.05	690.28
1998	492.00	861.83	460.68	686.60
1999	469.34	856.08	449.97	682.96
2000	446.69	850.43	438.83	679.44
2001	446.69	850.43	438.83	679.44
2002	446.69	850.43	438.83	679.44
2003	446.69	850.43	438.83	679.44
2004	446.69	850.43	438.83	679.44
2005	446.69	850.43	438.83	679.44
2006	446.69	850.43	438.83	679.44

Table 265: Implied NMVOC emission factors for Category 3 C Chemical Production, Manufacturing and Processing.

NFR	3.C	3.C	3.C	3.C	3.C	3.C	3.C	3.C	3.C
SNAP	**060305**	**060306**	**060307**	**060308**	**060309**	**060310**	**060311**	**060312**	**060314**
Unit					**kg/Mg Solvent**				
1990	985.87	462.52	53.64	50.75	200.10	10.39	1 000.00	886.79	224.37
1991	981.48	420.46	52.63	50.79	200.10	10.23	1 000.00	879.70	219.10
1992	976.39	378.51	51.61	50.70	200.10	10.26	666.67	885.71	213.84
1993	973.51	336.75	50.59	50.74	200.10	9.78	1 000.00	885.71	208.55
1994	968.66	294.77	49.56	50.80	200.10	10.09	1 000.00	885.42	203.29
1995	963.77	252.82	48.56	50.69	200.10	9.86	750.00	882.35	198.01
1996	958.67	253.96	45.93	50.73	199.95	10.11	750.00	887.64	190.57
1997	952.88	254.93	43.30	50.78	200.00	10.20	1 000.00	885.06	183.13
1998	946.15	255.91	40.70	50.65	200.09	9.90	1 000.00	873.24	175.67
1999	941.07	256.88	38.08	50.70	199.95	10.43	1 000.00	894.74	168.20
2000	935.48	257.92	35.46	50.55	200.00	10.39	800.00	892.86	160.74
2001	935.48	257.92	35.46	50.55	200.00	10.39	800.00	892.86	160.00
2002	935.48	257.92	35.46	50.55	200.00	10.39	800.00	892.86	160.00
2003	935.48	257.92	35.46	50.55	200.00	10.39	800.00	892.86	160.00
2004	935.48	257.92	35.46	50.55	200.00	10.39	800.00	892.86	160.00
2005	935.48	257.92	35.46	50.55	200.00	10.39	800.00	892.86	160.00
2006	935.48	257.92	35.46	50.55	200.00	10.39	800.00	892.86	160.00

Table 266: Implied NMVOC emission factors for Category 3 D Other.

NFR	3.D.5	3.D.5	3.D.5	3.D.5	3.D.5	3.D.5	3.D.5	3.D.5
SNAP	**060403**	**060404**	**060405**	**060406**	**060407**	**060408**	**060411**	**060412**
Unit					**kg/Mg Solvent**			
1990	859.05	192.24	860.44	989.81	846.15	838.54	940.85	916.72
1991	824.81	193.97	826.52	990.15	849.25	838.93	940.86	818.93
1992	790.50	194.74	792.10	990.31	848.84	839.32	940.86	721.40
1993	756.17	196.43	759.14	990.94	850.27	839.67	940.82	623.71
1994	721.92	197.86	723.96	990.84	851.06	840.06	941.00	525.94
1995	687.54	200.97	690.14	990.46	850.68	840.40	940.88	428.34
1996	681.47	200.54	679.40	991.60	852.22	840.65	940.83	411.59
1997	675.37	200.00	668.75	992.14	848.34	840.96	940.83	395.10
1998	669.29	200.65	659.65	991.24	852.46	841.16	940.79	378.46
1999	663.19	199.23	648.65	990.42	845.68	841.40	941.05	361.81
2000	657.10	202.25	638.41	991.47	851.43	841.69	940.72	345.28
2001	657.10	202.25	638.41	991.47	851.43	841.69	940.72	345.28
2002	657.10	202.25	638.41	991.47	851.43	841.69	940.72	345.28
2003	657.10	202.25	638.41	991.47	851.43	841.69	940.72	345.28
2004	657.10	202.25	638.41	991.47	851.43	841.69	940.72	345.28
2005	657.10	202.25	638.41	991.47	851.43	841.69	940.72	345.28
2006	657.10	202.25	638.41	991.47	851.43	841.69	940.72	345.28

6.3.5 Uncertainty Assessment

In the latest study on uncertainties of the Austrian inventory for Greenhouse gases (WINIWARTER 2008)(see also NIR 2008) the uncertainties of solvent emissions in Austria were determined, and were compared with the results of the detailed analysis of solvent emissions in Austria (WINDSPERGER et al. 2004)(see also IIR 2007). Differences between bottom-up and top-down methodology to estimate emissions were calculated at less than 10%, which is compatible with expert estimates on the uncertainties presented for national statistics. Additional uncertainty has been attributed to the released fraction of solvents employed, reflecting an emission factor (solvents are released as volatile organic compounds, which eventually are converted into CO_2 in the atmosphere).

Using the WINDSPERGER et al. (2004) data, an uncertainty of 5% is attributed to the activity data, and 10% to the emission factor of solvents. According to WINDSPERGER et al. (2004), the uncertainty should decrease and the overall quality improve between 1990 and current data. But according to WINIWARTER (2008) a general decrease in the quality of the import-export statistics, and a decrease in the released fraction of solvents (reflecting the emission factor) over the years results in a constant uncertainty.

In Table 267 and Table 268 the results of the studies are presented whereas the results of WINIWARTER (2008) are used for calculating the total uncertainty of the Austrian GHG inventory.

Table 267: Uncertainties of Sector 3 Solvent and other product use (WINDSPERGER et al. 2004).

	1990	1995	2000
Uncertainty solvent emissions	-21 to +24%	-18 to +21%	-13 to +14%

Table 268: Uncertainties of Sector 3 Solvent and other product use (WINIWARTER 2008).

IPCC Source category	Gas	AD	EF	Combined
			Uncertainty [%]	
3: Solvent and other product use	NMVOC	5.0	10.0	11.2

6.4 PM Emissions from Solvent and Other Product Use (NFR Sector 3)

Methodological issues

PM emissions from tabacoo consumption and fireworks are estimated the first time within the framework of a national study (WINIWARTER et al. 2008). PM emissions were calculated by applying national emission factors as listed in Table 269 on inhabitants in Austria (activity data)(see Table 270). Activity data were taken from STATISTIK AUSTRIA (2008).

Table 269: PM emissions factor for tabacoo consumption and fireworks in NFR 3.

Source	TSP	PM10	PM2.5	Reference
		g/INHABITANT		
Tobacco smoking	18.00	18.00	18.00	KUPIAINEN & KLIMONT, 2004
Fireworks	35.00	35.00	35.00	KLIMONT ET AL., 2002

Table 270: Inhabitants of Austria.

year	Inhabitants	year	Inhabitants
1990	7 678 000	1999	7 992 323
1991	7 754 891	2000	8 011 566
1992	7 840 709	2001	8 043 046
1993	7 905 632	2002	8 083 797
1994	7 936 118	2003	8 117 754
1995	7 948 278	2004	8 174 733
1996	7 959 016	2005	8 233 306
1997	7 968 041	2006	8 281 948
1998	7 976 789		

6.5 Recalculation for Emissions from Solvent and Other Product Use

Update of activity data

3.A, 3.B, 3.C and 3.D.5: NMVOC emissions from solvent use have been updated using short-term economic data provided by Statistik Austria.

Improvements of methodologies and emission factors

3 D 4: New sources like fireworks and tobacco are incorporated for estimation PM emission.

The tables below show the recalculation difference of emissions from Sector 3 Solvent and Other Product Use and its subcategories with respect to the previous submission.

Table 271: Recalculation difference with respect to submission 2007.

NMVOC Emission		Absolute difference [Gg]			Relative difference [Δ%]	
		2003	2004	2005	1990	2005
3	Solvent and Other Product Use	14.28	14.24	6.02	=	8%
3 A	Paint application	4.68	4.80	2.40	=	12%
3 B	Degreasing and dry cleaning	2.24	2.10	0.88	=	10%
3 C	Chemical products, manufacture and processing	-0.32	-0.27	-0.68	=	-6%
3 D 5	Other solvent use	7.68	7.61	3.42	=	10%

7 AGRICULTURE (NFR SECTOR 4)

7.1 Sector Overview

This chapter includes information on the estimation of the emissions of NEC gases, CO, particle matter (PM), heavy metals (HM) and persistent organic pollutant (POP) of the sector *Agriculture* in Austria corresponding to the data reported in Category 4 of the NFR format. It describes the calculations of source categories *4 B Manure Management, 4 D Agricultural Soils, 4 F Field Burning of Agricultural Residues* and *4 G Other.*

The Sector *Agriculture* is the most important source regarding NH_3 emissions in Austria; they make up about 93% of national total emissions (see Table 272). It is also an important source regarding particulate matter, where it contributes to about 16%, 12% and 5%, respectively, to national total TSP, PM10 and PM2.5 emissions. Furthermore it contributes each with about 2% to national total PAH emissions and national total NO_x emissions, and 2% to national total NMVOC emissions (in the year 2006).

The following table presents the source categories from the agricultural sector, which are key sources of the Austrian inventory with regard to the contribution to national total emissions (for details of the key source analysis see Chapter 1.4).

Table 272: Key Source in NFR sector 4 Agriculture.

	Source category									
	4 B 1	4 B 3	4 B 4	4 B 6	4 B 8	4 B 9	4 B 13	4 D	4 F	4 G
Pollutant	Cattle	Sheep	Goats	Horses	Swine	Poultry	Other	Agricultural Soils	Field Burning[(1)]	Agriculture – Other
SO_2									0.00%	
NO_x								**2.30%**	0.01%	
NMVOC								0.98%	0.06%	
NH_3	**55.9%**	**1.2%**	0.2%	1.11%	**14.19%**	**7.88%**	0.16%	**11.85%**	0.06%	
CO									0.13%	
Cd									0.16%	
Hg									0.03%	
Pb									0.08%	
PAH									**2.26%**	
Diox									0.33%	
HCB									0.07%	
TSP								**14.67%**		1.25%
PM10								**11.40%**		0.97%
PM2.5								**4.86%**		0.41%

Note: grey shaded are key sources

(1) Complete Description: 4 F Field Burning of Agricultural Residues

For the other pollutants the agricultural sector is only a minor source: emissions of SO_2, CO, heavy metals and POPs exclusively PAH arise from category *4 F Field Burning of Agricultural Wastes*; the contribution to the national total for SO_2, CO, dioxin, HCBs and heavy metals was below 0.3% for the whole time series.

In the following a brief description of Austria's farm structure is given according to the report „Grüner Bericht 2007" (BMLFUW 2007).

Generally it is to remark that Austria is an Alpine country and the highest tiers of Alpine cultural landscapes are the seasonally used Alpine pastures. According to the agricultural structure survey 2005 the number of agricultural and forestry enterprises in Austria was totally 189.591. There were 173.895 holdings with agriculturally used area and 150.229 holdings with areas used for forestry, of which 15.405 were pure forest enterprises. Austria's agriculture is small-structured: 61% of the farms have a size of less than 20 hectares cultivated area each and just only 4% of the farms have a size of more than 100 hectares. The average size of farms is about 18.8 hectares agriculturally used area and 34.7 hectares of cultivated area. In 2005 41% of all farms were full-time farms with 3.27 mio. hectares (42%) farm land. The big amount of Austrian farms (share about 55%) are part-time farms with 1.46 mio. hectares (20%) farm land, 4% are farms operated by companies with 2.47 mio. hectares (33%) farm land.

In Austria, 3.27 million ha of land were used for agricultural purposes and 3.31 hectares of land were forest. The shares of the different agricultural activities are as follows (BMLFUW 2007):

- 1.40 million hectares for arable farming;
- 1.79 million hectares for permanent grassland;
- 50 119 hectares for vineyards;
- 15 396 hectares for orchards, and
- 7 677 hectares for other purposes (house gardens, as well as vine and tree nurseries).

In 2006 about 72 153 holdings of all Austrian farms were classified as Alpine farmers, „Bergbauern", and were situated in less favoured areas. Mountainous areas account for 70% of Austria's federal territory, which is the highest share of all EU countries.

In 2006 the weather was full of untypical phenomena which affected on the one hand by drought in early and long sommer with impairment of agricultural use and pasture farming and on the other hand by flood and mudflow:

- in winter (very) low temperature and late and heavy snowfall, in spring because of sudden warming and heavy rainfall extensive floodings;
- in May summer started early with record temperatures and lasted until August.
- warmest autumn on record
- winter with warm weather and lack of snow

7.2 Emission Trend

In Table 273, Table 274 and Table 275 the emissions and trends from Sector 4 Agriculture and sub sectors for the key sources NO_x, NH_3 and PAH as well as TSP, PM10 and PM2.5 for the year 1990 to 2006 are presented.

PM, POPs and Heavy metals are emitted by different operation steps and various production processes but the whole extent and exposure of these emissions are widely unknown. This is subject to research. The reported emission data are calculated to the best standard of knowledge.

7.2.1 NEC Gases and CO

NH_3 (key source)

In 1990 national NH_3 emissions from the Sector *Agriculture* amounted to 66 Gg; emissions have decreased since then and by the year 2006 emissions were reduced by 8% to 61 Gg mainly due to reduced dairy cattle rearing (see Table 275). In the year 2006 the sector *Agriculture* contributed 93% to Austria's NH_3 emissions. Within this sector

- *Manure Management* (NFR 4 B) with a share of 81% has the highest contribution to total NH_3 emissions in 2006 (see Table 273). The agricultural NH_3 emissions result from animal husbandry, the storage of manure as well as the application of organic manure.
- *Agricultural Soils* (NFR 4 D) has a share of 12% in total NH_3 emissions in 2006. These emissions result from fertilisation with mineral N-fertilisers. Other sources of NH_3 emissions are biological nitrogen fixation (legume crops) and manure excreted on pastures by grazing animals.
- *Field burning of agricultural residues* (NFR 4 F): NH_3 emissions are negligible low (0.1% to total NH_3 emissions in 2006).

NO_x (key source)

In 1990 national NO_x emissions of the Sector *Agriculture* amounted to 6.1 Gg, which is a share of about 3% of the Austrian total NO_x emissions. Until 2006 emissions have decreased by 15% and amounted to 5.2 Gg, which is a share in national total NO_x emissions of 2%. This downwards-trend is mainly due to reduced use of synthetic N-fertilizers. Within this sector

- *Agricultural Soils* (NFR 4 D) has with a share of 2% to total NO_x emissions. Emissions result from nitrogen inputs into Agricultural soils.
- *Field burning of agricultural residues* (NFR 4 F) has a share of less than 0.1% to total NO_x emissions in 2006.

Table 273: Emissions and trends from Sector 4 Agriculture by gas (NO_x, NH_3 and PAH) and source categories 1990–2006.

Year	NO_x [Gg]			NH_3 [Gg]				PAH [Mg]	
	4	**4 D**	**4 F**	**4**	**4 B**	**4 D**	**4 F**	**4**	**4 F**
1990	**6.09**	6.06	0.03	**66.12**	58.00	8.08	0.05	**0.241**	0.241
1991	**6.31**	6.28	0.03	**66.87**	57.97	8.85	0.04	**0.241**	0.241
1992	**5.95**	5.92	0.03	**64.57**	56.22	8.31	0.04	**0.241**	0.241
1993	**5.71**	5.68	0.03	**64.59**	56.96	7.59	0.04	**0.239**	0.239
1994	**6.12**	6.09	0.03	**65.55**	56.79	8.72	0.04	**0.239**	0.239
1995	**6.18**	6.14	0.03	**67.12**	58.21	8.86	0.04	**0.238**	0.238
1996	**5.86**	5.82	0.03	**65.33**	57.07	8.22	0.04	**0.238**	0.238
1997	**5.91**	5.88	0.04	**65.60**	57.18	8.38	0.05	**0.234**	0.234
1998	**5.91**	5.88	0.03	**65.66**	57.05	8.57	0.05	**0.234**	0.234
1999	**5.76**	5.72	0.04	**64.39**	56.01	8.34	0.05	**0.233**	0.233
2000	**5.60**	5.57	0.03	**62.90**	54.81	8.05	0.04	**0.233**	0.233
2001	**5.57**	5.53	0.04	**62.68**	54.90	7.74	0.05	**0.233**	0.233
2002	**5.50**	5.47	0.04	**61.59**	53.67	7.87	0.05	**0.233**	0.233
2003	**5.40**	5.37	0.03	**61.38**	54.09	7.25	0.04	**0.229**	0.229

Year	NO_x [Gg]			NH_3 [Gg]				PAH [Mg]	
	4	**4 D**	**4 F**	**4**	**4 B**	**4 D**	**4 F**	**4**	**4 F**
2004	**5.26**	5.20	0.05	**60.90**	53.68	7.15	0.07	**0.292**	0.292
2005	**5.22**	5.19	0.03	**60.67**	53.20	7.43	0.04	**0.208**	0.208
2006	**5.21**	5.18	0.03	**60.93**	53.09	7.80	0.04	**0.197**	0.197
Trend									
1990–2006	***-14.5%***	*-14.5%*	*-17.0%*	***-7.9%***	*-8.5%*	*-3.5%*	*-16.5%*	***-18.1%***	*-18.1%*
2005–2006	***-0.2%***	*-0.1%*	*-12.7%*	***0.4%***	*-0.2%*	*5.0%*	*-11.0%*	***-5.1%***	*-5.1%*
Share in Sector Agriculture									
1990		*99.4%*	*0.6%*		*87.7%*	*12.2%*	*0.1%*		*100%*
2006		*99.5%*	*0.6%*		*87.1%*	*12.8%*	*0.1%*		*100%*
Share in National Total									
1990	***3.2%***	*3.1%*	*0.0%*	***93.1%***	*81.6%*	*11.4%*	*0.1%*	***1.4%***	*1.4%*
2006	***2.3%***	*2.3%*	*0.0%*	***92.6%***	*80.7%*	*11.9%*	*0.1%*	***2.3%***	*2.3%*

NMVOC (key source)

In 2006 NMVOC emissions of sector *Agriculture* only contribute 1.0% (1.9 Gg) to the Austrian total NMVOC emissions. From 1990 to 2006 NMVOC from agricultural vegetation – Sector *Agricultural Soils* (NFR 4 D) – decreased by 4% due to an increased harvest of agricultural crops.

SO_2

Field Burning of Agricultural Waste (NFR 4 F) is the only emission source for SO_2 emissions of the Sector *Agriculture*. In 2006, emissions only contribute less than 0.01% to national total SO_2 emissions. Emissions vary on a very small scale following the area of stubble fields burnt each year.

CO

Field Burning of Agricultural Waste (NFR 4 F) is the only emission source for CO emissions of the Sector *Agriculture*. In 2006, emissions only contribute 0.1% (1.0 Gg) to national total emissions. Emissions vary on a very small scale with the area of stubble fields burnt each year.

7.2.2 Persistent organic pollutants – POPs

Except of PAH, which is a key category, the emission of dioxin and HCB are not a key category.

PAH (key source)

As shown in Table 273 and Table 275 in 2006 in national PAH emissions of the sector *Agriculture* amounted to 0.2 Mg, which is a share of 2.3% of total PAH emission; emissions decreased by 18% mainly due to reduced burning of agricultural wastes (straw, residual wood) on fields. From 2005 to 2006 there was a decrease of 5% which is a consequence of decreasing area of stubble fields burnt in 2006. Within this source *Field burning of agricultural residues* (NFR 4 F) is the only source.

Dioxin/Furan and HCB

As shown in Table 273 in the period from 1990 to 2006

- **dioxin/furan** emissions decreased by 18% to 0.15g, which is a share of less than 0.3% in total dioxin emission. The emission trend from 2005 to 2006 amounts to -5%.
- **HCB** emissions decreased by 18% to 0.03 kg, which is a share of about 0.1% in total HCB emission. The emission trend from 2005 to 2006 amounts to -5%.

7.2.3 Heavy Metals – Cd, Hg, Pb

The emissions of heavy metals are not key categories. As shown in Table 275 in the period from 1990 to 2006

- **Cd** emissions decreased by 16% to 1.8 kg, which is a share of 0.2% in total Cd emission. The emission trend from 2005 to 2006 amounts to -7%.
- **Hg** emissions decreased by 16% to 0.3 kg, which is a share of less than 0.1% in total Hg emission. The emission trend from 2005 to 2006 amounts to -9%.
- **Pb** emissions increase by 16% to 11 kg, which is a share of about 0.1% in total Pb emission. The emission trend from 2005 to 2006 amounts to -7%.

From 2005 to 2006 there was a decrease in emission which is the consequence of decreasing area of stubble fields burnt in 2006.

7.2.4 Particulate matter (PM) – TSP, PM10, PM2.5 (key sources)

As sources for PM tillage operation, harvesting activities, transportation and stock transfer, animal husbandry and other operations were identified. Emissions of all three particulate matter sizes of PM are rated as key sources. As shown in Table 274 in the period from 1990 to 2006

- **TSP** emissions decreased by 4% to 11.9 Gg, which is a share of 16% in total TSP emission.
- **PM10** emissions decreased slightly by about 4% to 5.3 Gg, which is a share of 12% in total PM10 emission.
- **PM2.5** emissions decreased by 4% to 1.2 Gg, which is a share of 5% in total PM2.5 emission.

Tillage operations and harvesting activities are the main sources for PM emissions. With a share of 92% source category *Agricultural Soils* (NFR 4 D) had a high contribution to total TSP, PM10, and PM2.5 emissions respectively in 2006.

A comparatively small amount of about one-third of the agricultural PM10 emissions and PM2.5 emission, respectively, result from animal husbandry (NFR 4 G). Dust particle of this source category result from for example feed, litter, hair, plumes and excrements.

Table 274: Emissions and trends from Sector 4 Agriculture by gas (TSP, PM10, PM2.5) and source categories 1990–2006.

Year	TSP [Mg]			PM10 [Mg]			PM2.5 [Mg]		
	4	4 D	4 G	4	4 D	4 G	4	4 D	4 G
1990	12 453	11 355	1 098	5 604	5 110	494	1 245	1 136	110
1995	12 274	11 213	1 061	5 523	5 046	477	1 227	1 121	106
1999	12 169	11 154	1 015	5 476	5 019	457	1 217	1 115	101
2000	12 100	11 137	964	5 445	5 012	434	1 210	1 114	96
2001	12 099	11 128	971	5 444	5 007	437	1 210	1 113	97
2002	12 069	11 123	945	5 431	5 006	425	1 207	1 112	95
2003	12 153	11 193	960	5 469	5 037	432	1 215	1 119	96
2004	12 139	11 190	949	5 463	5 035	427	1 214	1 119	95
2005	11 966	11 020	946	5 385	4 959	426	1 197	1 102	95
2006	11 944	11 005	939	5 375	4 952	422	1 194	1 101	94
Trend									
1990–2006	*-4.1%*	*-3.1%*	*-14.5%*	*-4.1%*	*-3.1%*	*-14.5%*	*-4.1%*	*-3.1%*	*-14.5%*
2005–2006	*-0.2%*	*-0.1%*	*-0.8%*	*-0.2%*	*-0.1%*	*-0.8%*	*-0.2%*	*-0.1%*	*-0.8%*
Share in Sector Agriculture									
1990		*91.2%*	*8.8%*		*91.2%*	*8.8%*		*91.2%*	*8.8%*
2006		*92.1%*	*7.9%*		*92.1%*	*7.9%*		*92.1%*	*7.9%*
National Share									
1990	*18.2%*	*16.6%*	*1.6%*	*13.0%*	*11.9%*	*1.1%*	*5.0%*	*4.5%*	*0.4%*
2006	*15.9%*	*14.7%*	*1.3%*	*12.4%*	*11.4%*	*1.0%*	*5.3%*	*4.9%*	*0.4%*

Table 275: Emissions and trends from Sector 4 Agriculture 1990–2006.

Year	SO_2	NO_x	NMVOC	CO	NH_3	TSP	PM10	PM2.5	Cd	Hg	Pb	PAH	Dioxin	HCB
			[Gg]				[Mg]			[kg]		[Mg]	[g]	[g]
1990	0.002	6.09	1.85	1.20	66.12	12453	5604	1245	2.16	0.34	12.57	0.241	0.178	35.51
1991	0.002	6.31	1.84	1.19	66.87	NR	NR	NR	2.14	0.33	12.45	0.241	0.178	35.51
1992	0.001	5.95	1.78	1.13	64.57	NR	NR	NR	2.07	0.32	12.12	0.241	0.178	35.51
1993	0.001	5.71	1.75	1.12	64.59	NR	NR	NR	2.04	0.32	11.93	0.239	0.176	35.30
1994	0.002	6.12	1.81	1.17	65.55	NR	NR	NR	2.10	0.33	12.25	0.239	0.176	35.30
1995	0.002	6.18	1.82	1.18	67.12	12274	5523	1227	2.10	0.33	12.19	0.238	0.175	35.01
1996	0.002	5.86	1.80	1.16	65.33	NR	NR	NR	2.07	0.32	12.07	0.238	0.175	35.01
1997	0.002	5.91	1.88	1.24	65.60	NR	NR	NR	2.12	0.33	12.28	0.234	0.172	34.45
1998	0.002	5.91	1.84	1.20	65.66	NR	NR	NR	2.08	0.33	12.04	0.234	0.172	34.45
1999	0.002	5.76	1.88	1.24	64.39	12169	5476	1217	2.11	0.33	12.16	0.233	0.171	34.22
2000	0.001	5.60	1.78	1.15	62.90	12100	5445	1210	2.00	0.31	11.60	0.233	0.171	34.22
2001	0.002	5.57	1.86	1.22	62.68	12099	5444	1210	2.09	0.33	12.07	0.233	0.171	34.22
2002	0.002	5.50	1.85	1.22	61.59	12069	5431	1207	2.09	0.33	12.06	0.233	0.171	34.22
2003	0.001	5.40	1.73	1.11	61.38	12153	5469	1215	1.91	0.30	11.02	0.229	0.168	33.56
2004	0.002	5.26	1.97	1.72	60.90	12139	5463	1214	2.63	0.43	14.90	0.292	0.213	42.56
2005	0.001	5.22	1.86	1.13	60.67	11966	5385	1197	1.96	0.31	11.37	0.208	0.153	30.62
2006	0.001	5.21	1.79	1.01	60.93	11944	5375	1194	1.82	0.28	10.62	0.197	0.146	29.12
Trend														
1990–2006	*-16.4%*	*-14.5%*	*-3.4%*	*-16.4%*	*-7.9%*	*-4.1%*	*-4.1%*	*-4.1%*	*-15.7%*	*-15.9%*	*-15.5%*	*-18.1%*	*-18.0%*	*-18.0%*
2005–2006	*-10.5%*	*-0.2%*	*-4.2%*	*-10.6%*	*0.4%*	*-0.2%*	*-0.2%*	*-0.2%*	*-7.2%*	*-8.3%*	*-6.6%*	*-5.1%*	*-4.9%*	*-4.9%*
National Share														
1990	*0.0%*	*3.2%*	*0.7%*	*0.1%*	*93.1%*	*18.2%*	*13.0%*	*5.0%*	*0.1%*	*0.0%*	*0.0%*	*1.4%*	*0.1%*	*0.0%*
2006	*0.0%*	*2.3%*	*1.0%*	*0.1%*	*92.6%*	*15.9%*	*12.4%*	*5.3%*	*0.2%*	*0.0%*	*0.1%*	*2.3%*	*0.3%*	*0.1%*

7.3 General description

7.3.1 Methodology

Source Category 4 B

For the calculation of NH_3 emissions from cattle and swine the CORINAIR detailed methodology was applied, NH_3 emissions from the remaining livestock categories were estimated using the CORINAIR simple methodology.

Source Category 4 D

The CORINAIR detailed method was applied for the estimation of NH_3 emissions from synthetic fertilizers as well as from organic fertilizers from the livestock categories cattle and swine. For the remaining livestock categories the CORINAIR simple methodology was applied.

NH_3 emissions from legume cropland were estimated according the CORINAIR detailed methodology, NH_3 emissions from grassland and pastures were calculated using the CORINAIR simple method.

For estimation of NO_x and NMVOC emissions the CORINAIR simple method was used.

Source Category 4 F

For SO_2 and NH_3 the CORINAIR detailed methodology, for CO and NO_x the IPCC default method and for NMVOC a simple national method was used. Concerning heavy metals and POPs simple national methods and national emission factors were applied.

Detailed descriptions of the methodologies applied are presented in the following Chapters.

7.3.2 Recalculations

Update of activity data

4 D 1 c Direct Soil Emissions – Other

Updated pasture area led to increased NH_3 emissions 2005.

Improvements of methodologies and emission factors

4 B 1 a Manure Management – Dairy

As encouraged in the Draft LRTAP trial Centralized Review 2006, housing systems of dairy cattle have been reviewed: for 2006 a share of dairy cattle held in loose housing systems of 32% and a share of dairy cattle held in tied housing systems of 68% has been applied, which resulted in higher emissions from dairy cattle.

The new data on housing system distribution is based on the following study:

AMON, B., FRÖHLICH, M., WEIßENSTEINER, R, ZABLATNIK, B., AMON. T. (2007): Tierhaltung und Wirtschaftsdüngermanagement in Österreich. Endbericht Projekt Nr. 1441 Auftraggeber: Bundesministerium für Land- und Forstwirtschaft, Umwelt- und Wasserwirtschaft, Wien.

7.3.3 Completeness

Table 276 gives an overview of the NFR categories included in this chapter and provides information on the completeness of emission estimates of all sub categories. A "✓" indicates that emissions from this sub category were estimated.

Table 276: Overview of sub categories of Category Agriculture and status of estimation.

NFR Category		**Status**													
		NEC gases				**CO**	**PM**			**Heavy metals**			**POPs**		
		NO_x	**SO_2**	**NH_3**	**NMVOC**	**CO**	**TSP**	**PM10**	**PM2.5**	**Cd**	**Hg**	**Pb**	**Dioxin**	**PAK**	**HCB**
4 B	MANURE MANAGEMENT	NA	NA	✓	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4 B 1	Cattle	NA	NA	✓	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4 B 1 a	Dairy Cattle	NA	NA	✓	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4 B 1 b	Non-Dairy Cattle	NA	NA	✓	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4 B 2	Buffalo	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
4 B 3	Sheep	NA	NA	✓	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4 B 4	Goats	NA	NA	✓	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4 B 5	Camels and Lamas	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
4 B 6	Horses	NA	NA	✓	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4 B 7	Mules and Asses	IE(1)	IE (1)	IE(1)	IE(1)	IE(1)	IE(1)	IE(1)	IE(1)	IE(1)	IE(1)	IE(1)	IE(1)	IE(1)	IE(1)
4 B 8	Swine	NA	NA	✓	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4 B 9	Poultry	NA	NA	✓	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4 B 13	Other	NA	NA	✓	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4 C	RICE CULTIVATION	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
4 D	AGRICULTURAL SOILS	✓	NA	✓	✓	NA	✓	✓	✓	NA	NA	NA	NA	NA	NA
4 D 1	Direct Soil Emissions	✓	NA	✓	✓	NA	✓	✓	✓	NA	NA	NA	NA	NA	NA
4 F	FIELD BURNING OF AGRICULTURAL WASTE	✓	✓	✓	✓	✓	NE	NE	NE	✓	✓	✓	✓	✓	✓
4 G	OTHER	NA	NA	NA	NA	NA	✓	✓	✓	NA	NA	NA	NA	NA	NA

(1) *included in 4 B 6 Horses*

7.3.4 Uncertainty Assessment

Table 277 presents uncertainties for emissions, for activity data and for emission factors applied. Uncertainties were estimated or provided by the CORINAIR Guidebook (where default values were used for estimating emissions).

Compared to high uncertainties of emission factors, the uncertainty of the underlying statistical activity data is relatively low.

Table 277: Uncertainties of Emissions and Emission Factors (Agriculture).

Categories		NH_3 Emissions	NO_x Emissions	EF NH_3	EF NO_x
4B1a	Dairy Cattle	–	–	+/– 30%[(2)]	–
4B1b	Non-dairy Cattle	–	–	+/– 30%[(2)]	–
4B8	Swine	–	–	+/– 30%[(2)]	–
4B 3/4/6/9	Sheep, Goats, Horses, Poultry	–	–	+/– 30%[(2)]	–
4D	Agricultural Soils	+/– 50%[(3)]	+/– 36%[(3)]	+/– 50%[(2a)]	
4F	Field Burning	–	–	–	–
Activity Data					
	Animal population		+/– 10%[(1)]		
	Agricultural used land		+/– 5%[(1)]		

(1) *(WINIWARTER & RYPDAL 2001)*

(2) *CORINAIR*

(2a) *overall uncertainty of CORINAIR emission factors of all fertilizer types*

(3) *Monte Carlo Analysis: 95% probability (GEBETSROITHER et al. 2002)*

7.4 NFR 4 B Manure Management

This chapter describes the estimation of NH_3 emissions from housing, storage and spreading of animal excreta.

The sub categories cattle, swine, poultry and sheep contribute significantly to national total NH_3 emissions, and thus are key sources of the Austrian inventory (see the sector overview for emission trends): the share in national total emissions of the year 2006 from these sub categories together was 79.2%. The following table presents the emissions per sub category and their trend from 1990 to 2006.

Table 278: NH_3 emissions and trend from Manure Management 1990–2006 by sub categories and share in National Total.

Year	NH_3 Emissions [Gg] – Livestock Category									
	4 B	4 B 1	4 B 1 a	4 B 1 b	4 B 3	4 B 4	4 B 6	4 B 8	4 B 9	4 B 13
	TOTAL	Cattle	Dairy	Non-Dairy	Sheep	Goats	Horses	Swine	Poultry	Other
1990	58.00	40.53	18.21	22.32	0.79	0.10	0.41	10.59	5.48	0.09
1991	57.97	40.18	17.87	22.32	0.83	0.10	0.48	10.45	5.82	0.09
1992	56.22	38.53	17.39	21.13	0.80	0.10	0.52	10.68	5.50	0.09
1993	56.96	38.51	17.34	21.18	0.85	0.12	0.54	10.97	5.87	0.09
1994	56.79	38.57	17.17	21.40	0.87	0.13	0.56	10.81	5.74	0.10
1995	58.21	39.98	15.98	24.00	0.93	0.14	0.61	10.85	5.60	0.10
1996	57.07	39.43	15.94	23.49	0.97	0.14	0.61	10.59	5.22	0.11
1997	57.18	38.78	16.74	22.04	0.98	0.15	0.62	10.61	5.90	0.14
1998	57.05	38.58	17.26	21.32	0.92	0.14	0.63	10.93	5.71	0.13
1999	56.01	38.58	16.84	21.74	0.90	0.15	0.68	9.85	5.74	0.10
2000	54.81	38.71	15.29	23.42	0.87	0.14	0.68	9.56	4.75	0.10
2001	54.90	38.14	15.06	23.08	0.82	0.15	0.68	9.99	5.01	0.10
2002	53.67	37.41	15.04	22.38	0.78	0.15	0.68	9.54	5.01	0.10

Year	NH_3 Emissions [Gg] – Livestock Category									
	4 B	4 B 1	4 B 1 a	4 B 1 b	4 B 3	4 B 4	4 B 6	4 B 8	4 B 9	4 B 13
	TOTAL	Cattle	Dairy	Non-Dairy	Sheep	Goats	Horses	Swine	Poultry	Other
2003	54.09	37.40	14.52	22.88	0.83	0.14	0.73	9.70	5.18	0.11
2004	53.68	37.57	14.29	23.28	0.84	0.14	0.73	9.11	5.18	0.11
2005	53.20	36.83	14.23	22.60	0.83	0.14	0.73	9.38	5.18	0.11
2006	53.09	36.80	14.27	22.53	0.80	0.14	0.73	9.34	5.18	0.11
Trend 1990–2006	*-8.5%*	*-9.2%*	*-21.6%*	*0.9%*	*0.8%*	*42.2%*	*77.0%*	*-11.8%*	*-5.4%*	*11.0%*
Share in Nat. Total	*80.7%*	*55.9%*	*21.7%*	*34.2%*	*1.2%*	*0.2%*	*1.1%*	*14.2%*	*7.9%*	*0.2%*

7.4.1 Methodological Issues

Ammonia emissions from cattle and swine are estimated with the CORINAIR detailed methodology, as these are the most important livestock categories. NH_3 emissions from the remaining livestock categories were estimated with the CORINAIR simple methodology.

Activity data

The Austrian official statistics (STATISTIK AUSTRIA 2006) provides national data of annual livestock numbers on a very detailed level. These data are based on livestock counts held in December each year[121].

In Table 279 and Table 280 applied animal data are presented. Background information to the data is listed below:

From 1990 onwards: The continuous decline of *dairy cattle* numbers is connected with the increasing milk yield per cow: For the production of milk according to Austria's milk quota every year a smaller number of cows is needed.

1991: A minimum counting threshold for *poultry* was introduced. Farms with less than 11 poultry were not considered any more. However, the contribution of these small farms is negligible, both with respect to the total poultry number and to the trend.

The increase of the *soliped* population between 1990 and 1991 is caused by a better data collection from riding clubs and horse breeding farms.

1993: New characteristics for *swine and cattle* categories were introduced in accordance with Austria's entry into the European Economic Area and the EU guidelines for farm animal population categories. In 1993 part of the "*Young cattle < 1 yr*" category was included in the "*Young cattle 1–2 yr*" category. This shift is considered to be insignificant: no inconsistency in the emission trend of "Non-Dairy Cattle" category was recorded.

In the same year "*Young swine < 50 kg*" were shifted to "*Fattening pigs > 50 kg*" (before 1993 the limits were 6 months and not 50 kg which led to the shift) causing distinct inconsistencies in time series. Following a recommendation of the Centralized Review 2003, the age class split for *swine* categories of the years 1990–1992 was adjusted using the split from 1993.

121 For cattle livestock counts are also held in June, but seasonal changes are very small (between 0% and 2%). Livestock counts of sheep are only held in December (sheep is only a minor source for Austria and seasonal changes of the population are not considered relevant).

1993: For the first time other animals e.g. *deer (but not wild living animals)* were counted. Following the recommendations of the Centralized Review 2004, to ensure consistency and completeness animal number of 1993 was used for the years 1990 to 1992.

1995: The financial support of suckling cow husbandry increased significantly in 1995 when Austria became a Member State of the European Union. The husbandry of suckling cows is used for the production of veal and beef; the milk yield of the cow is only provided for the suckling calves. Especially in mountainous regions with unfavourable farming conditions, suckling cow husbandry allows an extensive and economic reasonable utilisation of the pastures. Suckling cow husbandry contributes to the conservation of the traditional Austrian alpine landscape.

1996–1998: The market situation affected a decrease in veal and beef production, resulting in a declining suckling cow husbandry. Farmers partly used their former suckling cows for milk production. Thus, dairy cow numbers slightly increased at this time. Reasons are manifold: Changing market prices, BSE epidemic in Europe and change of consumer behaviour, milk quota, etc.

1998–2002: increasing/ decreasing *swine* numbers: The production of swine has a high elasticity to prices: Swine numbers are changing due to changing market prices very rapidly. Market prices change due to changes in costumer behaviour, saturation of swine production, epidemics, etc.

Table 279: Domestic livestock population and its trend 1990–2006 (I).

Year	Population size [heads] *							
	Livestock Category							
	Dairy	Non Dairy	Suckling Cows > 2 yr	Young Cattle < 1 yr	Young Cattle 1–2 yr	Cattle > 2 yr	Sheep	Goats
1990	904 617	1 679 297	47 020	925 162	560 803	146 312	309 912	37 343
1991	876 000	1 658 088	57 333	894 111	555 432	151 212	326 100	40 923
1992	841 716	1 559 009	60 481	831 612	521 078	145 838	312 000	39 400
1993	828 147	1 505 740	69 316	705 547	572 921	157 956	333 835	47 276
1994	809 977	1 518 541	89 999	706 579	573 177	148 786	342 144	49 749
1995	706 494	1 619 331	210 479	691 454	564 352	153 046	365 250	54 228
1996	697 521	1 574 428	212 700	670 423	537 382	153 923	380 861	54 471
1997	720 377	1 477 563	170 540	630 853	514 480	161 690	383 655	58 340
1998	728 718	1 442 963	154 276	635 113	496 159	157 415	360 812	54 244
1999	697 903	1 454 908	176 680	630 586	488 283	159 359	352 277	57 993
2000	621 002	1 534 445	252 792	655 368	466 484	159 801	339 238	56 105
2001	597 981	1 520 473	257 734	658 930	455 712	148 097	320 467	59 452
2002	588 971	1 477 971	244 954	640 060	449 932	143 025	304 364	57 842
2003	557 877	1 494 156	243 103	641 640	446 121	163 292	325 495	54 607
2004	537 953	1 513 038	261 528	646 946	441 397	163 167	327 163	55 523
2005	534 417	1 476 263	270 465	628 426	436 303	141 069	325 728	55 100
2006	527 421	1 475 498	271 314	631 529	434 991	137 664	312 375	53 108
Trend 90–06	*-41.7%*	*-12.1%*	*477.0%*	*-31.7%*	*-22.4%*	*-5.9%*	*0.8%*	*42.2%*

**…..adjusted age class split for swine as recommended in the centralized review (October 2003)*

The FAO agricultural data base (FAOSTAT) provides worldwide harmonized data (FAO AGR. STATISTICAL SYSTEM 2001). In the case of Austria, these data come from the national statistical system (Statistik Austria). However, there are inconsistencies between these two data sets.

Analysis shows that there is often a time gap of one year between the two data sets. FAOSTAT data are seemingly based on the official Statistik Austria data but there is an annual attribution error. In the Austrian inventory Statistik Austria data is used, they are the best available.

Table 280: Domestic livestock population and its trend 1990–2006 (II).

Year	Population size [heads] *				
	Livestock Category				
	Horses	Swine	Fattening Pig > 50 kg	Swine for breeding > 50 kg	Young Swine < 50 kg
1990	49 200	3 687 981	1 308 525	382 335	1 997 120
1991	57 803	3 637 980	1 290 785	377 152	1 970 044
1992	61 400	3 719 653	1 319 744	385 613	2 014 296
1993	64 924	3 819 798	1 355 295	396 001	2 068 502
1994	66 748	3 728 991	1 323 145	394 938	2 010 908
1995	72 491	3 706 185	1 312 334	401 490	1 992 361
1996	73 234	3 663 747	1 262 391	398 633	2 002 723
1997	74 170	3 679 876	1 268 856	397 742	2 013 278
1998	75 347	3 810 310	1 375 037	386 281	2 048 992
1999	81 566	3 433 029	1 250 775	343 812	1 838 442
2000	81 566	3 347 931	1 211 988	334 278	1 801 665
2001	81 566	3 440 405	1 264 253	350 197	1 825 955
2002	81 566	3 304 650	1 187 908	341 042	1 775 700
2003	87 072	3 244 866	1 243 807	334 329	1 666 730
2004	87 072	3 125 361	1 159 501	317 033	1 648 827
2005	87 072	3 169 541	1 224 053	315 731	1 629 757
2006	87 072	3 139 438	1 197 124	321 828	1 620 486
Trend 90–06	*77.0%*	*-14.9%*	*-8.5%*	*-15.8%*	*-18.9%*

**…..adjusted age class split for swine as recommended in the centralized review (October 2003)*

Table 281: Domestic livestock population and its trend 1990–2006 (III).

Year	Population size [heads] *			
	Livestock Category			
	Poultry	Chicken	Other Poultry	Other
1990	13 820 961	13 139 151	681 810	37 100
1991	14 397 143	13 478 820	918 323	37 100
1992	13 683 900	12 872 100	811 800	37 100
1993	14 508 473	13 588 850	919 623	37 100
1994	14 178 834	13 265 572	913 262	37 736
1995	13 959 316	13 157 078	802 238	40 323
1996	12 979 954	12 215 194	764 760	41 526
1997	14 760 355	13 949 648	810 707	56 244
1998	14 306 846	13 539 693	767 153	50 365
1999	14 498 170	13 797 829	700 341	39 086
2000	11 786 670	11 077 343	709 327	38 475

Year	Population size [heads] *			
	Livestock Category			
	Poultry	Chicken	Other Poultry	Other
2001	12 571 528	11 905 111	666 417	38 475
2002	12 571 528	11 905 111	666 417	38 475
2003	13 027 145	12 354 358	672 787	41 190
2004	13 027 145	12 354 358	672 787	41 190
2005	13 027 145	12 354 358	672 787	41 190
2006	13 027 145	12 354 358	672 787	41 190
Trend 90–06	*-5.7%*	*-6.0%*	*-1.3%*	*11.0%*

**…..adjusted age class split for swine as recommended in the centralized review (October 2003)*

Manure Management Systems

In Austria national statistics on manure management systems are not available. Inventory data is based on a comprehensive survey carried out by (KONRAD 1995). The manure management system distribution is used for the whole period from 1990–2006 (see Table 282).

MMS are distinguished for *Dairy Cattle*, *Suckling Cows* and *Cattle 1–2 years* in "summer situation" and "winter situation" (Table 282). During the summer months, a part of the manure from these livestock categories is managed in "pasture/range/ paddock". The value for "pasture/range/paddock" is estimated as follows: During summer, 14.1% of Austrian dairy cows and suckling cows are on alpine pastures 24 hours a day. 43.6% are on pasture for 4 hours a day and 42.3% stay in the housing for the whole year (KONRAD 1995). "Alpine pasture" and "pasture" are counted together as MMS "pasture/range/paddock". As "pasture" only lasts for about 4 hours a day, only 1/6 of the dairy cow pasture (43.6%) is added to the total number. This results in 21.3% "pasture/range/paddock" during summer. In winter, "pasture/range/paddock" does not occur in Austria. Summer and winter both last for six months.

Table 282: Manure Management System distribution in Austria: Cattle and Swine.

Livestock category	Liquid/Slurry [%]	Solid Storage [%]	Pasture/range/paddock [%]
dairy cattle summer	16.7(1)	62.0(1)	21.3(1)
dairy cattle winter	21.2(1)	78.8(1)	–
Dairy cattle winter/summer	18.95(1)	70.4(1)	10.65(1)
suckling cows summer	16.7(1)	62.0(1)	21.3(1)
suckling cows winter	21.2(1)	78.8(1)	–
suckling cows winter/summer	18.95(1)	70.4(1)	10.65(1)
cattle 1–2 years summer	7.7(1)	39.9(1)	52.4(1)
cattle 1–2 years winter	16.2(1)	83.8(1)	–
cattle 1–2 years winter/summer	11.95(1)	61.85(1)	26.2(2)
cattle < 1 year	28.75(1)	71.25(1)	–
non dairy cattle > 2 years	48.6(1)	51.4(1)	–
breeding sows	70(2)	30(2)	–
fattening pigs	71.9(1)	28.1(1)	–

(1) *„Die Rinder-, Schweine- und Legehennenhaltung in Österreich aus ethologischer Sicht" (KONRAD 1995)*

(2) *Estimation of Dipl.-Ing. Alfred Pöllinger (Agricultural Research Centre Gumpenstein) following (KONRAD 1995)*

Estimation of NH_3 emissions includes one additional aspect: the differentiation between tied and loose housing systems for dairy cattle. NH_3 emissions from tied systems are much lower than from loose housing systems.

Following (KONRAD 1995) at the beginning of the 1990ies in Austria 98% of the dairy cattle were kept in tied systems. Thus, 98% of N was excreted in tied systems and 2% in loose housing systems. All other cattle livestock categories are assumed to be housed in loose housing systems (1990–2006).

As encouraged in the Draft LRTAP trial Centralized Review 2006, in this inventory housing systems of dairy cattle have been reviewed: Based on a study (AMON et al. 2007) for the year 2006 a share of dairy cattle held in loose housing systems of 32% and a share of dairy cattle held in tied housing systems of 68% has been applied. To ensure consistency of time series, the share continuously has been adjusted from 1990 onwards.

As there is currently no exact data available on manure management systems in Austrian animal husbandry, manure management system distribution (solid system, liquid system, grazing) within these two systems (loose and tied housing) is assumed to be the same.

From 2005 to 2007 a comprehensive investigation of Austria's agricultural practice was carried out by the Department of Sustainable Agricultural Systems – Division of Agricultural Engineering, University of Natural Resources and Applied Life Sciences, Vienna. The updated figures will be implemented in the Austrian Air Emission Inventory, submission 2009.

7.4.1.1 Cattle (4 B 1) and Swine (4 B 8)

Key Sources: NH_3

In the detailed methodology, the flow of total ammoniacal nitrogen (TAN or mineral N) is followed through the manure management system. The relative volumes of flow through the different pathways are determined by country-specific information on animal husbandry and manure management systems, while the proportion volatilised as ammonia at each stage in the system is treated as a percentage, based on measured values and expert judgement. The detailed methodology requires input data of animal numbers, nitrogen excretion and manure management systems.

Total NH_3 emissions from Category *4 B 1* and *4 B 8* are calculated as follows:

$$NH_{3\ Total} = NH_{3\ (housing)} + NH_{3\ (storage)} + NH_{3\ (spreading)}$$

NH_3 emissions from housing

NH_3 emissions from dairy cattle are estimated by multiplying N excretion with an emission factor for solid storage and liquid slurry systems, respectively:

$$NH_3\text{-N (solid storage)} = \text{Nex (solid storage) x EF(ss)}$$

$$NH_3\text{-N (liquid slurry)} = \text{Nex (liquid slurry) x EF(ls)}$$

The sum of both gives NH_3-N emitted from housing:

$$NH_3\text{ (housing)} = [NH_3\text{-N (solid storage)} + NH_3\text{-N (liquid slurry)}] \text{ x } (17/14)$$

N excretion by manure management system

Country-specific N excretion rates for Austrian *cattle* and *swine* were calculated using following formula.

N excretion per animal waste management system:

$$\mathbf{Nex_{(AWMS)} = \sum_{(T)} [N_{(T)} \times Nex_{(T)} \times AWMS_{(T)}]}$$

$Nex_{(AWMS)}$	=	*N excretion per animal waste management system [kg yr^{-1}]*
$N_{(T)}$	=	*number of animals of type T in the country (see Table 279, Table 280 and Table 281))*
$Nex_{(T)}$	=	*N excretion of animals of type T in the country [kg N animal^{-1} yr^{-1}] (see Table 283, Table 284)*
$AWMS_{(T)}$	=	*fraction of $Nex_{(T)}$ that is managed in one of the different distinguished animal waste management systems for animals of type T in the country (see Table 282)*
(T)	=	*type of animal category*

N excretion

N excretion values as shown in Table 283 and Table 284 base on following literature: (GRUBER & POETSCH 2006), (PÖTSCH et al. 2005), (STEINWIDDER & GUGGENBERGER 2003), (UNTERARBEITS-GRUPPE N-ADHOC 2004) and (ZAR 2004). Values consider the typical agricultural practice in Austria.

Table 283: Austria specific N excretion values of dairy cows for the period 1990–2006 and for 1980.

Year	Milk yield [kg yr^{-1}]	Nitrogen excretion [kg/animal*yr]	Year	Milk yield [kg yr^{-1}]	Nitrogen excretion [kg/animal*yr]
1980	3 518	74.16	1998	4 924	86.82
1990	3 791	76.62	1999	5 062	88.06
1991	3 862	77.26	2000	5 210	89.39
1992	3 934	77.90	2001	5 394	91.05
1993	4 005	78.54	2002	5 487	91.88
1994	4 076	79.18	2003	5 638	93.24
1995	4 619[1)]	84.07	2004	5 802	94.72
1996	4 670	84.53	2005	5 783	94.55
1997	4 787	85.58	2006	5 903	95.63

1) From 1995 onwards data have been revised by Statistik Austria, which led to significant higher milk yield data of Austrian dairy cows.

According to the requirements of the European nitrate directive, the Austrian N excretion data were calculated following the guidelines of the European Commission. The nitrogen excretion coefficients were calculated based on following input parameters:

Cattle: Feed rations represent data of practical farms consulting representatives of the working groups "Dairy production". These groups are managed by well-trained advisors. Their members, i.e. farmers, regularly exchange their knowledge and experience. Forage quality is based on field studies, carried out in representative grassland and dairy farm areas. The calculations depend on feeding ration, gain of weight, nitrogen and energy uptake, efficiency, duration of livestock keeping etc.

Sheep and goats: life weight, daily gain of weight, degree of pregnancy or lactating, feeding rations.

Pigs: breeding pigs, piglets, boars, fattening pigs: number and weight of piglets, daily gain of weight, energy content of feeding, energy and nitrogen uptake, N-reduced feeding.

Poultry: feeding ration, duration of keeping, nitrogen uptake, nitrogen efficiency.

Horses: feeding ration per horse category, weight of horses.

Table 284: Austria specific N excretion values of other livestock categories.

Livestock category	Nitrogen excretion [kg N per animal per yr]	Livestock category	Nitrogen excretion [kg N per animal per yr]
suckling cows(1)	69.5	sheep	13.1
cattle 1–2 years	53.6	goats	12.3
cattle < 1 year	25.7	horses	47.9
cattle > 2 years	68.4	Chicken(2)	0.52
breeding sows	29.1	other poultry (3)	1.1
fattening pigs	10.3	other livestock/deer(4)	13.1

(1) *annual milk yield: 3 000 kg*

(2) *weighted average of hens and broilers*

(3) *weighted average of turkeys and other (ducks, gooses)*

(4) *N-ex value of sheep applied*

Livestock numbers per category can be found in Table 279, Table 280 and Table 281, manure management system distribution for *cattle* and *swine* can be found in Table 282.

Emission Factors

Table 285 gives emission factors for NH_3 emissions from animal housing. As far as possible, Swiss default values as given in the CORINAIR guidelines have been chosen to compile the Austrian inventory. Swiss animal husbandry is closest to Austrian animal husbandry. If no CORINAIR emission factors from Switzerland were available, the CORINAIR German default values were used.

Table 285: Emission factors for NH_3 emissions from animal housing used in the Austrian inventory.

Manure management system	CORINAIR Emission factor [kg NH_3-N (kg N excreted)$^{-1}$]
Dairy cattle, tied systems, liquid slurry system	0.040(1)
Dairy cattle, tied systems, solid storage system	0.039(1)
Diary cattle, loose houses, liquid slurry system	0.118(1)
Diary cattle, loose houses, solid storage system	0.118(1)
Other cattle, loose houses, liquid slurry system	0.118(1)
Other cattle, loose houses, solid storage system	0.118(1)
Fattening pigs, liquid slurry system	0.150(2)

Manure management system	CORINAIR Emission factor [kg NH_3-N (kg N excreted)$^{-1}$]
Fattening pigs, solid storage system	15% of total N + 30% of the remaining TAN(2)
Sows plus litter, liquid slurry system	0.167(1)
Sows plus litter, solid storage system	0.167(1)

(1) DÖHLER et al. 2002

(2) EIDGENÖSSISCHE FORSCHUNGSANSTALT 1997

NH_3 emissions from storage

NH_3 emissions from storage are estimated from the amount of N left in the manure when the manure enters the storage. This amount of N is calculated as following:

- From total N excretion the N excreted during grazing (see above) and
- the NH_3-N losses from housing (see above) are subtracted;
- the remaining N enters the store.

TAN content in excreta

The detailed method makes use of the total ammoniacal nitrogen (TAN) when calculating emissions. The initial share of TAN must be known as well as any transformation rates between organic N and TAN. TAN content for Austrian cattle and pig manure is given in SCHECHTNER 1991.

Table 286: TAN content for Austrian cattle and pig manure after (SCHECHTNER 1991).

Manure	TAN content for Austria [%]	Manure	TAN content for Austria [%]
cattle – solid storage system	15.0	pig – solid storage system	19.5
cattle – liquid slurry system	50.0	pig – liquid slurry system	65.0

Emission Factors

During manure storage, NH_3 is lost. These losses are estimated with CORINAIR default emission factors given in Table 287.

Table 287: NH_3-emission factors for manure storage.

Manure storage system	CORINAIR Emission factor [kg NH_3-N (kg TAN)$^{-1}$]
Cattle, liquid slurry system	0.15
Cattle, solid storage system	0.30
Pigs, liquid slurry system	0.12
Pigs, solid storage system	0.30

Source: EIDGENÖSSISCHE FORSCHUNGSANSTALT 1997

Emission factors only distinguish between cattle and pigs and between liquid slurry systems and solid storage systems (farmyard manure). According to the CORINAIR guidelines, uncertainties in ammonia emission factors are about ± 30%.

A more accurat estimation of NH_3 emissions only is possible when new information on Austria's agricultural practice is available. From 2005 to 2007 a comprehensive investigation concerning this matter was carried out by the University of Natural Resources and Applied Life Sciences, Vienna. The results of this investigation will be implemented in the next inventory.

Amount of manure N left for spreading on agricultural soils

After storage, manure is applied to agricultural soils. Manure application is connected with NH_3 and N_2O losses that depend on the amount of manure N.

From total N excretion by Austrian livestock, the following losses were subtracted:

- N excreted during grazing (see formula N excretion per animal waste management system given in chapter "NH_3 emissions from housing").
- NH_3-N losses from the housing (see above);
- NH_3-N losses during manure storage (see above);
- N_2O-N losses from manure management (see NIR 2008);

The remaining N (calculated for each relevant animal category) is spread to agricultural soils ("manure N left for spreading").

Table 288 and Table 289 present the calculated amounts of nitrogen left for spreading from 1990 to 2006.

Table 288: Animal manure left for spreading on agricultural soils per livestock category 1990–2006 (I).

year	Nitrogen left for spreading [Mg N per year]							
	IPCC Livestock Categories							
	total	dairy cattle	suckling cows	cattle 1–2 a	cattle < 1 a	cattle > 2 a	sows	fattening pigs
1990	141 271	55 395	2 398	18 215	19 501	8 193	8 525	10 334
1991	140 940	54 007	2 924	18 041	18 846	8 468	8 409	10 194
1992	136 344	52 241	3 084	16 925	17 529	8 167	8 598	10 423
1993	137 847	51 741	3 535	18 609	14 872	8 845	8 829	10 704
1994	137 429	50 938	4 589	18 617	14 893	8 332	8 806	10 450
1995	140 023	47 098	10 733	18 330	14 575	8 570	8 952	10 364
1996	137 709	46 680	10 847	17 454	14 131	8 619	8 888	9 970
1997	138 091	48 733	8 697	16 711	13 297	9 054	8 868	10 021
1998	137 403	49 928	7 867	16 116	13 387	8 815	8 613	10 860
1999	134 901	48 424	9 010	15 860	13 292	8 924	7 666	9 878
2000	131 389	43 670	12 891	15 152	13 814	8 949	7 453	9 572
2001	130 720	42 762	13 143	14 802	13 889	8 293	7 808	9 985
2002	127 729	42 437	12 491	14 614	13 491	8 009	7 604	9 382
2003	128 189	40 726	12 397	14 490	13 525	9 144	7 454	9 823
2004	127 181	39 830	13 337	14 337	13 636	9 137	7 069	9 157
2005	125 892	39 433	13 792	14 171	13 246	7 900	7 040	9 667
2006	125 265	39 300	13 836	14 129	13 312	7 709	7 176	9 455

Table 289: Animal manure left for spreading on agricultural soils per livestock category 1990–2006 (II).

year	Nitrogen left for spreading [Mg N per year]						
	IPCC Livestock Categories						
	total	chicken	other poultry	sheep	goats	horses/ solipeds	other animals
1990	141 271	8 100	1 057	5 909	712	2 225	708
1991	140 940	8 309	1 424	6 217	781	2 614	708
1992	136 344	7 935	1 259	5 948	752	2 776	708
1993	137 847	8 377	1 426	6 365	902	2 935	708
1994	137 429	8 178	1 416	6 523	949	3 018	720
1995	140 023	8 111	1 244	6 964	1 034	3 278	769
1996	137 709	7 530	1 186	7 261	1 039	3 311	792
1997	138 091	8 600	1 257	7 314	1 113	3 354	1 073
1998	137 403	8 347	1 189	6 879	1 035	3 407	961
1999	134 901	8 506	1 086	6 716	1 106	3 688	746
2000	131 389	6 829	1 100	6 468	1 070	3 688	734
2001	130 720	7 339	1 033	6 110	1 134	3 688	734
2002	127 729	7 339	1 033	5 803	1 103	3 688	734
2003	128 189	7 616	1 043	6 206	1 042	3 937	786
2004	127 181	7 616	1 043	6 237	1 059	3 937	786
2005	125 892	7 616	1 043	6 210	1 051	3 937	786
2006	125 265	7 616	1 043	5 955	1 013	3 937	786

Calculation of NH_3 emissions from manure application on agricultural soils

For *cattle and swine* the CORINAIR detailed methodology was applied.

This method distinguishes between the kind of waste produced by each animal sub category: solid manure and liquid slurry. This is relevant, because TAN contents and therefore NH_3 emissions are highly dependent on the quality of waste and organic matter content in slurry. Furthermore, the detailed methodology suggests different NH_3-emission-factors depending on the target of land spreading: emissions are thought to be higher on grassland soils than on cropland soils, due to infiltration of applied animal waste being slower there.

$$NH_3\text{-}N_{spread} = N_{exLFS} * (Frac_{SS} * F_{TAN\ SS} * EF\text{-}NH_3\text{-}N_{spread\ SS} + Frac_{LS} * F_{TAN\ LS} * EF\text{-}NH_3\text{-}N_{spread\ LS})$$

$NH_3\text{-}N_{spread}$	=	*NH_3-N emissions driven by intentional spreading of animal waste from Manure Management systems on agricultural soils (droppings of grazing animals are not included!)*
N_{exLFS}	=	*Annual amount of nitrogen in animal excreta left for spreading on agricultural soils, corrected for losses during manure management; it does not include nitrogen from grazing animals*
$Frac_{SS}$	=	*Fraction of nitrogen left for spreading produced as farmyard manure in a solid waste management system*
$Frac_{LS}$	=	*Fraction of nitrogen left for spreading produced as liquid slurry in a liquid waste management system*
$F_{TAN\ SS}$	=	*Fraction of total ammoniacal nitrogen (TAN) in animal waste produced in a solid waste management system*
$F_{TAN\ LS}$	=	*Fraction of total ammoniacal nitrogen (TAN) in animal waste produced as slurry in a liquid waste management system*
$EF\text{-}NH_3\text{-}N_{spread\ SS}$	=	*NH_3-N Emission factor of animal waste from a solid manure system (farmyard manure) spread on agricultural soils (see below)*
$EF\text{-}NH_3\text{-}N_{spread\ LS}$	=	*NH_3-N Emission factor of animal waste from a liquid slurry waste management system spread on agricultural soils (see below)*

No appropriate Austrian specific data were available to use different emission factors depending on the target of spreading, i.e. whether animal waste is spread on grassland or cropland soils. Thus, following assumptions were made:

- To avoid underestimation of emissions, emission factors for spreading without incorporation were used.
- Animal waste from solid systems (farmyard manure) is spread on cropland soils only. This is in compliance with CORINAIR detailed method, which does not provide an emission factor for spreading of solid waste on grassland soils.
- For liquid slurry it was assumed, that cattle slurry is applied to grassland soils, while pig slurry is applied to arable soils. This assumption is driven by the idea, that feed for pig husbandry is produced on cropland soils, while fertilized grassland soils serve as feed producing area for cattle husbandry.

CORINAIR default NH_3-N emission factors for spreading of slurry and farmyard manure (expressed as share of TAN):

- Cattle .... spreading of liquid slurry on grassland....... 0.60
- Pigs........................ spreading of liquid slurry on arable land 0.25
- Cattle and Pigs ...... spreading of solid manure (arable land)..... 0.90

7.4.1.2 Sheep (4 B 3), Goats (4 B 4), Horses (4 B 6), Poultry (4 B 9) and Other Animals (4 B 13)

Key Sources: NH_3 (4 B 3, 4 B 9)

The CORINAIR simple methodology uses an average emission factor per animal for each livestock category and multiplies this factor by the number of animals counted in the annual agricultural census. Table 290 presents the recommended ammonia emission factors for the different livestock categories given in the CORINAIR guidelines. Emission factors include emissions from housing and storage. The calculation of NH_3 emissions from manure application on agricultural soils is described below.

Table 290: CORINAIR default ammonia emission factors (simple methodology) manure management.(1)

NFR	Livestock category	NH_3 loss housing [kg NH_3 head^{-1} yr^{-1}]	NH_3 loss storage [kg NH_3 head^{-1} yr^{-1}]
4 B 3	Sheep(2)	0.24	
4 B 4	Goats(2)	0.24	
4 B 6	Horses (mules and asses included)	2.9	
4 B 9	Laying hens	0.19	0.03
4 B 9	Other Poultry (ducks, geese, turkeys)	0.48	0.06
4 B 13	Other animals	0.24	

(1) *Emissions are expressed as kg NH_3 per animal, as counted in the annual agricultural census*

(2) *The emission factors are calculated for female adult animals, emissions of young animals are included.*

The CORINAIR guidelines do not give default values for NH_3 emissions from the livestock category *Other Animals*. In Austria deer dominates this livestock category. As sheep is the most similar livestock category to deer, for *Other Animals* the NH_3 emission factor of sheep is used.

CORINAIR distinguishes the livestock category “chicken” into “laying hens” and “broilers”. In Austria chicken numbers are not distinguished. Thus, NH_3 emissions from both laying hens and broilers are estimated with the laying hen emission factor (and therefore slightly overestimated).

Amount of manure N left for spreading on agricultural soils

The amount of N left in the manure after housing and storage is presented in Table 288 and Table 289.

Calculation of NH_3 emissions from manure application on agricultural soils

For *Sheep, Horses* and *Poultry* the CORINAIR simple methodology is applied.

The share of mineral N (total ammoniacal nitrogen, TAN) is estimated by application of a default factor for each animal waste category. NH_3 losses are derived in a second step based on TAN values by application of a CORINAIR default emission factor ($EF\text{-}NH_3\text{-}N_{spread}$), which is also dependent on the quality of animal waste.

$$NH_3\text{-}N_{spread} = N_{exLFS} * Frac_{TAN} * EF\text{-}NH_3\text{-}N_{spread}$$

NH_3-N_{spread}	=	*Emissions of NH_3-N, driven by intentional spreading of animal waste from manure management systems on agricultural soils (droppings of grazing animals are not included) [t N]*
N_{exLFS}	=	*Annual amount of nitrogen in animal excreta left for spreading on agricultural soils, corrected for losses during manure management; it does not include nitrogen from grazing animals*
$Frac_{TAN}$	=	*Fraction of total ammoniacal nitrogen (= mineral nitrogen) in animal manure (CORINAIR 1996)*
EF-NH_3-N_{spread}	=	*Emission factor for NH_3-N volatised from spreading of mineral nitrogen (CORINAIR 1996)*

7.4.2 Recalculations

As encouraged in the Draft LRTAP trial Centralized Review 2006, housing systems of dairy cattle have been reviewed (see chapter 7.4.1): for 2006 a share of dairy cattle held in loose housing systems of 32% and a share of dairy cattle held in tied housing systems of 68% has been applied, which resulted in higher emissions from dairy cattle. To ensure consistency of time series, the share continuously has been adjusted from 1990 onwards.

Table 291: Difference to last submission of NH_3 emissions from Category 4 B.

Year	NH_3 Emissions [Gg]	
	4 B Total	**4 B 1 a Dairy**
1990	0.00	0.00
1991	0.09	0.09
1992	0.17	0.17
1993	0.25	0.25
1994	0.28	0.28
1995	0.26	0.26
1996	0.25	0.25
1997	0.25	0.25
1998	0.26	0.26
1999	0.24	0.24
2000	0.21	0.21
2001	0.21	0.21
2002	0.20	0.20
2003	0.19	0.19
2004	0.18	0.18
2005	0.17	0.17

7.4.3 Planned Improvements

In 2007 a comprehensive investigation of Austria's agricultural practice was finalized by the Department of Sustainable Agricultural Systems – Division of Agricultural Engineering, University of Natural Resources and Applied Life Sciences, Vienna. The updated figures will be implemented in the Austrian Air Emission Inventory, submission 2009.

7.5 NFR 4 D Agricultural Soils

Key Source: NH_3, NO_X, TSP, PM10, PM2.5

NFR sector *4D Agricultural Soils* includes emissios of ammonia (NH_3), nitrogen oxide (NO_x), non-methane volatile organic compounds (NMVOC) and particulate matter (TSP, PM).

7.5.1 Methodological Issues

Emissions of NH_3, NO_x and NMVOC were calculated following the CORINAIR methodology. Wherever feasible, the „detailed methodology" has been applied. The methodology for estimating PM emissions is presented in a separate chapter (chapter 7.6).

Activity Data

Activity data are taken from the following sources:

Table 292: Data sources for nitrogen input to Agricultural Soils.

Category	Data Sources
Synthetic Fertilizers	Mineral N fertilizer consumption: 48. Grüner Bericht (BMLFUW 2007)[(1)]; urea application in Austria: Sales data RWA, 2007[(2)]
Animal Waste applied to soils	The amount of manure left for spreading was calculated within source category 4 B following (AMON et al. 2002)
N- fixing Crops	Cropped area legume production: (BMLFUW 2007)[(1)]
Agricultural Land Use	BUNDESANSTALT FÜR AGRARWIRTSCHAFT 2007[(3)]
Grazing Animals	Calculations within source category 4 B are based on (AMON et al. 2002)

(1) http://www.gruenerbericht.at and http://www.awi.bmlf.gv.at

(2) RWA: Raiffeisen Ware Austria

(3) http://www.awi.bmlf.gv.at

Mineral Fertilizer Application

Detailed data about the use of different kind of fertilizers are available until 1994, because until then, a fertilizer tax („Düngemittelabgabe") had been collected. Data about the total mineral fertilizer consumption are available for amounts (but not for fertilizer types) from the statistical office (Statistik Austria) and from an agricultural marketing association (Agrarmarkt Austria, AMA). Annual sales figures about urea are available for the years 1994 onwards from a leading fertilizer trading firm (RWA). These sources were used to get a time series of annual fertilizer application distinguishing urea fertilizers and other N-fertilizers ("mineral fertilizers").

The high inter-annual variations are caused by the effect of storage: Fertilizers have a high elasticity to prices. Sales data are changing very rapidly due to changing market prices. Not the whole amount purchased is applied in the year of purchase. The fertilizer tax intensivied this effect at the beginning of the 1990ies. Considering this effect, the arithmetic average of each two years is used as fertilizer application data.

The time series for fertilizer consumption is presented in Table 293.

Table 293: Mineral fertilizer N consumption in Austria 1990–2006 and arithmetic average of each two years.

Year	Annual Nutrient Sales Data [t N/yr]	of which Urea	Data Source	Weighted Nutrient Consumption [t N/yr]	Weighted Urea Consumption [t N/yr]
1989	133 304	1 700	FAO		
1990	140 379	3 965	estimated, GB[1]	136 842	2 833
1991	180 388	3 965	GB[1]	160 384	3 965
1992	91 154	3 886	GB[1]	135 771	3 926
1993	123 634	3 478	GB[3], RWA[2]	107 394	3 682
1994	177 266	4 917	GB[3], RWA[2]	150 450	4 198
1995	128 000	5 198	GB[4], RWA[2]	152 633	5 058
1996	125 300	4 600	GB[5], RWA[2]	126 650	4 899
1997	131 800	6 440	GB[6], RWA[2]	128 550	5 520
1998	127 500	6 440	GB[6], RWA[2]	129 650	6 440
1999	119 500	6 808	GB[6], RWA[2]	123 500	6 624
2000	121 600	3 848	GB[6], RWA[2]	120 550	5 328
2001	117 100	3 329	GB[6], RWA[2]	119 350	3 589
2002	127 600	4 470	GB[6], RWA[2]	122 350	3 900
2003	94 400	6 506	GB[6], RWA[2]	111 000	5 488
2004	100 800	7 293	GB[6], RWA[2]	97 600	6 900
2005	99 700	7 673	GB[6], RWA[2]	100 250	7 483
2006	103 700	11 310	GB[6], RWA[2]	101 700	9 491

1 - (BMLFUW 2000); 2 - Raiffeisen Ware Austria, sales company; 3 - (BMLFUW 2003); 4 - (BMLFUW, 2005)
5 - (BMLFUW, 2006); 6 - (BMLFUW, 2007)

Land use and legume production

The yearly numbers of the legume cropping areas were taken from official statistics (BMLFUW 2007). Data of agricultural land use are taken from the datapool of (BUNDESANSTALT FÜR AGRARWIRTSCHAFT 2007).

Table 294: Legume cropping areas and agricultural land use 1990–2006.

Year	Legume Areas [ha]				Land Use Areas [1000 ha]		
	peas	soja beans	horse/field beans	clover hey, lucerne, …	Cropland (total)	Grassland (total)	Grassland (extensive)
1990	40 619	9 271	13 131	57 875	1 408	1 993	846
1991	37 880	14 733	14 377	65 467	1 427	1 993	846
1992	43 706	52 795	14 014	64 379	1 418	1 993	846
1993	44 028	54 064	1 064	68 124	1 402	1 982	848
1994	38 839	46 632	10 081	72 388	1 403	1 982	848
1995	19 133	13 669	6 886	71 024	1 403	1 977	857
1996	30 782	13 315	4 574	72 052	1 403	1 977	857
1997	50 913	15 217	2 783	75 976	1 386	1 980	851
1998	58 637	20 031	2 043	76 245	1 386	1 980	851

Year	Legume Areas [ha]				Land Use Areas [1000 ha]		
	peas	soja beans	horse/field beans	clover hey, lucerne, …	Cropland (total)	Grassland (total)	Grassland (extensive)
1999	46 007	18 541	2 333	75 028	1 386	1 957	833
2000	41 114	15 537	2 952	74 266	1 382	1 957	833
2001	38 567	16 336	2 789	72 196	1 380	1 957	833
2002	41 605	13 995	3 415	75 429	1 379	1 957	833
2003	42 097	15 463	3 465	78 813	1 380	1 848	709
2004	39 320	17 864	2 835	83 349	1 379	1 848	709
2005	36 037	21 429	3 549	88 973	1 380	1 830	731
2006	32 652	25 013	4 555	97 549	1 377	1 830	731

Legume harvest data were taken from (BMLFUW 2007) and are presented in Table 295.

Table 295: Legume harvest data 1990–2006.

Year	Harvest [1000 t]			
	clover-hey	soja bean	horse-/fodder bean	peas
1990	717	18	41	145
1991	797	37	37	133
1992	587	81	31	137
1993	628	103	29	107
1994	743	105	27	134
1995	823	31	17	60
1996	858	27	10	93
1997	962	34	6	162
1998	1 014	51	5	178
1999	1 025	50	6	140
2000	1 440	33	7	97
2001	1 349	34	7	112
2002	1 395	35	9	96
2003	1 425	39	9	93
2004	1 474	45	8	122
2005	1 515	61	10	90
2006	1 635	65	12	90

Application of fertilizers

Synthetic fertilizers

NH_3

For the calculation of NH_3 emissions from synthetic fertilizers the CORINAIR detailed methodology was applied. This method uses specific NH_3 emission factors for different types of synthetic fertilizers and for different climatic conditions (see CORINAIR Emission Inventory Guidebook, Tab 5.1, p. B1010–15; 'Group III countries'). According to CORINAIR, Austria belongs to Group III '*temperate and cool temperate countries*' with largely acidic soils.

In Austria, full time-series data only for urea and non-urea synthetic N fertilizers (see Table 293), but with no further specifications, are available. For urea the CORINAIR default value of 0.15 t NH_3-N per ton of fertilizer-N was applied. As calcium-ammonium-nitrate and ammonium-nitrate fertilizers represent the dominant form of non-urea synthetic fertilizers being used in Europe (FREIBAUER & KALTSCHMITT 2001), an average emission factor of 0.02 t NH_3-N per ton of fertilizer-N is applied for fertilizers other than urea (STREBL et al. 2003).

NO_x

The CORINAIR simple methodology is applied. Emissions of NO_x are calculated as a fixed percentage of total fertilizer nitrogen applied to soil. For all mineral fertilizer types the CORINAIR recommended emission factor of 0.3% (i.e. 0.003 t NO_x-N per ton applied fertilizer-N) is used.

Organic Fertilizers

NH_3

In compliance with the CORINAIR Guidelines NH_3 emissions from manure application on agricultural soils are reported in source category *4 B Manure Management* (see chapter 7.4.1 – land spreading of animal excreta).

NO_x

NO_x losses from animal manure spreading are not addressed explicitly in the CORINAIR Guidebook. (FREIBAUER & KALTSCHMITT 2001) suggest in their calculation of an European greenhouse gas inventory a conservative estimate of 1% of manure nitrogen being emitted in the form of NO_x-N. Following these recommendations, an emission factor of 0.01 t NO_x-N per ton of organic fertilizer-N spread on agricultural soils is used. In the Austrian inventory resulting NO_x-emissions are reported under NFR category *4 D Agricultural Soils*.

NMVOC from fertilized cultures

NMVOC emissions from agricultural crops and grassland were estimated. For the calculations of NMVOC from fertilized and unfertilized vegetation the same method was applied. The method is described in chapter 0 under 'NMVOC emissions from vegetation'.

Unfertilized cultures

Legume cropland

NH_3

The CORINAIR detailed methodology using the CORINAIR default emission factor of 0.01 t of NH_3-N per ton of N was applied. The amount of N-input to soils via N-fixation of legumes (F_{BN}) was estimated on the basis of the cropping areas and specific consideration of nitrogen fixation rates of all relevant N-fixing crops:

$$\mathbf{F_{BN} = LCA * B_{Fix}/1000}$$

F_{BN} = Annual amount of nitrogen input to agricultural soils from N-fixation by legume crops [t]

LCA = Legume cropping area [ha]

B_{Fix} = Annual biological nitrogen fixation rate of legumes [kg/ha]

Activity values (LCA) for the years 1990–2006 can be found in Table 294. Values for biological nitrogen fixation (120 kg N/ha for peas, soja beans and horse/field beans and 160 kg N/ha for clover-hey, respectively) were taken from a publication made by the Umweltbundesamt (GÖTZ 1998); these values are constant over the time series.

NO_x

According to the CORINAIR guidebook definition, unfertilized cropland includes legume production on agricultural areas. For the calculation of NO_x emissions from unfertilized cropland the CORINAIR simple methodology was applied.

Nitrogen input through legume crop residues is calculated according to the CORINAIR recommended procedure. Nitrogen fixed in biomass, given in annual harvest data (see Table 295) is multiplied with the expansion factor for crop residues (GÖTZ 1998). The same NO_x emission factor as for emissions from synthetic fertilizers was applied (0.003 t NO_x-N per ton applied fertilizer-N).

Grassland and Pastures

The CORINAIR simple methodology was applied. According to the CORINAIR Guidebook, unfertilized pasture grassland represents areas that receive nitrogen through manure from grazing animals but no fertilizer inputs. For these areas the CORINAIR default value of 4 kg NH_3-N per ha was applied.

NMVOC emissions from vegetation

CORINAIR simple methodology was applied. Biogenic emissions from vegetation canopies of natural grasslands are derived as described in the following equation (CORINAIR 1999, p. B 1104–7, Table 4.1). This method is also suggested to be applied for fertilized cultures.

$$\textbf{E-NMVOC} = \textbf{CA} * \varepsilon\textbf{-NMVOC} * \textbf{D} * \Gamma$$

E-NMVOC	=	*Annual NMVOC emissions from vegetation [t]*
CA	=	*Cropping area of vegetation [ha]*
ε–NMVOC	=	*NMVOC potential emission rate per unit of dry matter and time unit [mg/dry matter.hours]*
D	=	*Foliar biomass density [t dry matter/ha]*
Γ	=	*Time integral (over 6 or 12 months) of emission hours. This value includes a correction variable that represents the effect of short-term temperature and solar radiation changes [hours].*

Aboveground biomass of agricultural crops was calculated using official cropping area (see Table 294) and expansion factors for leaves. For simplification, wheat was considered to be representative for the vegetation cover of agricultural crop land (see Table 296).

Table 296: Cereal production in Austria [t/ha].

Year	harvest per area [t/ha]	Year	harvest per area [t/ha]
1990	5.58	1999	5.95
1991	5.46	2000	5.42
1992	5.16	2001	5.87
1993	5.10	2002	5.85
1994	5.40	2003	5.27
1995	5.51	2004	6.53
1996	5.40	2005	6.17
1997	5.92	2006	5.75
1998	5.70		

Table 297: Parameters for calculation of NMVOC emissions from vegetation canopies of agriculturally used land.

	Effective emission hours[(1)] (12 mon)			Biomass Density D[(2)] [t/ha]	Emission Potential[(3)]		
	Γ-mts	Γ-ovoc [hours]	Γ–iso		ε–iso	ε-mts	ε-ovoc [µg/g dry matter. hour]
Grassland	734	734	540	0.4	0	0.1	1.5
Alpine grassland	734	734	540	0.2	0	0.1	1.5
Agricultural crops	734	734	540	0.617[(4)]	0.09	0.13	1.5

Abreviations:iso = isopren; mts = terpene; ovoc = other VOC's

(1) Γ = integrated effective emission hours, corrected to represent the effects of short term temperature and solar radiation changes on emissions

(2) D = foliar biomass density (in t dry matter per ha)

(3) ε = average emission potential

(4) based on cereal harvest data (2005-value see Table 296)

The results are highly dependent on the assumptions about biomass density.

7.5.2 Recalculations

Update of activity data

4 D 1 c Direct Soil Emissions – Other

Updated pasture area led to increased NH_3 emissions 2005.

Table 298: Difference to last submission of NH_3 emissions from Category 4 D Agricultural Soils.

Year	NH_3 Emissions [Gg]	
	4 D Total	4 D 1 c Other
2005	0.11	0.11

Note: Following the CORINAIR guidelines, NH_3 emissions from land spreading of animal excreta are reported under source category *4 B Manure Management* (see Chapter 7.4.1).

7.5.3 Planned Improvements

In 2007 a comprehensive investigation of Austria's agricultural practice was finalized by the Department of Sustainable Agricultural Systems – Division of Agricultural Engineering, University of Natural Resources and Applied Life Sciences, Vienna. The updated figures will be implemented in the Austrian Air Emission Inventory, submission 2009.

7.6 NFR 4 D Particle Emissions from Agricultural Soils

Particle emissions from source category 4 D result from certain steps of work such as soil cultivation and harvesting. The revised calculations are based on (WINIWARTER et al. 2007).

7.6.1 Methodological Issues

Emissions of particulate matter from field operations are linked with the usage of machines on agricultural soils. They are considered in relationship with the treated areas.

Activity Data

Agricultural land use data applied for the calculation of particle emissions are taken from the datapool of (BUNDESANSTALT FÜR AGRARWIRTSCHAFT 2007).

Table 299: Agricultural land use data 1990–2006.

Land Use Area Data					
Year	**arable farm land [1 000 ha]**	**grassland (excl. mountain pastures [1 000 ha]**	**Year**	**arable farm land [1 000 ha]**	**grassland (excl. mountain pastures [1 000 ha]**
1990	1 408	1 147	1999	1 386	1 124
1991	1 427	1 147	2000	1 382	1 124
1992	1 418	1 147	2001	1 380	1 124
1993	1 402	1 133	2002	1 379	1 124
1994	1 403	1 133	2003	1 380	1 139
1995	1 403	1 120	2004	1 379	1 139
1996	1 403	1 120	2005	1 380	1 099
1997	1 386	1 129	2006	1 377	1 099
1998	1 386	1 129			

Due to the limited number of measurements, a separate parameterization of different field crops as well as a different treatment of cropland and grassland activities is not yet possible. Thus, as activity data the sum of cropland and grassland area (excluding extensiv mountain pastures) is used.

Emission factors

For the estimation of emissions from field operations an emission factor of 5kg/ha PM10 has been applied (ÖTTL & FUNK 2007). PM emissions occuring from harvesting have been calculated using an emission factor of 5kg/ha PM10 (HINZ & VAN DER HOEK 2006). Both emission factors are based on measurements carried out directly on the field (two meters above soil and on the harvester).

Emission factors reflect constant dry conditions and are consistant with other reported emission factors e.g. (EPA 1999). Nevertheless, resulting emissions would exceed their actual atmospheric occurrence. They are rather 'potential emissions' marking the upper boundaries. To get more reliable data, the wet situation in Austria has to be taken into account.

Wet conditions in Austria

Following Hinz, under wet conditions only a small part of the particle emissions stays in the atmosphere. In this inventory a value of 10% has been applied.

Operations under dry conditions

Dry weather conditions have been considered by the use of a variable climate factor. This factor represents the share of operations under dry conditions. As currently no solid data for operations under dry conditions is available, a share of 0.1 has been assumed. Activities under dry conditions cause 10 times higher emissions compared to wet conditions.

The calculations resulted in following emissions per hectar:

Table 300: Resulting implied PM emission factors.

Implied Emission Factor [g/ha]		
TSP	**PM10**	**PM2.5**
4 444	2 000	444

The following fractions have been used for conversation:

PM2.5 ....TSP*10%

PM10 ....TSP*45%

7.6.2 Recalculations

The application of the new emission model (WINIWARTER et al. 2008) resulted in considerable lower emissions.

Table 301: Difference to last submission of TSP and PM emissions from Category 4 D Agricultural Soils.

4 D 1 Direct Soil Emissions [Mg]							
Year	**TSP**	**PM10**	**PM2.5**	**Year**	**TSP**	**PM10**	**PM2.5**
1990	-18 370	-1 099	-330	2002	-15 664	-620	-207
1995	-14 036	-285	-120	2003	-12 930	-67	-66
2000	-14 293	-349	-137	2004	-18 533	-1 166	-347
2001	-16 099	-705	-228	2005	-16 488	-809	-253

7.7 NFR 4 F Field Burning of Agricultural Waste

Burning agricultural residues on open fields in Austria is legally restricted by provincial law and since 1993 additionally by federal law and is only occasionally permitted on a very small scale. Therefore the contribution of emissions from the category *Field Burning of Agricultural Waste* to total emissions is very low (below 0.5%), except for PAH emissions where this source category is a key source with a contribution of 2.3% to national total emissions in 2006.

7.7.1 Methodological Issues

Emissions from agricultural straw burning and the burning of residual wood of vinicultures on fields are estimated like following:

Activity Data

According to the *Presidential Conference of the Austrian Chambers of Agriculture* (personal communication to Dr. Reindl 2006), in Austria's most important cereal production areas about 1 920 ha were burnt in 2006. The extrapolation to Austria's total cereal production area results in 2 010 ha burnt in 2006. This value was applied for the national inventory and corresponds to about 0.3% of total area under cereals 2006. For 1990 an average value of 2 500 ha was indicated (Dr. Reindl 2004). Cereal crop yield data per ha is given in Table 296.

Activity data (viniculture area) are taken from the Statistical Yearbooks 1992–2002 (Statistik Austria) and the "Green Reports" of (BMLFUW 2007). According to an expert judgement from the *Federal Association of Viniculture* (Bundesweinbauverband Österreich) the amount of residual wood per hectare viniculture is 1.5 to 2.5 t residual wood and the part of it that is burnt is estimated to be 1 to 3%. For the calculations the upper limits (3% of 2.5 t/ha) have been used resulting in a factor of 0.075 t burnt residual wood per hectare viniculture area.

Table 302: Activity data for 4 F Field Burning of Agricultural Waste 1990–2006.

Year	Viniculture Area [ha]	Burnt Residual Wood [t]
1990	58 364	4 377
1991	58 364	4 377
1992	58 364	4 377
1993	57 216	4 291
1994	57 216	4 291
1995	55 628	4 172
1996	55 628	4 172
1997	52 494	3 937
1998	52 494	3 937
1999	51 214	3 841
2000	51 214	3 841
2001	51 214	3 841
2002	51 214	3 841
2003	47 572	3 568
2004	47 572	3 568
2005	50 119	3 759
2006	50 119	3 759

The amount of agricultural waste burned is multiplied with a default or a country specific emission factor.

Cereals

CO, NO_x

The IPCC default method was used. For residue/crop product the default ratio of 1.3 (wheat) was taken (IPCC 2000, Table 4-16). For dry matter fraction an Austrian specific value of 0.86 was used (LÖHR 1990). For CO an emission ratio of 0.06, for NO_x an emission ratio of 0.121 was used (IPCC 1997, Table 4-16).

NH_3

The CORINAIR detailed method with the default emission factor of 2.4 mg NH_3 per gram straw was used. For dry matter fraction the Austrian specific value of 0.86 was used (LÖHR 1990). For residue/crop product the default ratio of 1.3 (wheat) was taken (IPCC GPG Table 4-16).

SO_2

The CORINAIR detailed method and a national emission factor of 78 g per ton straw (dm) was applied. The emission factor corresponds to burning wood logs in poor operation furnace systems (JOANNEUM RESEARCH 1995). For dry matter fraction the Austrian specific value of 0.86 was used (LÖHR 1990). For residue/crop product the default ratio of 1.3 (wheat) was taken (IPCC GPG Table 4-16).

NMVOC

A simple national method with a national emission factor of 28 520 g NMVOC per ha burnt was applied (ÖFZS 1991).

Heavy metals (Cd, Hg, Pb)

The CORINAIR detailed method with national emission factors has been applied.

The Hg, Cd, and Pb emission factors were taken from (HÜBNER 2001a):

- Cd .... 0.09 mg/kg dm_{straw}, 20% remaining in ash
- Pb .... 0.48 mg/kg dm_{straw}, 20% remaining in ash
- Hg .... 0.013 mg/kg dm_{straw}, 0% remaining in ash

The fraction of dry matter burned was estimated by applying the residue/crop product ratio of 1.3 (wheat) taken from (IPCC GPG Table 4-16). For the dry matter content of cereals an Austrian specific value of 0.86 was used (LÖHR 1990).

POPs (PAH, HCB, dioxin/furan)

A country specific method was applied (HÜBNER 2001b). National emission factors were taken from HÜBNER (2001b):

- PAH .... 70 000 mg/ha
- PCDD/F .. 50 µgTE/ha
- HCB .... 10 000 µg/ha.

Viniculture

SO_2, NO_x, NMVOC and NH_3

A country specific method was applied. National emission factors for SO_2, NO_x and NMVOC were taken from (JOANNEUM RESEARCH 1995). A calorific value of 7.1 MJ/kg burnt wood which corresponds to burning wood logs in poor operation furnace systems was used to convert the emission factors from [kg/TJ] to [kg/Mg]. For NH_3 the Corinair emission factor of 1.9 kg per ton burnt wood was taken. Table 303 presents the resulting emission factors.

Table 303: Emission factors for burning straw and residual wood of vinicultures.

	SO_2 [g/Mg Waste]	NO_x [g/Mg Waste]	NMVOC [g/Mg Waste]	NH_3 [g/Mg Waste]
Residual wood of vinicultures	78	284	14 200	1 900

Heavy metals (Cd, Hg, Pb)

A country specific method was applied: The dry matter content of residual wood was assumed to be 80%, national emission factors were taken from (HÜBNER 2001a):

- Cd .... 0.37 mg/kg dm_{wood}, 20% remaining in ash
- Pb .... 2.35 mg/kg dm_{wood}, 20% remaining in ash
- Hg .... 0.038 mg/kg dm_{wood}, 0% remaining in ash

POPs (PAH, HCB, PCDD/F)

A country specific method was applied. The national emission factors per ton burnt wood were taken from (HÜBNER 2001b):

- PAH .... 15.000 mg/Mg Waste
- PCDD/F .. 12 µgTE/Mg Waste
- HCB .... 2 400 µg/Mg Waste

7.8 NFR 4 G Particle Emissions from Animal Husbandry

Particle emissions from this source are primary connected with the manipulation of forage, a smaller part arises from dispersed excrements and litter. Wet vegetation and mineral particles of soils are assumed to be negligible, thus particle emissions from free-range animals are not included.

7.8.1 Methodological Issues

The estimations of particle emissions from animal husbandry are related to the Austrian livestock number.

Activity data

Livestock Numbers

The Austrian official statistics (STATISTIK AUSTRIA 2006) provides national data of annual livestock numbers on a very detailed level (see Table 279, Table 280 and Table 281).

Emission Factors

Measurements and emission estimates of 'primary biological aerosol particles' based on such measurements (WINIWARTER et al. 2007) don't indicate high amounts of cellulosic materials existing in the atmosphere. This is in contrast to the results of the first estimate approach following (EEA 2006) applied in the recent Austrian air emission inventory.

Due to the lack of more reliable up-to-date data, in this inventory the emission factors of the RAINS model (LÜKEWILLE et al. 2001) have been used, resulting in significant lower estimates.

In Table 304 the applied emission factors are listed.

Table 304: TSP emission factors animal housing.

Livestock	Emission Factor [kg TSP/animal]
Dairy cows	0.235
Other cattle	0.235
Fattening pigs	0.108
Sows	0.108
Ovines	0.235
Horses	0.153
Laying hens	0.016
Broilers	0.016
Other poultry (ducks,gooses,etc.)	0.016
Goats	0.153
Other	0.016

Following (KLIMONT et al. 2002) the share of PM10 in TSP is assumed to be 45% and the share of PM2.5 in TSP is assumed to be 10%.

7.8.2 Recalculations

The application of the RAINS emission factor (LÜKEWILLE et al. 2001) resulted in significant lower emissions.

Table 305: Difference to last submission of TSP and PM emissions from Category 4 D Agricultural Soils.

4 D 1 Direct Soil Emissions [Mg]							
Year	**TSP**	**PM10**	**PM2.5**	**Year**	**TSP**	**PM10**	**PM2.5**
1990	-2 780	-2 737	-681	2002	-2 902	-2 781	-644
1995	-3 016	-2 920	-686	2003	-3 283	-3 103	-682
2000	-2 752	-2 662	-641	2004	-3 323	-3 133	-688
2001	-2 939	-2 821	-656	2005	-3 387	-3 185	-694

8 WASTE (NFR SECTOR 6)

8.1 Sector Overview

This chapter includes information on and descriptions of methodologies applied for estimating emissions of NEC gases, CO, heavy metals, persistent organic pollutants (POPs) and particulate matter (PM), as well as references for activity data and emission factors concerning waste management and treatment activities reported under NFR Category *6 Waste* for the period from 1990 to 2006.

Emissions addressed in this chapter include emissions from the sub categories

- *Solid Waste Disposal on Land* (NFR Sector 6 A);
- *Wastewater Handling* (NFR Sector 6 B), where no emissions were reported;
- *Waste Incineration* (NFR Sector 6 C), which comprises the incineration of corpses, municipal waste, and waste oil;
- *Other* (NFR Sector 6 D), which comprises sludge spreading and compost production.

NH_3 and CO emissions of this source have been identified as key category. The following Table 306 presents the results of the key source analysis of the Austrian inventory with regard to the contribution to national total emissions (for details of the key source analysis see Chapter 1.4).

Table 306: Contribution to National Total Emissions from NFR sector 6 Waste in 2006.

Pollutant	Source Category: 6 Waste	Pollutant	Source Category: 6 Waste
SO_2	0.2%	PAH	< 0.1%
NO_x	< 0.1%	Diox	0.4%
NMVOC	0.1%	HCB	0.1%
NH_3	**1.6%**	TSP	0.3%
CO	**0.8%**	PM10	0.2%
Cd	0.1%	PM2.5	0.1%
Hg	2.1%		
Pb	0.1%		

8.2 Emission trend

In Table 307 and Table 311 emissions and trends from NFR Sector 6 *Waste* and sub-sectors for the year 1990 to 2006 are listed.

The overall emission trend reflects changes in waste management policies as well as waste treatment facilities. According to the Landfill Ordinance[122] waste has to be treated before being deposited (in order to reduce the organic carbon content). Decreasing amounts of deposited waste in turn result in decreasing NH_3 emissions. Although an increasing amount of waste is incinerated, NO_x, NMVOC and NH_3 emissions from Waste Incineration (without energy recovery) are decreasing (emissions are taken into account in Sector 1). NH_3 emissions arising from category 6 D Compost Production are increasing as a result of the increasing amount of biologically treated waste (facilitated by the separate collection of organic waste).

[122] Deponieverordnung, Federal Gazette BGBl. Nr. 164/1996

- Primary measures
  - waste avoidance in households: savings in packaging materials; returnable (plastic) bottles instead of non-returnable packages; intensive waste separation, composting of biological; reuse; separate collection of hazardous waste like solvents, paints or (car) batteries.
  - waste avoidance in industry and energy industry: waste separation regarding material, recyclable waste, hazardous waste; more efficient process lines; use of co- and by-product process line; (scap) recycling; substitution of raw material/fuel; reduction in use of raw material/fuel and additive raw material; higher product quality.
  - recycling of old cars (recycling certificate).
- Secondary measures
  - general strategy: waste avoidance prior to waste recycling/reuse prior to landfilling;
  - recovery of (recyclable) material from waste like steel and aluminium recycling, and recycling of paper, glass, plastic;
  - recovery of (recyclable) material from electronic waste;
  - composting of biogenic material;
  - mechanical-biological treatment of residual waste;
  - fermentation of biogenic material;
  - energetic use in waste incineration.

8.2.1 NEC Gases and CO

SO_2 Emissions

In 1990 national SO_2 emissions of the Sector *Waste* amounted to 0.07 Gg; emissions have steeply decreased until 1992 and show then a steady increase until 1998. Since 1999 emissions are stable at a level of 0.06 Gg.

In the year 2006 the *Sector Waste* contributed only 0.2% to Austria's SO_2 emissions. NFR Sector 6 C *Waste incineration* is the only source of SO_2 emissions.

NO_x Emissions

The share of NO_x emissions from this sector in national total emissions was less than 0.1% in 1990 as well as in 2006. As shown in the tables mentioned above, NO_x emissions from the w*aste* sector decreased by about 50% over the period from 1990 to 2006 to 0.05 Gg.

The only source of NO_x emissions of NFR Category *6 Waste* is NFR Sector 6 C *Waste Incineration*.

NMVOC Emissions

In 2006, NMVOC emissions from sector *Waste* contribute less than 0.1% (0.08 Gg) to Austrian total NMVOC emissions. From 1990 to 2006 NMVOC from NFR Sector 6 *Waste* decreased by 50%.

In 2006, 96% of the NMVOC emissions from the Sector W*aste* arose from NFR Sector 6 A, and 4% from NFR Sector 6 C.

Table 307: Emissions and trends from Sector 6 Waste by gas (SO_2, NO_x and NMVOC) and source categories 1990–2006.

	SO_2 [Gg]		NO_x [Gg]		NMVOC [Gg]		
	6	**6 C**	**6**	**6 C**	**6**	**6 A**	**6 C**
1990	0.071	0.071	0.103	0.103	0.161	0.150	0.011
1991	0.057	0.057	0.087	0.087	0.160	0.150	0.011
1992	0.037	0.037	0.060	0.060	0.149	0.146	0.003
1993	0.041	0.041	0.052	0.052	0.146	0.144	0.003
1994	0.048	0.048	0.045	0.045	0.138	0.136	0.002
1995	0.049	0.049	0.046	0.046	0.131	0.128	0.002
1996	0.051	0.051	0.046	0.046	0.124	0.122	0.002
1997	0.053	0.053	0.047	0.047	0.118	0.116	0.002
1998	0.055	0.055	0.048	0.048	0.114	0.112	0.002
1999	0.057	0.057	0.049	0.049	0.109	0.107	0.003
2000	0.057	0.057	0.049	0.049	0.105	0.102	0.003
2001	0.057	0.057	0.049	0.049	0.101	0.098	0.003
2002	0.057	0.057	0.049	0.049	0.099	0.097	0.003
2003	0.057	0.057	0.050	0.050	0.101	0.098	0.003
2004	0.057	0.057	0.051	0.051	0.094	0.091	0.003
2005	0.057	0.057	0.052	0.052	0.087	0.084	0.003
2006	0.057	0.057	0.052	0.052	0.081	0.078	0.003
Trend							
1990–2006	*-20.4%*	*-20.4%*	*-49.6%*	*-49.6%*	*-49.8%*	*-47.9%*	*-75.0%*
2005–2006	*0.0%*	*0.0%*	*0.0%*	*0.0%*	*-7.0%*	*-7.2%*	*0.0%*
Share in Sector Waste							
1990		*100%*		*100%*		*92.9%*	*7.1%*
2006		*100%*		*100%*		*96.5%*	*3.5%*
Share in National Total							
1990	*0.1%*	*0.1%*	*0.1%*	*0.1%*	*0.1%*	*0.1%*	*< 0.1%*
2006	*0.2%*	*0.2%*	*0.1%*	*0.1%*	*0.0%*	*0.0%*	*< 0.1%*

CO Emissions

In 2006, CO emissions of sector *Waste* only contribute 0.8% (5.9 Gg) to the Austrian total CO emissions. From 1990 to 2006, CO emissions from NFR Sector 6 *WASTE* decreased by about 48%.

In 2006, within this source NFR Sector 6 A *Managed Waste Disposal* has a share of 99.8% in total CO emissions. NFR Sector 6 C *Waste incineration* has a share of 0.2% in total CO emissions.

NH_3 Emissions

In 1990 national NH_3 emissions of the Sector *Waste* amounted to about 0.4 Gg; emissions increased by about 177% to 1.0 Gg in 2006 mainly due to increasing mechanical biological treatment of waste and collection of bio-waste, lopping, etc. In the year 2006 the Sector W*aste* contributed 1.6% to Austria's NH_3 emissions.

Within this source NFR Sector 6 A *Managed Waste Disposal* and NFR Sector 6 C *Waste incineration* have each a share of less than 0.1% in total NH_3 emissions. NFR Sector 6 D *Other* (compost production) has a share of about 1.6% in total NH_3 emissions in 2006.

Table 308: Emissions and trends from Sector 6 Waste for NH_3 and CO and source categories 1990–2006.

	CO [Gg]			NH_3 [Gg]			
	6	6 A	6 C	6	6 A	6 C	6 D
1990	11.37	11.32	0.051	0.378	0.005	0.0002	0.3723
1991	11.35	11.30	0.050	0.391	0.005	0.0002	0.3863
1992	11.01	11.00	0.010	0.449	0.005	0.0002	0.4435
1993	10.86	10.85	0.009	0.539	0.005	0.0002	0.5335
1994	10.27	10.26	0.008	0.623	0.005	0.0003	0.6184
1995	9.71	9.70	0.008	0.642	0.004	0.0003	0.6377
1996	9.19	9.18	0.008	0.666	0.004	0.0003	0.6614
1997	8.75	8.74	0.008	0.649	0.004	0.0003	0.6446
1998	8.43	8.42	0.008	0.668	0.004	0.0003	0.6644
1999	8.08	8.07	0.008	0.705	0.004	0.0003	0.7013
2000	7.73	7.72	0.008	0.720	0.003	0.0003	0.7160
2001	7.44	7.44	0.008	0.735	0.003	0.0003	0.7311
2002	7.32	7.31	0.008	0.751	0.003	0.0003	0.7478
2003	7.41	7.39	0.010	0.763	0.003	0.0003	0.7597
2004	6.88	6.87	0.012	0.955	0.003	0.0003	0.9515
2005	6.37	6.36	0.013	1.043	0.003	0.0003	1.0394
2006	5.91	5.90	0.013	1.044	0.003	0.0003	1.0414
Trend							
1990–2006	*-48.0%*	*-47.9%*	*-74.9%*	*176.6%*	*-47.9%*	*33.5%*	*179.8%*
2005–2006	*-7.2%*	*-7.2%*	*0.0%*	*0.2%*	*-7.2%*	*0.0%*	*0.2%*
Share in Sector Waste							
1990		*99.6%*	*0.5%*		*1.3%*	*0.1%*	*98.6%*
2006		*99.8%*	*0.2%*		*0.2%*	*< 0.1%*	*99.7%*
Share in National Total							
1990	*0.8%*	*0.8%*	*< 0.01%*	*0.5%*	*< 0.1%*	*< 0.1%*	*0.5%*
2006	*0.8%*	*0.8%*	*0.00%*	*1.6%*	*< 0.1%*	*< 0.1%*	*1.6%*

8.2.2 Persistent organic pollutants – POPs

Emissions of the persistent organic pollutants (POPs) PAH, dioxin/furan and HCB from Sector NFR *6 Waste* are not rated as key sources of the Austrian Inventory.

As shown in Table 311 in the period from 1990 to 2006

- **PAH** emissions decreased by about 89% to 0.028 kg, which is a share of less than 0.1% in total PAH emissions.
- **dioxin/furan** emissions decreased by about 99% to 0.166 g, which is a share of about 0.4% in total dioxin/furan emissions, whereas in 1990 dioxin/furan emissions contribute 11,3% to the total dioxin/furan emissions.
- **HCB** emissions decreased by 91% to 0.034 kg, which is a share of less than 0.1% in total HCB emissions.

Within this source the NFR Sector 6 C *waste incineration* is the only source of POP emissions.

8.2.3 Heavy Metals – Cd, Hg, Pb

Emissions of the heavy metals Cd, Hg and Pb from NFR *6 Waste* are not rated as key sources of the Austrian Inventory. As shown in Table 309 and Table 311 in the period from 1990 to 2006

- **Cd** emissions decreased by about 98% to 1.44 kg, which is a share of 0.1% in total Cd emission. The emission trend from 2005 to 2006 amount to -4%.
- **Hg** emissions decreased by about 62% to 20.61 kg, which is a share of about 2.0% in total Hg emission. The emission trend from 2005 to 2006 amount to 0.0%.
- **Pb** emissions decreased by about 99% to 8.71 kg, which is a share of about 0.1% in total Pb emission. The emission trend from 2005 to 2006 amount to -1%.

Within this source the NFR Sector 6 C *Waste Incineration* is the main source of heavy metal emissions. Another but small source is NFR Sector 6 A *Solid Waste Disposal on Land.*

Table 309: Emissions and trends from Sector 6 Waste for heavy metals and source categories 1990–2006.

	Cd [kg]			**Hg [kg]**			**Pb [kg]**		
	6	**6 A**	**6 C**	**6**	**6 A**	**6 C**	**6**	**6 A**	**6 C**
1990	59.18	1.50	57.68	53.59	0.01	53.58	1015.83	1.50	1014.33
1991	48.43	1.50	46.93	45.54	0.01	45.53	777.59	1.50	776.09
1992	5.31	1.46	3.85	23.89	0.01	23.88	488.33	1.46	486.88
1993	4.62	1.44	3.18	22.80	0.01	22.80	381.10	1.44	379.67
1994	3.90	1.36	2.54	21.43	0.01	21.42	265.71	1.36	264.35
1995	1.94	1.28	0.65	20.28	0.01	20.27	9.19	1.28	7.91
1996	1.87	1.22	0.66	18.25	0.01	18.24	9.13	1.22	7.91
1997	1.81	1.16	0.66	16.06	0.01	16.05	9.08	1.16	7.92
1998	1.77	1.12	0.66	13.97	0.01	13.96	9.04	1.12	7.92
1999	1.73	1.07	0.66	12.07	0.01	12.06	9.00	1.07	7.93
2000	1.68	1.02	0.66	10.02	0.01	10.02	8.95	1.02	7.93
2001	1.64	0.98	0.66	9.78	0.01	9.78	8.92	0.98	7.93
2002	1.63	0.97	0.66	9.95	0.01	9.94	8.90	0.97	7.93
2003	1.64	0.98	0.66	14.63	0.01	14.62	8.91	0.98	7.93
2004	1.57	0.91	0.66	19.31	0.01	19.30	8.84	0.91	7.93
2005	1.50	0.84	0.66	20.61	0.01	20.60	8.77	0.84	7.93
2006	1.44	0.78	0.66	20.61	0.01	20.60	8.71	0.78	7.93
Trend									
1990–2006	*-97.6%*	*-47.9%*	*-98.9%*	*-61.5%*	*-47.9%*	*-61.5%*	*-99.1%*	*-47.9%*	*-99.2%*
2005–2006	*-4.1%*	*-7.2%*	*< 0.1%*	*0.0%*	*-7.2%*	*0.0%*	*-0.7%*	*-7.2%*	*0.0%*
Share in Sector Waste									
1990		*2.5%*	*97.5%*		*< 0.1%*	*~100.0%*		*0.1%*	*99.9%*
2006		*54.2%*	*45.8%*		*< 0.1%*	*~100.0%*		*9.0%*	*91.0%*
Share in National Total									
1990	*3.8%*	*0.1%*	*3.7%*	*2.5%*	*< 0.1%*	*2.5%*	*0.5%*	*< 0.1%*	*0.5%*
2006	*0.1%*	*< 0.1%*	*< 0.1%*	*2.2%*	*< 0.1%*	*2.0%*	*< 0.1%*	*< 0.1%*	*< 0.1%*

8.2.4 Particulate matter (PM) – TSP, PM10, PM2.5

Emissions of TSP, PM10, PM2.5 from NFR Sector *6 Waste* are not rated as key sources of the Austrian Inventory. As shown in Table 311 in the period from 1990 to 2006.

- **TSP** emissions increase by 32% to about 191 Mg, which is a share of 0.3% in total TSP emission. The emission trend from 2005 to 2006 amount to 1.5%.
- **PM10** emissions increase by 30% to about 90 Mg, which is a share of 0.2% in total PM10 emission. The emission trend from 2005 to 2006 amount to 1.5%.
- **PM2.5** emissions increase by 25% to about 28 Mg, which is a share of 0.1% in total PM2.5 emission. The emission trend from 2005 to 2006 amount to about 1.5%.

Except for 1990, where 6 C contributes 1.3%, 2.5% and 6.4% to TSP, PM10 and PM2.5, within sector NFR 6 *Waste* NFR 6 A *Solid Waste Disposal on Land* is the only source. Emissions vary according to underlying activity data.

Table 310: Emissions and trends from Sector 6 Waste by TSP, PM10, PM2.5 and source categories 1990–2006.

	TSP [Mg]			PM10 [Mg]			PM2.5 [Mg]		
	6	**6 A**	**6 C**	**6**	**6 A**	**6 C**	**6**	**6 A**	**6 C**
1990	145.41	143.46	1.95	69.63	67.87	1.76	22.82	21.36	1.46
1995	159.30	159.30		75.37	75.37		23.72	23.72	
1999	59.20	59.20		28.01	28.01		8.81	8.81	
2000	90.61	90.61		42.87	42.87		13.49	13.49	
2001	86.95	86.95		41.14	41.14		12.95	12.95	
2002	109.73	109.73		51.91	51.91		16.34	16.34	
2003	129.58	129.58		61.31	61.31		19.29	19.29	
2004	170.28	170.28		80.56	80.56		25.35	25.35	
2005	188.41	188.41		89.14	89.14		28.05	28.05	
2006	191.16	191.16		90.44	90.44		28.46	28.46	
Trend									
1990–2006	*31.5%*	*33.2%*		*29.9%*	*33.2%*		*24.7%*	*33.2%*	
2005–2006	*1.5%*	*1.5%*		*1.5%*	*1.5%*		*1.5%*	*1.5%*	
Share in Sector Waste									
1990	*98.7%*	*98.7%*	*1.3%*		*97.5%*			*93.6%*	*6.4%*
2006	*100.0%*	*100.0%*			*100.0%*			*100.0%*	
Share in National Total									
1990	*0.2%*	*0.2%*	*< 0.1%*	*0.2%*	*0.2%*	*< 0.1%*	*0.1%*	*0.1%*	*< 0.1%*
2006	*0.3%*	*0.3%*		*0.2%*	*0.2%*		*0.1%*	*0.1%*	

Table 311: Emissions and trends from Sector 6 Waste 1990–2006.

	SO_2	NO_x	NMVOC	NH_3	CO	TSP	PM10	PM2.5	Cd	Hg	Pb	PAH	Dioxin	HCB
			[Gg]				[Mg]		[kg]		[Mg]	[kg]	[g]	[kg]
1990	0.071	0.103	0.161	0.378	11.371	145.41	69.63	22.82	59.18	53.59	1.016	0.246	18.190	0.392
1991	0.057	0.087	0.160	0.391	11.347				48.43	45.54	0.778	0.241	17.752	0.275
1992	0.037	0.060	0.149	0.449	11.011				5.31	23.89	0.488	0.016	0.529	0.106
1993	0.041	0.052	0.146	0.539	10.857				4.62	22.80	0.381	0.018	0.220	0.045
1994	0.048	0.045	0.138	0.623	10.270				3.90	21.43	0.266	0.021	0.082	0.017
1995	0.049	0.046	0.131	0.642	9.708	159.30	75.37	23.72	1.94	20.28	0.009	0.021	0.083	0.017
1996	0.051	0.046	0.124	0.666	9.185				1.87	18.25	0.009	0.022	0.082	0.017
1997	0.053	0.047	0.118	0.649	8.750				1.81	16.06	0.009	0.023	0.081	0.017
1998	0.055	0.048	0.114	0.668	8.429				1.77	13.97	0.009	0.023	0.080	0.017
1999	0.057	0.049	0.109	0.705	8.077	59.20	28.01	8.81	1.73	12.07	0.009	0.024	0.080	0.017
2000	0.057	0.049	0.105	0.720	7.730	90.61	42.87	13.49	1.68	10.02	0.009	0.024	0.079	0.017
2001	0.057	0.049	0.101	0.735	7.444	86.95	41.14	12.95	1.64	9.78	0.009	0.024	0.077	0.016
2002	0.057	0.049	0.099	0.751	7.320	109.73	51.91	16.34	1.63	9.95	0.009	0.024	0.078	0.016
2003	0.057	0.050	0.101	0.763	7.405	129.58	61.31	19.29	1.64	14.63	0.009	0.026	0.117	0.024
2004	0.057	0.051	0.094	0.955	6.882	170.28	80.56	25.35	1.57	19.31	0.009	0.028	0.156	0.032
2005	0.057	0.052	0.087	1.043	6.371	188.41	89.14	28.05	1.50	20.61	0.009	0.028	0.166	0.034
2006	0.057	0.052	0.081	1.044	5.911	191.16	90.44	28.46	1.44	20.61	0.009	0.028	0.166	0.034
Trend														
1990–2006	*-20.4%*	*-49.6%*	*-49.8%*	*176.6%*	*-48.0%*	*31.5%*	*29.9%*	*24.7%*	*-97.6%*	*-61.5%*	*-99.1%*	*-88.6%*	*-99.1%*	*-91.3%*
2005–2006	*0.0%*	*0.0%*	*-7.0%*	*0.2%*	*-7.2%*	*1.5%*	*1.5%*	*1.5%*	*-4.1%*	*0.0%*	*-0.7%*	*0.0%*	*0.0%*	*0.0%*
National Share														
1990	*0.1%*	*0.1%*	*0.1%*	*0.5%*	*0.8%*	*0.2%*	*0.2%*	*0.1%*	*3.8%*	*2.5%*	*0.5%*	*< 0.1%*	*11.3%*	*0.4%*
2006	*0.2%*	*0.0%*	*0.0%*	*1.6%*	*0.8%*	*0.3%*	*0.2%*	*0.1%*	*0.1%*	*2.0%*	*0.1%*	*< 0.1%*	*0.4%*	*0.1%*

8.2.5 General description

Methodology

In general the CORINAIR simple methodology, multiplying activity data for each sub category with an emission factor, is applied. For waste disposal the IPCC methodology was used to calculate the amount of landfill gas, the methodology is described in detail below.

Recalculations

Recalculations have been made for sub categories 6 A 1 *Managed Waste Disposal on Land,* 6 C *Waste Incineration, 6 D Other*, explanations are provided in the respective subchapters.

6 A 1 Managed Waste Disposal

Update of activity data

Activity data (1998 to 2005) has been updated. According to the Austrian Landfill Ordinance, the operators of landfill sites have to report their activity data annually. Based on reports received after the due date and updates the amount of deposited waste changed slightly (< 10%) compared to the previous submission.

According to the recommendation of the ERT the double counting of deposited waste due to clean-up of former waste deposits, was corrected and resulted in lower amounts of deposited waste in 2002 and 2003.

6 C Incineration of Corps

Update of activity data according to expert judgements.

6 D Other

Sewage sludge is no longer considered as separate waste fraction for composting as it can be assumed that it is already accounted for in the waste fraction undergoing a mechanical-biological treatment. Emissions from mechanical-biological treatment are considered in this source category.

Activity Data for mechanical-biological treatment are updated for the years 2003–2005, as new data were available.

Completeness

Table 312 gives an overview of the NFR categories included in this chapter and also provides information on the status of emission estimates of all sub categories. A "✓" indicates that emissions from this sub category have been estimated.

Table 312: Overview of sub categories of Category 6 Waste and status of estimation.

NFR Category		Status													
		NEC gas				CO	PM			Heavy metals			POPs		
		NO_x	SO_2	NH_3	NMVOC	CO	TSP	PM10	PM2.5	Cd	Hg	Pb	Dioxin	PAK	HCB
6 A	Solid Waste Disposal on Land	NA	NA	✓	✓	✓	✓	✓	✓	✓	✓	✓	NA	NA	NA
6 B	Wastewater Handling	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
6 C	Waste Incineration	✓	✓	✓	✓	✓	NE	NE	NE	✓	✓	✓	✓	✓	✓
6 D	Other Waste	NA	NA	✓	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

8.3 NFR 6 A Waste Disposal on Land

8.3.1 Managed Waste Disposal on Land (6 A 1)

Source Category Description

In Austria all waste disposal sites are managed sites (landfills).

NFR 6 A 1 *Managed waste disposal on land* accounts for the main source of NH_3 and NMVOC emissions of NFR Category 6 Waste.

The anaerobic degradation of land filled organic substances results in the formation of landfill gas. About 300 mg per m³ landfill gas are NMVOC and about 10 mg per m³ landfill gas are NH_3. Most active landfills in Austria have gas collection systems. According to a study [ROLLAND & OLIVA 2004], the amount of the collected and burnt landfill gas increased over the period. For example, the amount of the collected landfill gas was about 2% in 1990, and 13% in the year 2002 respectively.

Table 307 and Table 308 present NMVOC and NH_3 emissions from managed waste disposal on land for the period from 1990 to 2006. As can be seen in the tables, the trend of NMVOC and NH_3 emissions during the period is decreasing. From 1990 to 2006, both emissions decreased by 48% due to less deposited waste and increasing amount of collected landfill-gas.

Methodological Issues

The amount of generated landfill gas from disposed solid waste was calculated by taking into account the amount of directly deposited waste, reported by landfill operators for different waste categories (Residual Waste and Non-Residual Waste), the carbon content of each waste fraction and several other parameters. This method accords IPCC Guidelines.

Activity data

Activity data for residual waste and non-residual waste are presented in Table 313.

In 1990 the Austrian Waste Management Law[123] took into force (1990). As a consequence, from 1990 to 1995, the amount of deposited waste decreased and waste separation and reuse as well as recycling activities increased. After 1994/1995, the potential of waste prevention and waste recycling was exhausted, so amounts of deposited waste did not decrease any further. The amount of deposited waste peaked in 2003, probably because from beginning of 2004 only pre-treated or harmless waste was allowed to be deposited (see Landfill Ordinance[124]).

The strong decrease after 2003 is due to the taking effect of the Landfill Ordinance, which only allows the disposal of treated waste and therefore leads to reduced waste volumes and masses, as well as decreased carbon content in deposited waste.

Between 1990 and 2006, residual waste decreased by 87%, non residual waste by 48%, and total waste by 78%.

Table 313: Activity data for "Residual waste" and "Non Residual Waste" 1990–2006.

Year	residual waste [Mg]	non-residual waste [Mg]	total waste [Mg]
1990	1 995 747	664 536	2 660 283
1991	1 799 718	677 827	2 477 545
1992	1 614 157	691 383	2 305 541
1993	1 644 718	705 211	2 349 929
1994	1 142 067	719 315	1 861 382
1995	1 049 709	733 702	1 783 410
1996	1 124 169	748 376	1 872 545
1997	1 082 634	763 343	1 845 977
1998	1 081 114	778 610	1 859 724
1999	1 084 625	841 169	1 925 794
2000	1 052 061	843 780	1 895 841
2001	1 065 592	795 262	1 860 854
2002	1 174 543	812 080	1 986 623
2003	1 385 944	899 563	2 285 507
2004	282 656	356 973	639 629
2005	241 733	340 676	582 409
2006	251 112	345 406	596 519

Residual Waste

"Residual waste" corresponds to waste from households and similar establishments after separate collection directly deposited at landfills without any treatment. It originates from private households, administrative facilities of commerce, industry and public administration, kindergartens, schools, hospitals, small enterprises, agriculture, market places and other generation points covered by the municipal waste collecting system.

[123] Abfallwirtschaftsgesetz (AWG): BGBl. Nr. 325/1990, in der Fassung BGBl. I. Nr. 102/2002

[124] Deponieverordnung: BGBl. Nr. 164/1996, in der Fassung BGBl II Nr. 49/2004

Only 7.7% of residual waste was deposited in 2004. The remaining part was recycled, incinerated or treated biologically. According to the recent federal waste management plans, recycling and treatment of waste from households and similar establishments was performed as listed in Table 314.

Table 314: Recycling and treatment of waste from households and similar establishments (BAWP 1998, BAWP 2006).

Treatment	1989	2004
mechanical-biological treatment	16.7%	11.2%
thermal treatment (incineration)	5.9%	28.3%
treatment in plants for hazardous waste	0.4%	1.2%
recycling	12.9%	35.6%
recycling (biogenous waste)	1.0%	16.0%
direct deposition at landfills ("residual waste")	63.1%	7.7%

The quantities of "residual waste" were taken from the following sources:

- From 1998 to 2006 data were taken from the database for solid waste disposals "Deponiedatenbank" ("Austrian landfill database"). According to the Landfill Ordinance[125], which came into force in 1997, the operators of landfill sites have to report how much and what kind of waste they receive at their landfill site annually to the Umweltbundesamt, where the data are stored in the database for solid waste disposals.
- From 1950 to 1997 data were calculated based on national studies (HACKL & MAUSCHITZ 1999), (HÄUSLER 2001) and the respective Federal Waste Management Plans (BAWP 1995, 2001).

However in the federal waste management plan and the national study (HACKL & MAUSCHITZ 1999) the amount of residual waste from administrative facilities of businesses and industries is not considered (data from 1960 to 1999) whereas it is reported by the operators of landfill sites from 1998 on and included in the "Deponiedatenbank". Thus to achieve a consistent time series the two overlapping years (1998 and 1999) were examined and the difference which represents the residual waste from administrative facilities of industries and businesses calculated. This difference was then applied to the years 1960 to 1997 according to the relative known change in data from residual waste from households. The amount of deposited Waste for 1950–1959 is firstly estimated in (HÄUSLER 2001).

Non Residual Waste

"Non Residual Waste" is directly deposited waste other than residual waste, but with biodegradable lots. Non Residual Waste comprises for example:

- bulky waste
- construction waste
- mixed industrial waste
- road sweepings
- sewage sludge
- rakings
- residual matter from waste treatment

[125] Deponieverordnung: BGBl. Nr. 164/1996, in der Fassung BGBl II Nr. 49/2004

The quantities of "non residual waste" from 1998 to 2006 were taken from the database for solid waste disposals "Deponiedatenbank" ("Austrian landfill database"), whereas only the amount of waste with biodegradable lots was considered. Table 315 presents a summary of all considered waste types and the corresponding identification numbers. For calculating the emissions of residual waste the waste types were aggregated to the categories wood, paper, sludge, other waste, bio waste, textiles, construction waste and fats. There are no data available for the years before 1998. Thus extrapolation was done using the Austrian GDP (gross domestic product) per inhabitant (KAUSEL 1998) as indicator using a 20 year average value in order to get a more robust estimate.

Table 315:Considered types of waste.

Waste Identification No	Type of Waste	Waste Identification No	Type of Waste
200301	mixed municipal waste ("residual waste")	170204	Glass, plastic and wood containing or contaminated with dangerous substances
303	wastes from pulp, paper and cardboard production and processing	170903	other construction and demolition wastes (including mixed wastes) containing dangerous substances
1905	wastes from aerobic treatment of solid waste	170904	mixed construction and demolition waste
1908	wastes from wastewater treatment plants not otherwise specified	190805	sludge from treatment of urban wastewater
1909	wastes from the preparation of water intended for human consumption or water for industrial use	190809	grease and oil mixture from oil/water separation containing only edible oil and fats
1912	wastes from the mechanical treatment of waste (for example sorting. crushing. compacting. pelletising) not otherwise specified	200101/ 200102	paper and cardboard
20303	waste from solvent extraction	200108	biodegradable kitchen and canteen waste
30105	Sawdust, shavings, cuttings, wood, particle board and veneer	200111	textiles
30304	de-inking sludge from paper recycling	200201	Bio-degradable wastes
30307	mechanically separated rejects from pulping of waste paper and cardboard	200302	waste from markets
30310	fibre rejects, fibre-, filler-. and coating sludge from mechanical separation	200307	bulky waste
40106	Sludge, in particular from on-site effluent treatment containing chromium	190811–14	sludge from treatment of industrial wastewater
40109	waste from dressing and finishing	20 01 25	edible oil and fat
40221	wastes from unprocessed textile fibres	170201	wood
150103	wooden packaging	303	wastes from pulp. paper and cardboard production and processing

The methodology of emission calculation for the two subcategories is presented in the following subchapters.

Methodology

Where available, country specific factors are used. If these were not available IPCC default values are taken. Table 316 summarises the parameters used and the corresponding references.

Table 316: Parameters for calculating methane emissions of SWDS.

Parameters	residual waste	wood	paper	sludges	bulky waste & other waste	bio-waste	textiles	construction waste	fats
Fraction of degradable organic carbon dissimilated DOC_F	0.6	0.5	0.55	0.77	0.55	0.77	0.55	0.55	0.77
	The DOC_F for residual waste reflects the recent increase of biogenic components (Table 316). IPCC default taking into account national waste expertises.								
DOC	see Table 318	0.45	0.3	0.11	0.16	0.16	0.5	0.09	0.2
	HACKL; ROLLAND[(1)]	BAUMELER et al. 1998							
Half life period	7	25	15	7	20	10	15	20	4
	National waste experts	GILBERG et al. 2005		Assumption: same as residual waste	IPCC default slow decay	Assumption: better than paper	Assump-tion: same as paper	IPCC default slow decay	GILBERG et al. 2005
Number of considered years	56								
	IPCC default including data for 3 to 5 half lives								

[(1)] *HACKL & MAUSCHITZ 1999; ROLLAND & SCHEIBENGRAF 2003*

Biodegradable organic carbon (DOC) of residual waste

The decrease during the 1990ies in DOC-content was due to the introduction of separate collection of bioorganic waste and paper waste. The amount of bio-waste that is collected separately increased over the time, while the organic share in residual waste decreased. This resulted in a change of waste composition with the effect of a decreasing DOC content. Since 2000 biogenic components in residual waste are increasing, this might be due to reduced public awareness.

A study (ROLLAND & SCHEIBENGRAF 2003) was undertaken in 2003 to estimate the carbon content in residual waste. The carbon content of different fractions was estimated by viewing literature on direct waste analyses. According to the changing waste composition the carbon content of residual waste (mixture of different waste fractions) over the time was calculated until 2003. For this years' submission the DOC value was updated for the year 2004 based on the most recent composition of residual waste. This new value resulted in updated values from 2001 to 2006.For 2004 and 2005, the same DOC values as for 2003 is used.

Table 317 presents the composition of residual waste for several years between 1990 and 2004. On the basis of this information a time series for DOC was estimated (see Table 318). For the years before 1990, quantities according to a national study (HACKL & MAUSCHITZ 1999) were used.

Table 317: Composition of residual waste (ROLLAND & SCHEIBENGRAF 2003), (BAWP 2006).

Residual waste	1990	1993	1996	1999	2004
	[% of moist mass]				
Paper, cardboard	21.9	18.3	13.5	14	11
Glass	7.8	6.3	4.4	3	5
Metal	5.2	4.4	4.5	4.6	3
Plastic	9.8	9.3	10.6	15	10

Residual waste	1990	1993	1996	1999	2004
	[% of moist mass]				
Composite materials	11.3	11.3	13.8	–	8
Textiles	3.3	3.1	4.1	4.2	6
Hygiene materials	–	–	–	12	11
Biogenic components	29.8	34.4	29.7	17.8	37
Hazardous household waste	1.4	1.5	0.9	0.3	2
Mineral components	7.2	7.9	3.8	–	4
Wood, leather, rubber, other components	2.3	3.6	1.1	2.6	1
Residual fraction	–	–	13.6	26.5	2

Source: ROLLAND & SCHEIBENGRAF (2003), BAWP 2006

Table 318: Time series of bio-degradable organic carbon content of directly deposited residual waste 1950–1989: (HACKL & MAUSCHITZ 1999), 1990-2000: (ROLLAND & SCHEIBENGRAF 2003); 2001–2006 update according to BAWP 2006).

year	bio-degradable organic carbon [g/kg Waste (moist mass)]	year	bio-degradable organic carbon [g/kg Waste (moist mass)]
1950–1959	240	1997	130
1960–1969	230	1998	130
1970–1979	220	1999	120
1980–1989	210	2000	120
1990	200	2001	132
1991	190	2002	144
1992	180	2003	157
1993	170	2004	169
1994	160	2005	169
1995	150	2006	169
1996	140		

Landfill gas recovery

In 2004, the *Umweltbundesamt* investigated the amount of annual collected landfill gas by questionnaires sent to landfill operators (ROLLAND & OLIVA 2004). The amount of collected and burnt landfill gas increased constantly over the time period (Figure 14). While for example the amount of the collected landfill gas was about 2% in 1990, this amount reached 13% in the year 2002.

As this study only covers the amount of collected landfill gas from 1990 to 2002, the 2002 data were also used for 2003 to 2005. A study to update the amounts of collected landfill gas will be undertaken and results are expected for next year's submission.

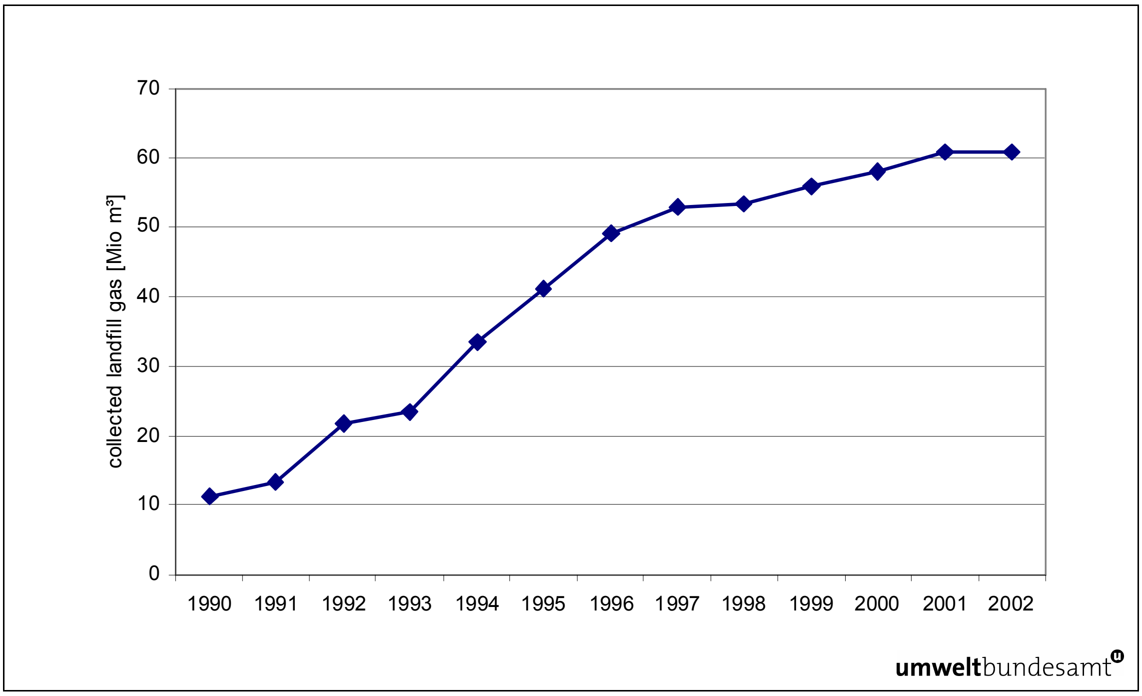

Figure 14: Amount of collected landfill gas 1990 to 2002 (ROLLAND & OLIVIA 2004).

Emission Factors

NMVOC, CO, NH_3 and heavy metal emissions are calculated according to their content in the emitted landfill-gases (after consideration of gas recovery).[126]

Table 319: Emission factors for CO, NMVOC, NH_3 and heavy metals.

	CO	NMVOC	NH_3	Cd	Hg	Pb
	Vol.%	Vol.%	Vol.%	mg/Nm³	mg/Nm³	mg/Nm³
concentration in landfill gas	2	300	10	0.003	0.00002	0.003

PM emissions are calculated according WINIWARTER et al. 2008 It is assumed that PM10 is 47% of TSP and PM2.5 is 15% of TSP.

Table 320: Emission factors for PM.

TSP	PM10	PM2.5
g/Mg WASTE	g/Mg WASTE	g/Mg WASTE
18.00	8.52	2.68

8.3.1.1 Recalculations

Improvements and recalculations made are described in Chapter 3.

[126] according to UMWELTBUNDESAMT (2001b)

8.4 NFR 6 C Waste Incineration

Source Description

In this category emissions are included from

- incineration of corpses
- hospital waste
- waste oil
- incineration of domestic or municipal solid waste without energy recovery.

Additionally heavy metal and POPs emissions of a single plant without emission control 1990 to 1991 are included here. From 1992 the plant was equiped with ESP. Emissions 1992 to 2000 are included in category 1 A 4 a and from 2001 on in category 1 A 1 a. Emissions from incineration of carcasses are not estimated.

In Austria waste oil is incinerated in especially designed so called "USK-facilities". The emissions of waste oil combustion for energy use (e.g. in cement industry) are reported under NFR sector 1 A Fuel Combustion.

In general, municipal, industrial and hazardous waste are combusted in district heating plants or in industrial sites and the energy is used. Therefore their emissions are reported in NFR category 1 A Fuel Combustion. There is only one waste incineration plant which has been operated until 1991 with a capacity of 22 000 tons of waste per year without energy recovery and emission controls. This plant has been rebuilt as a district heating plant starting operation in 1996. Therefore the emissions of this plant are reported under NFR category 1 A Fuel Combustion from 1996 onwards.

Methodology

The simple CORINAIR methodology is used. Emission factors are specific to type of waste and combustion techology.

Activity data

For municipal solid waste the known capacity of 22 000 tons of waste per year of one waste incineration plant was taken.

Waste oil activity data 1990 to 1999 were taken from (BOOS et al. 1995). For 2000 to 2006 the activity data of 1999 was used. (PERZ 2001) quotes that in 2001 total waste oil accumulation was about 37 500 t. Nevertheless, waste oil is mainly used for energy recovery in cement kilns or public power plants and it is consequently accounted for in the energy balance as *Industrial Waste*.

Activity data of clinical waste is determined by data interpretation of the waste flow database at the *Umweltbundesamt* considering the waste key number "971" for the years 1990 and 1994 and extrapolated for the remaining time series.

Generally, few amounts of clinical waste and waste oil are nowadays incinerated without energy recovery in Austria. Thus, it is assumed that activity data since the last surveys are overestimated but no explicit survey to update these data has been made yet.

Activity data of hazardous waste and sewage sludge are plant specific. From 1992 on hazardous waste and sewage sludge are considered in categories 1 A 4 a and 1 A 1 a.

Activity data of incineration of corps are based on expert judgement.

Table 321: Activity data for category 6 C Waste Incineration.

Year	Municipal Waste	Clinical Waste	Waste Oil	Hazardous waste	Sewage sludge	Corps
	[Mg]					
1990	22 000	9 000	2 200	71 000	62 000	9954
1991	22 000	7 525	1 500	71 000	62 000	10011
1992	0	6 050	1 800	IE	IE	9979
1993	0	4 575	2 100	IE	IE	9902
1994	0	3 100	2 500	IE	IE	9682
1995	0	3 100	2 600	IE	IE	9741
1996	0	3 100	2 700	IE	IE	9695
1997	0	3 100	2 800	IE	IE	9532
1998	0	3 100	2 900	IE	IE	9401
1999	0	3 100	3 000	IE	IE	9384
2000	0	3 100	3 000	IE	IE	9214
2001	0	3 100	3 000	IE	IE	8972
2002	0	3 100	3 000	IE	IE	9136
2003	0	3 100	3 000	IE	IE	13818
2004	0	3 100	3 000	IE	IE	18500
2005	0	3 100	3 000	IE	IE	19800
2006	0	3 100	3 000	IE	IE	19800
Trend						
1990–2006	*-100%*	*-66%*	*36%*			*99%*

Emission factors

Heavy metal emission factors are taken from (HÜBNER 2001a). POPs emission factors are taken from (HÜBNER 2001b). Main pollutant emission factors: For municipal waste the industrial waste emissions factors from (BMWA 1990) are taken and converted by means of a NCV of 8.7 TJ/kt. Waste oil emission factors are selected similar to uncontrolled industrial residual fuel oil boilers. Clinical waste emission factors selected by means of industrial waste emissions factors from (BMWA 1990). Table 322 shows emission factors of the air pollutants.

Table 322: NFR 6 C Waste Incineration: emission factors by type of waste.

Type of waste	NO_x	CO	NMVOC	SO_2	NH_3
	[kg/kt]				
Waste oil	8 060.0	604.5	403.0	18 135.0	110.0
Municipal waste	870.0	1 740.0	330.6	1 131.0	0.2
Clinical waste	7 000.0	840.0	330.0	700.0	0.2

Municipal waste	Cd	Hg	Pb	PAH	DIOX	HCB
	[kg/kt]					
1985	2 580.0	1 800.0	30 000.0	0.7	250.0	850.0
1986	2 078.2	1 499.8	24 234.0	0.7	250.0	850.0
1987	1 576.4	1 199.6	18 468.0	0.7	250.0	850.0
1988	1 074.6	899.4	12 702.0	0.7	250.0	850.0
1989	572.8	599.2	6 936.0	0.7	250.0	850.0
1990	71.0	299.0	1 170.0	0.7	250.0	850.0
1991	59.2	263.2	966.0	0.7	250.0	850.0

Industrial Waste	Cd	Hg	Pb	PAH	DIOX	HCB
	[kg/kt]					
1985	720.0	100.0	8300.0	1.6	160.0	970.0
1986	678.0	102.4	7120.0	1.6	160.0	970.0
1987	636.0	104.8	5940.0	1.6	160.0	970.0
1988	594.0	107.2	4760.0	1.6	160.0	970.0
1989	552.0	109.6	3580.0	1.6	160.0	970.0
1990	510.0	112.0	2400.0	1.6	160.0	970.0
1991	414.0	99.4	1922.0	1.6	160.0	970.0

sludges from waste water treatment	Cd	Hg	Pb	PAH	DIOX	HCB
	[kg/kt]					
1985	6.0	3.0	280.0	1.6	1.5	300.0
1986	51.8	13.4	370.0	1.6	1.5	300.0
1987	97.6	23.8	460.0	1.6	1.5	300.0
1988	143.4	34.2	550.0	1.6	1.5	300.0
1989	189.2	44.6	640.0	1.6	1.5	300.0
1990	235.0	55.0	730.0	1.6	1.5	300.0
1991	191.8	45.8	585.2	1.6	1.5	300.0

Clinical waste	Cd	Hg	Pb	PAH	DIOX	HCB
	[kg/kt]					
1985–1990	4.77	5.76	540.00	0.00	1.08	216.00
1991	3.99	4.82	451.50	0.00	0.68	135.45
1992	3.21	3.87	363.00	0.00	0.36	72.60
1993	2.42	2.93	274.50	0.00	0.14	27.45
1994	1.64	1.98	186.00	0.00	0.00	0.19
1995–2006	0.62	0.71	7.75	0.00	0.00	0.19

Waste oil	Cd	Hg	Pb	PAH	DIOX	HCB
	[kg/kt]					
1985	1 800.0	150.0	200 000.0	6.7	37.0	37 000.0
1986	1 512.0	126.0	181 260.0		37.0	37 000.0
1987	1 224.0	102.0	162 520.0		37.0	37 000.0
1988	936.0	78.0	143 780.0		35.6	35 591.2
1989	648.0	54.0	125 040.0		31.9	31 947.6
1990	360.0	30.0	106 300.0		17.0	17 020.0
1991			87 560.0		0.4	370.0
1992			68 820.0			
1993			50 080.0			
1994			31 340.0			
1995–2006	13.0		60.0			

Table 323: NFR 6 C Waste Incineration of corps: emission factors.

Hg	Pb	PAH	Dioxin	HCB
[kg/kt]		[kg/kt]	[mg/corps]	[µg/corps]
3 000(4)	0.02(1)	0.40(1)	16.60(2)	3 320(2)
2 500(5)			8.30(3)	1 660(3)
2 500(6)				
1 000(7)				

(1) *for 1985–2006*

(2) *for 1980–1992*

(3) *for 1993–2006*

(4) *for 1985–1990*

(5) *for 1991*

(6) *for 1992–1995*

(7) *for 2000–2006*

8.5 NFR 6 D Other Waste

Source Category Description

In this category mechanical biological treatment and composting of waste is addressed.

Compost Production

This category includes NH_3 emissions from biological treatment of waste, which are presented in Table 308 for the period from 1990 to 2006.

NH_3 emissions arising from this subcategory increased over the time period as a result of the increasing amount of biologically treated waste.

Methodological Issues

Emissions were estimated using a country specific methodology. To estimate the amount of composted waste it was split up into three fractions of composted waste:

- mechanically biologically treated residual waste
- composted waste: bio-waste collected separately, loppings. home composting

NH_3 emissions were calculated by multiplying an emission factor with the quantity of waste.

Activity data

Activity data were taken from several national studies. For years where no data were available inter- or extrapolation was done.

Table 324: Activity data for NFR Category 6 D Other Waste (Compost Production).

	Total waste	Mechanical biological treated waste		Bio waste collected separately*	Loppings; gardening waste		Home composting	
	[Gg]	[Mg]	source	[Mg]	[Mg]	source	[Mg]	
1990	758.2	345 000	(BAUMELER et al. 1998)	5 790	37 370	Sum of data reported by the Austrian federal provinces, (AMLINGER 2003)	370 000	(AMLINGER 2003)
1991	793.3	345 000		22 342	50 995		375 000	
1992	936.3	345 000		82 853	48 464		460 000	
1993	1 161.2	345 000		156 775	149 470		510 000	
1994	1 373.5	345 000		246 385	197 130		584 985	
1995	1 446.6	295 000	(ANGERER 1997)	302 383	249 264		600 000	
1996	1 513.5	280 000	(Rolland) expert judgement	334 371	283 127		616 000	
1997	1 489.1	245 000	(LAHL 1998)	351 862	229 643		662 571	
1998	1 540.9	240 000	(LAHL 2000)	362 572	241 835		696 487	
1999	1 620.7	265 000	(GRECH & ROLLAND 2001)	378 796	244 587		732 273	
2000	1 664.7	250 673	Same as 1999	374 550	267 670	interpolated	771 773	
2001	1 709.5	236 346		410 630	290 752		771 773	
2002	1 758.5	222 020		450 835	313 835		771 773	
2003	1 795.3	207 693	(NEUBAUER, et al. 2006);	478 919	336 917		771 773	Same as 2002
2004	2 134.6	488 426		514 357	360 000	BAWP 2006	771 773	
2005	2 292.3	612 500	BAWP 2006	548 010	360 000	Same as 2005	771 773	
2006	2 297.3	612 500	Same as 2005	552 999	360 000		771 773	

* *source of data for 1990–2006: Sum of data reported by the Austrian federal provinces, partly interpolated*

Emission factors

Due to different emission factors in different national references an average value was used for each of the three fractions of composted waste.

Table 325: Emission factors for IPCC Category 6 D Other Waste (Compost Production).

	NH_3 [kg/t FS]	**References**
mechanical biological treated residual waste	0.6	(UMWELTBUNDESAMT Berlin 1999) (AMLINGER et al. 2003) (ANGERER. FRÖHLICH 2002)
Bio-waste, lopping, home composting	0.4	(AMLINGER et al. 2003)

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10 ABBREVIATIONS

AMA .... Agrarmarkt Austria

BAWP .... Bundes-Abfallwirtschaftsplan (Federal Waste Management Plan)

BMLFUW .... Bundesministerium für Land- und Forstwirtschaft, Umwelt und Wasserwirtschaft (Federal Ministry for Agriculture, Forestry, Environment and Water Management)

BMUJF .... Bundesministerium für Umwelt, Jugend und Familie (Federal Ministry for Environment, Youth and Family (before 2000, now domain of Environment: BMLFUW))

BUWAL .... Bundesamt für Umwelt, Wald und Landschaft. Bern (The Swiss Agency for the Environment, Forests and Landscape (SAEFL), Bern)

CORINAIR .... Core Inventory Air

CORINE .... Coordination d´information Environmentale

CRF .... Common Reporting Format

DKDB .... Dampfkesseldatenbank (Austrian annual steam boiler inventory)

EC .... European Community

EEA .... European Environment Agency

EIONET .... European Environment Information and Observation NETwork

EMEP .... Cooperative Programme for Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe

ETS .... Emission Trading System

EPER .... European Pollutant Emission Register

GLOBEMI .... Globale Modellbildung für Emissions- und Verbrauchsszenarien im Verkehrssektor ((Global Modelling for Emission- and Fuel consumption Scenarios of the Transport Sector) see (HAUSBERGER 1998))

GPG .... Good Practice Guidance (of the IPCC)

HM .... Heavy Metals

IEA .... International Energy Agency

IEF .... Implied emission factor

IFR .... Instrument Flight Rules

IIR .... Informative Inventory Report

IPCC .... Intergovernmental Panel on Climate Change

LTO .... Landing/Take-Off cycle

MEET .... MEET (1999): MEET – Methodology for calculating transport emissions and energy consumption. European Commission, DG VII, Belgium.

NACE .... Nomenclature des activites economiques de la Communaute Europeenne

NAPFUE .... Nomenclature for Air Pollution Fuels

NEC .... National Emissions Ceiling (Directive 2001/81/EC of The European Parliament And Of The Council of 23 October 2001 on national emission ceilings for certain atmospheric pollutants – NEC Directive)

NFR .... Nomenclature for Reporting (Format of Reporting under the UNECE/LRTAP Convention)

NIR........................ National Inventory Report (Submission under the United Nations Framework Convention on Climate Change)

NISA .... National Inventory System Austria

OECD .... Organisation for Economic Co-operation and Development

OLI .... Österreichische Luftschadstoff InventurAustrian Air Emission Inventory

PHARE .... Phare is the acronym of the Programme's original name: 'Poland and Hungary: Action for the Restructuring of the Economy'. It covers now 14 partner countries: Albania, Bosnia and Herzegovina, Bulgaria, Croatia, the Czech Republic, Estonia, the Former Yugoslav Republic of Macedonia (FYROM), Hungary, Latvia, Lithuania, Poland, Romania, Slovakia and Slovenia, (However, Croatia was suspended from the Phare Programme in July 1995.)

PM .... Particular Matter

POP .... Persistent Organic Pollutants

PRTR .... Pollution Release and Transfer Register

QA/QC .... Quality Assurance/Quality Control

QMS...................... Quality Management System

RWA .... Raiffeisen Ware Austria (see www.rwa.at)

SNAP .... Selected Nomenclature on Air Pollutants

TAN....................... Total ammoniacal nitrogen

Umweltbundesamt.. Umweltbundesamt (Federal Environment Agency)

UNECE/LRTAP..... United Nations Economic Commission for Europe.Convention on Long-range Transboundary Air Pollution

UNFCCC............... United Nations Framework Convention on Climate Change

VFR....................... Visual Flight Rules

WIFO .... Wirtschaftsforschungsinstitut (Austrian Institute for Economic Research)

11 ANNEX

1. NFR for 2006
2. Footnotes to NFR
3. Austria's emissions for SO_2, NO_x, NMVOC and NH_3 according to the submission under NEC directive
4. Emission Trends per Sector
5. Annex: Extracts from Austrian Legislation

11.1 Nomenclature for Reporting (NFR) - Format of Reporting under the UNECE/LRTAP Convention

11.1.1 NFR for 2006

c
Version 2004-1

COUNTRY:	AT	(as ISO2 code)
DATE:	14.02.2008	(as DD.MM.YYYY)
YEAR:	2006	(as YYYY, year of Emissions)

NFR sectors to be reported to LRTAP			A = Allowable Aggregation	NOx	CO	NMVOC	SOx	NH3	TSP	PM10	PM2.5	Pb	Cd	Hg
				Main Pollutants					Particulate Matter			Priority Heavy Metals		
				Gg NO_2	Gg	Gg	Gg SO_2	Gg	Gg	Gg	Gg	Mg	Mg	Mg
1 A 1 a	(a)	**1 A 1 a Public Electricity and Heat Production**		10,50	4,11	0,70	4,16	0,26	1,14	1,05	0,88	1,45	0,10	0,20
1 A 1 b	(a)	**1 A 1 b Petroleum refining**		3,39	0,46	IE	3,69	0,10	0,10	0,09	0,08	0,29	0,17	0,01
1 A 1 c	(a)	**1 A 1 c Manufacture of Solid Fuels and Other Energy Industries**		1,48	0,10	0,00	NA	0,01	0,07	0,07	0,07	0,00	0,00	0,00
1 A 2	(a)	**1 A 2 Manufacturing Industries and Construction**	A	35,37	168,71	3,06	10,29	0,29	3,20	2,61	2,12	3,09	0,20	0,27
1 A 2 a	(a)	1 A 2 a Iron and Steel		5,23	148,00	0,33	5,76	0,05	0,06	0,06	0,07	0,20	0,00	0,00
1 A 2 b	(a)	1 A 2 b Non-ferrous Metals		0,21	0,04	0,00	0,10	0,00	0,01	0,01	0,01	1,05	0,02	0,01
1 A 2 c	(a)	1 A 2 c Chemicals		1,20	1,29	0,16	0,44	0,03	0,41	0,37	0,31	0,38	0,01	0,01
1 A 2 d	(a)	1 A 2 d Pulp, Paper and Print		5,12	2,01	0,25	1,17	0,07	0,27	0,25	0,20	0,77	0,09	0,07
1 A 2 e	(a)	1 A 2 e Food Processing, Beverages and Tobacco		0,78	0,13	0,01	0,24	0,02	0,04	0,04	0,03	0,01	0,00	0,00
1 A 2 f	(a)	1 A 2 f Other (Please specify in a covering note)		22,83	17,24	2,30	2,58	0,12	2,40	1,89	1,50	0,69	0,07	0,18
1 A 3 a ii (i)		**1 A 3 a ii (i) Civil Aviation (Domestic, LTO)**		0,19	2,64	0,22	0,02	0,00	0,02	0,02	0,02	0,00	0,00	0,00
1 A 3 a ii (ii)		**1 A 3 a ii (ii) Civil Aviation (Domestic, Cruise)**		0,57	0,17	0,06	0,05	0,00	0,05	0,05	0,05	0,00	0,00	0,00
1 A 3 b	(a)	**1 A 3 b Road Transportation**	A	129,92	235,80	21,25	0,13	2,38	14,44	7,67	5,31	0,01	0,09	0,00
1 A 3 b i		1 A 3 b i R.T., Passenger cars		41,71	190,10	10,72	0,07	2,27	2,02	2,02	2,02	0,01	0,00	0,00
1 A 3 b ii		1 A 3 b ii R.T., Light duty vehicles		5,97	8,81	0,67	0,01	0,05	0,44	0,44	0,44	0,00	0,00	0,00
1 A 3 b iii		1 A 3 b iii R.T., Heavy duty vehicles		81,81	15,47	4,48	0,05	0,06	1,84	1,84	1,84	0,00	0,00	0,00
1 A 3 b iv		1 A 3 b iv R.T., Mopeds & Motorcycles		0,43	21,42	1,86	NA	0,00	0,00	0,00	0,00	0,00	0,00	0,00
1 A 3 b v		1 A 3 b v R.T., Gasoline evaporation		NA	NA	3,52	NA	NA	NA	NA	NA	NA	NA	NA
1 A 3 b vi		1 A 3 b vi R.T., Automobile tyre and brake wear		IE	IE	IE	IE	IE	IE	IE	IE	IE	0,00	IE
1 A 3 b vii		1 A 3 b vii R.T., Automobile road abrasion		NA	NA	NA	NA	NA	10,15	3,38	1,01	NA	0,09	NA
1 A 3 c	(a)	**1 A 3 c Railways**		1,36	0,36	0,17	0,06	0,00	1,61	0,58	0,21	0,00	0,00	0,00
1 A 3 d ii		**1 A 3 d ii National Navigation**		0,45	2,88	0,62	0,01	0,00	0,03	0,03	0,03	0,00	0,00	0,00
1 A 3 e	(a)	**1 A 3 e Other (Please specify in a covering note)**	A	1,22	0,08	0,00	NA	0,01	0,00	0,00	0,00	NA	NA	NA
1 A 3 e i		1 A 3 e i Pipeline compressors		1,22	0,08	0,00	NA	0,01	0,00	0,00	0,00	NA	NA	NA
1 A 3 e ii		1 A 3 e ii Other mobile sources and machinery		NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
1 A 4 a	(a)	**1 A 4 a Commercial / Institutional**		2,79	13,04	1,34	1,73	0,12	0,56	0,52	0,48	0,33	0,04	0,02
1 A 4 b	(a)	**1 A 4 b Residential**	A	12,98	285,14	31,95	6,49	0,55	8,31	7,57	6,83	2,14	0,24	0,18
1 A 4 b i		1 A 4 b i Residential plants		12,21	267,52	29,56	6,49	0,55	8,17	7,43	6,69	2,14	0,24	0,18
1 A 4 b ii		1 A 4 b ii Household and gardening (mobile)		0,77	17,62	2,39	0,00	0,00	0,15	0,15	0,15	0,00	0,00	0,00
1 A 4 c	(a)	**1 A 4 c Agriculture / Forestry / Fishing**	A	17,85	39,83	7,57	0,33	0,05	3,03	2,73	2,53	0,16	0,05	0,01
1 A 4 c i		1 A 4 c i Stationary		0,95	18,94	2,11	0,28	0,04	0,56	0,50	0,45	0,16	0,05	0,01
1 A 4 c ii		1 A 4 c ii Off-road Vehicles and Other Machinery		16,90	20,89	5,45	0,05	0,01	2,47	2,23	2,08	0,00	0,00	0,00
1A 4 c iii		1A 4 c iii National Fishing		NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
1 A 5 a	(a)	**1 A 5 a Other, Stationary (including Military)**		IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
1 A 5 b	(a)	**1 A 5 b Other, Mobile (Including military)**		0,21	0,75	0,05	0,04	0,00	0,05	0,04	0,04	0,00	0,00	0,00
1B1	(a)	**1B1 Fugitive Emissions from Solid Fuels**	A	NA	NA	NA	NA	NA	0,59	0,28	0,09	NA	NA	NA
1 B 1 a	(a)	1 B 1 a Coal Mining and Handling		NA	NA	NA	NA	NA	0,59	0,28	0,09	NA	NA	NA
1 B 1 b	(a)	1 B 1 b Solid fuel transformation		IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
1 B 1 c	(a)	1 B 1 c Other (Please specify in a covering note)		NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
1 B 2	(a)	**1 B 2 Oil and natural gas**	A	IE	IE	3,12	0,17	IE	IE	IE	IE	IE	IE	IE
1 B 2 a	(a)	**1 B 2 a Oil**		NA	NA	2,86	NA	NA	NA	NA	NA	NA	NA	NA
1 B 2 a i	(a)	1 B 2 a i Exploration Production, Transport		NA	NA	0,91	NA	NA	NA	NA	NA	NA	NA	NA
1 B 2 a iv	(a)	1 B 2 a iv Refining / Storage		NA	NA	0,95	NA	NA	NA	NA	NA	NA	NA	NA
1 B 2 a v	(a)	1 B 2 a v Distribution of oil products		NA	NA	1,00	NA	NA	NA	NA	NA	NA	NA	NA
1 B 2 a vi	(a)	1 B 2 a vi Other		NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
1 B 2 b	(a)	1 B 2 b Natural gas		NA	NA	0,26	0,17	NA	NA	NA	NA	NA	NA	NA
1 B 2 c	(a)	1 B 2 c Venting and flaring		IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE

Yearly minimum reporting (continued) / *Additional reporting*

NFR	Aldrin	Chlordane	Chlordecone	Dieldrin	Endrin	Heptachlor	Hexabromo-	Mirex	Toxaphene	HCH	DDT	PCB	DIOX	benzo(a)p	benzo(b)fl	benzo(k)fl	Indeno(1,	Total 1-4	HCB	As	Cr	Cu	Ni	Se	Zn	PCP	SCCP
	Persistent Organic Pollutants (POPs) Annex I (1)									POPs Annex II (2)			POPs Annex III (3)	PAH						Other Heavy Metals						Other POPs (4)	
	kg	kg	kg	kg	kg	kg	kg	kg	kg	kg	kg	kg	g I-Teq	Mg	Mg	Mg	Mg	Mg	kg	Mg	Mg	Mg	Mg	Mg	Mg	kg	kg
1 A 1 a	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	0,79	NR	NR	NR	NR	0,01	0,34	NR	NR	NR	NR	NR	NR	NR	NR
1 A 1 b	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	0,02	NR	NR	NR	NR	0,00	0,00	NR	NR	NR	NR	NR	NR	NR	NR
1 A 1 c	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	0,00	NR	NR	NR	NR	0,00	0,00	NR	NR	NR	NR	NR	NR	NR	NR
1 A 2	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	5,18	NR	NR	NR	NR	0,19	1,50	NR	NR	NR	NR	NR	NR	NR	NR
1 A 2 a	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	0,04	NR	NR	NR	NR	0,00	0,01	NR	NR	NR	NR	NR	NR	NR	NR
1 A 2 b	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	2,22	NR	NR	NR	NR	0,00	1,00	NR	NR	NR	NR	NR	NR	NR	NR
1 A 2 c	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	0,58	NR	NR	NR	NR	0,02	0,09	NR	NR	NR	NR	NR	NR	NR	NR
1 A 2 d	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	0,63	NR	NR	NR	NR	0,00	0,13	NR	NR	NR	NR	NR	NR	NR	NR
1 A 2 e	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	0,04	NR	NR	NR	NR	0,00	0,01	NR	NR	NR	NR	NR	NR	NR	NR
1 A 2 f	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	1,67	NR	NR	NR	NR	0,16	0,27	NR	NR	NR	NR	NR	NR	NR	NR
1 A 3 a ii (i)	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NE	NR	NR	NR	NR	NE	NE	NR	NR	NR	NR	NR	NR	NR	NR
1 A 3 a ii (ii)	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NE	NR	NR	NR	NR	NE	NE	NR	NR	NR	NR	NR	NR	NR	NR
1 A 3 b	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	1,13	NR	NR	NR	NR	1,57	0,23	NR	NR	NR	NR	NR	NR	NR	NR
1 A 3 b i	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	0,42	NR	NR	NR	NR	0,67	0,08	NR	NR	NR	NR	NR	NR	NR	NR
1 A 3 b ii	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	0,10	NR	NR	NR	NR	0,15	0,02	NR	NR	NR	NR	NR	NR	NR	NR
1 A 3 b iii	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	0,60	NR	NR	NR	NR	0,69	0,12	NR	NR	NR	NR	NR	NR	NR	NR
1 A 3 b iv	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	0,01	NR	NR	NR	NR	0,05	0,00	NR	NR	NR	NR	NR	NR	NR	NR
1 A 3 b v	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	IE	NR	NR	NR	NR	NA	NA	NR	NR	NR	NR	NR	NR	NR	NR
1 A 3 b vi	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	IE	NR	NR	NR	NR	IE	IE	NR	NR	NR	NR	NR	NR	NR	NR
1 A 3 b vii	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NA	NR	NR	NR	NR	NA	NA	NR	NR	NR	NR	NR	NR	NR	NR
1 A 3 c	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	0,02	NR	NR	NR	NR	0,01	0,00	NR	NR	NR	NR	NR	NR	NR	NR
1 A 3 d ii	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	0,01	NR	NR	NR	NR	0,00	0,00	NR	NR	NR	NR	NR	NR	NR	NR
1 A 3 e	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	0,00	NR	NR	NR	NR	NA	0,00	NR	NR	NR	NR	NR	NR	NR	NR
1 A 3 e i	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	0,00	NR	NR	NR	NR	NA	0,00	NR	NR	NR	NR	NR	NR	NR	NR
1 A 3 e ii	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NO	NR	NR	NR	NR	NO	NO	NR	NR	NR	NR	NR	NR	NR	NR
1 A 4 a	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	2,21	NR	NR	NR	NR	0,16	1,37	NR	NR	NR	NR	NR	NR	NR	NR
1 A 4 b	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	27,08	NR	NR	NR	NR	5,78	32,46	NR	NR	NR	NR	NR	NR	NR	NR
1 A 4 b i	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	27,03	NR	NR	NR	NR	5,75	32,45	NR	NR	NR	NR	NR	NR	NR	NR
1 A 4 b ii	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	0,05	NR	NR	NR	NR	0,03	0,01	NR	NR	NR	NR	NR	NR	NR	NR
1 A 4 c	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	2,18	NR	NR	NR	NR	0,58	3,36	NR	NR	NR	NR	NR	NR	NR	NR
1 A 4 c i	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	2,05	NR	NR	NR	NR	0,45	3,33	NR	NR	NR	NR	NR	NR	NR	NR
1 A 4 c ii	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	0,13	NR	NR	NR	NR	0,13	0,03	NR	NR	NR	NR	NR	NR	NR	NR
1A 4 c iii	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NO	NR	NR	NR	NR	NO	NO	NR	NR	NR	NR	NR	NR	NR	NR
1 A 5 a	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	IE	NR	NR	NR	NR	IE	IE	NR	NR	NR	NR	NR	NR	NR	NR
1 A 5 b	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	0,00	NR	NR	NR	NR	0,00	0,00	NR	NR	NR	NR	NR	NR	NR	NR
1B1	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NA	NR	NR	NR	NR	NA	NA	NR	NR	NR	NR	NR	NR	NR	NR
1 B 1 a	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NA	NR	NR	NR	NR	NA	NA	NR	NR	NR	NR	NR	NR	NR	NR
1 B 1 b	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	IE	NR	NR	NR	NR	IE	IE	NR	NR	NR	NR	NR	NR	NR	NR
1 B 1 c	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NO	NR	NR	NR	NR	NO	NO	NR	NR	NR	NR	NR	NR	NR	NR
1 B 2	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	IE	NR	NR	NR	NR	IE	IE	NR	NR	NR	NR	NR	NR	NR	NR
1 B 2 a	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NA	NR	NR	NR	NR	NA	NA	NR	NR	NR	NR	NR	NR	NR	NR
1 B 2 a i	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NA	NR	NR	NR	NR	NA	NA	NR	NR	NR	NR	NR	NR	NR	NR
1 B 2 a iv	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NA	NR	NR	NR	NR	NA	NA	NR	NR	NR	NR	NR	NR	NR	NR
1 B 2 a v	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NA	NR	NR	NR	NR	NA	NA	NR	NR	NR	NR	NR	NR	NR	NR
1 B 2 a vi	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NE	NR	NR	NR	NR	NE	NE	NR	NR	NR	NR	NR	NR	NR	NR
1 B 2 b	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NA	NR	NR	NR	NR	NA	NA	NR	NR	NR	NR	NR	NR	NR	NR
1 B 2 c	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	IE	NR	NR	NR	NR	IE	IE	NR	NR	NR	NR	NR	NR	NR	NR

2 A	(a)	2 A MINERAL PRODUCTS (b)	A	NA	9,78	IE	NA	NA	26,29	12,52	1,49	NA	NA	NA	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NA	NR	NR	NR	NR	NA	NA	NR	NR	NR	NR	NR	NR	NR	NR
2 A 1	(a)	2 A 1 Cement Production		NA	NA	NA	NA	NA	0,10	0,09	0,08	NA	NA	NA	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NA	NR	NR	NR	NR	NA	NA	NR	NR	NR	NR	NR	NR	NR	NR
2 A 2	(a)	2 A 2 Lime Production		NA	NA	NA	NA	NA	0,10	0,09	0,06	NA	NA	NA	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NA	NR	NR	NR	NR	NA	NA	NR	NR	NR	NR	NR	NR	NR	NR
2 A 3	(a)	2 A 3 Limestone and Dolomite Use		NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NO	NR	NR	NR	NR	NO	NO	NR	NR	NR	NR	NR	NR	NR	NR
2 A 4	(a)	2 A 4 Soda Ash Production and use		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NA	NR	NR	NR	NR	NA	NA	NR	NR	NR	NR	NR	NR	NR	NR
2 A 5	(a)	2 A 5 Asphalt Roofing		NA	9,78	IE	NA	NA	NA	NA	NA	NA	NA	NA	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NA	NR	NR	NR	NR	NA	NA	NR	NR	NR	NR	NR	NR	NR	NR
2 A 6	(a)	2 A 6 Road Paving with Asphalt		NA	NA	IE	NA	NA	NA	NA	NA	NA	NA	NA	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NA	NR	NR	NR	NR	NA	NA	NR	NR	NR	NR	NR	NR	NR	NR
2 A 7	(a)	2 A 7 Other including Non Fuel Mining & Construction (Please specify in a covering note)		NA	NA	NA	NA	NA	26,09	12,35	1,35	NA	NA	NA	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NA	NR	NR	NR	NR	NA	NA	NR	NR	NR	NR	NR	NR	NR	NR
2 B	(a)	2 B CHEMICAL INDUSTRY	A	0,45	11,14	1,32	0,77	0,07	0,48	0,28	0,15	0,00	0,00	0,00	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NA	NR	NR	NR	NR	NA	NA	NR	NR	NR	NR	NR	NR	NR	NR
2 B 1	(a)	2 B 1 Ammonia Production		0,22	0,08	IE	NA	0,01	NA	NA	NA	NA	NA	NA	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NA	NR	NR	NR	NR	NA	NA	NR	NR	NR	NR	NR	NR	NR	NR
2 B 2	(a)	2 B 2 Nitric Acid Production		0,17	NA	NA	NA	0,00	NA	NA	NA	NA	NA	NA	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NA	NR	NR	NR	NR	NA	NA	NR	NR	NR	NR	NR	NR	NR	NR
2 B 3	(a)	2 B 3 Adipic Acid Production		NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NO	NR	NR	NR	NR	NO	NO	NR	NR	NR	NR	NR	NR	NR	NR
2 B 4	(a)	2 B 4 Carbide Production		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NA	NR	NR	NR	NR	NA	NA	NR	NR	NR	NR	NR	NR	NR	NR
2 B 5	(a)	2 B 5 Other (Please specify in a covering note)		0,07	11,07	1,32	0,77	0,06	0,48	0,28	0,15	0,00	0,00	0,00	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NA	NR	NR	NR	NR	NA	NA	NR	NR	NR	NR	NR	NR	NR	NR
2 C	(a)	2 C METAL PRODUCTION		0,11	2,67	0,47	0,45	IE	1,42	1,00	0,44	6,61	0,22	0,31	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	4,63	NR	NR	NR	NR	0,18	3,74	NR	NR	NR	NR	NR	NR	NR	NR
2 D	(a)	2 D OTHER PRODUCTION (b)	A	1,07	0,78	2,94	NA	NA	1,02	0,41	0,16	NA	NA	NA	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	0,13	NR	NR	NR	NR	0,04	0,03	NR	NR	NR	NR	NR	NR	NR	NR
2 D 1	(a)	2 D 1 Pulp and Paper		1,07	0,78	0,79	NA	NA	0,35	0,14	0,06	NA	NA	NA	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NA	NR	NR	NR	NR	NA	NA	NR	NR	NR	NR	NR	NR	NR	NR
2 D 2	(a)	2 D 2 Food and Drink		NA	NA	2,15	NA	NA	0,00	0,00	0,00	NA	NA	NA	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	0,13	NR	NR	NR	NR	0,04	0,03	NR	NR	NR	NR	NR	NR	NR	NR
2 G	(a)	2 G OTHER (Please specify in a covering note)		NA	NA	NA	NA	0,00	NA	NA	NA	NA	NA	NA	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NA	NR	NR	NR	NR	NA	NA	NR	NR	NR	NR	NR	NR	NR	NR
3 A	(a)	3 A PAINT APPLICATION		NA	NA	27,25	NA	NA	NA	NA	NA	NA	NA	NA	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NA	NR	NR	NR	NR	NA	NA	NR	NR	NR	NR	NR	NR	NR	NR
3 B	(a)	3 B DEGREASING AND DRY CLEANING		NA	NA	11,80	NA	NA	NA	NA	NA	NA	NA	NA	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NA	NR	NR	NR	NR	NA	NA	NR	NR	NR	NR	NR	NR	NR	NR
3 C	(a)	3 C CHEMICAL PRODUCTS, MANUFACTURE AND PROCESSING		NA	NA	11,37	NA	NA	NA	NA	NA	NA	NA	NA	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NA	NR	NR	NR	NR	NA	NA	NR	NR	NR	NR	NR	NR	NR	NR
3 D	(a)	3 D OTHER including products containing HMs and POPs (Please specify in a covering note)		NA	NA	44,51	NA	NA	0,44	0,44	0,44	NA	NA	NA	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NE	NR	NR	NR	NR	NE	NE	NR	NR	NR	NR	NR	NR	NR	NR
4 B	(a)	4 B MANURE MANAGEMENT (c)	A	NA	NA	NA	NA	53,09	NA	NA	NA	NA	NA	NA	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NA	NR	NR	NR	NR	NA	NA	NR	NR	NR	NR	NR	NR	NR	NR
4 B 1	(a)	4 B 1 Cattle		NA	NA	NA	NA	36,80	NA	NA	NA	NA	NA	NA	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NA	NR	NR	NR	NR	NA	NA	NR	NR	NR	NR	NR	NR	NR	NR
4 B 1 a	(a)	4 B 1 a Dairy		NA	NA	NA	NA	14,27	NA	NA	NA	NA	NA	NA	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NA	NR	NR	NR	NR	NA	NA	NR	NR	NR	NR	NR	NR	NR	NR
4 B 1 b	(a)	4 B 1 b Non-Dairy		NA	NA	NA	NA	22,53	NA	NA	NA	NA	NA	NA	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NA	NR	NR	NR	NR	NA	NA	NR	NR	NR	NR	NR	NR	NR	NR
4 B 2	(a)	4 B 2 Buffalo		NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NO	NR	NR	NR	NR	NO	NO	NR	NR	NR	NR	NR	NR	NR	NR
4 B 3	(a)	4 B 3 Sheep		NA	NA	NA	NA	0,80	NA	NA	NA	NA	NA	NA	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NA	NR	NR	NR	NR	NA	NA	NR	NR	NR	NR	NR	NR	NR	NR
4 B 4	(a)	4 B 4 Goats		NA	NA	NA	NA	0,14	NA	NA	NA	NA	NA	NA	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NA	NR	NR	NR	NR	NA	NA	NR	NR	NR	NR	NR	NR	NR	NR
4 B 5	(a)	4 B 5 Camels and Llamas		NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NO	NR	NR	NR	NR	NO	NO	NR	NR	NR	NR	NR	NR	NR	NR
4 B 6	(a)	4 B 6 Horses		NA	NA	NA	NA	0,73	NA	NA	NA	NA	NA	NA	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NA	NR	NR	NR	NR	NA	NA	NR	NR	NR	NR	NR	NR	NR	NR
4 B 7	(a)	4 B 7 Mules and Asses		IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	IE	NR	NR	NR	NR	IE	IE	NR	NR	NR	NR	NR	NR	NR	NR
4 B 8	(a)	4 B 8 Swine		NA	NA	NA	NA	9,34	NA	NA	NA	NA	NA	NA	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NA	NR	NR	NR	NR	NA	NA	NR	NR	NR	NR	NR	NR	NR	NR
4 B 9	(a)	4 B 9 Poultry		NA	NA	NA	NA	5,18	NA	NA	NA	NA	NA	NA	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NA	NR	NR	NR	NR	NA	NA	NR	NR	NR	NR	NR	NR	NR	NR
4 B 13	(a)	4 B 13 Other		NA	NA	NA	NA	0,11	NA	NA	NA	NA	NA	NA	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NA	NR	NR	NR	NR	NA	NA	NR	NR	NR	NR	NR	NR	NR	NR
4 C	(a)	4 C RICE CULTIVATION		NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NO	NR	NR	NR	NR	NO	NO	NR	NR	NR	NR	NR	NR	NR	NR
4 D 1	(a)	4 D 1 Direct Soil Emission		5,18	NA	1,67	NA	7,80	11,01	4,95	1,10	NA	NA	NA	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NA	NR	NR	NR	NR	NA	NA	NR	NR	NR	NR	NR	NR	NR	NR
4 F	(a)	4 F FIELD BURNING OF AGRICULTURAL WASTES		0,03	1,01	0,11	0,00	0,04	NE	NE	NE	0,01	0,00	0,00	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	0,15	NR	NR	NR	NR	0,20	0,03	NR	NR	NR	NR	NR	NR	NR	NR
4 G	(a)	4 G OTHER (d)		NA	NA	NA	NA	NA	0,94	0,42	0,09	NA	NA	NA	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NA	NR	NR	NR	NR	NA	NA	NR	NR	NR	NR	NR	NR	NR	NR
5 B	(a)	5 B FOREST AND GRASSLAND CONVERSION		NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NE	NR	NR	NR	NR	NE	NE	NR	NR	NR	NR	NR	NR	NR	NR
6 A	(a)	6 A SOLID WASTE DISPOSAL ON LAND		NA	5,90	0,08	NA	0,00	0,19	0,09	0,03	0,00	0,00	0,00	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NA	NR	NR	NR	NR	NA	NA	NR	NR	NR	NR	NR	NR	NR	NR
6 B	(a)	6 B WASTE-WATER HANDLING		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NA	NR	NR	NR	NR	NA	NA	NR	NR	NR	NR	NR	NR	NR	NR
6 C	(a)	6 C WASTE INCINERATION (e)		0,05	0,01	0,00	0,06	0,00	NE	NE	NE	0,01	0,00	0,02	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	0,17	NR	NR	NR	NR	0,00	0,03	NR	NR	NR	NR	NR	NR	NR	NR
6 D	(a)	6 D OTHER WASTE (f)		NA	NA	NA	NA	1,04	NA	NA	NA	NA	NA	NA	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NA	NR	NR	NR	NR	NA	NA	NR	NR	NR	NR	NR	NR	NR	NR
7	(a)	7 OTHER		NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NO	NR	NR	NR	NR	NO	NO	NR	NR	NR	NR	NR	NR	NR	NR
NATIONAL TOTAL	(g)	National Total for the entire territory (2002 Guidelines)		225,16	785,35	171,63	28,46	65,81	75,00	43,45	22,67	14,12	1,12	1,02	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	43,69	NR	NR	NR	NR	8,73	43,10	NR	NR	NR	NR	NR	NR	NR	NR
Memo Items. NOT TO BE INCLUDED IN NATIONAL TOTALS IF NOT OTHERWISE STATED																																									
SNAP NATIONAL	(g)	National Total for the entire territory (1997 Guidelines)		225,16	785,35	171,63	28,46	65,81	75,00	43,45	22,67	14,12	1,12	1,02	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	43,69	NR	NR	NR	NR	8,73	43,10	NR	NR	NR	NR	NR	NR	NR	NR
GRID TOTAL	(h)	National Total for the EMEP grid domain		225,16	785,35	171,63	28,46	65,81	75,00	43,45	22,67	14,12	1,12	1,02	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	43,69	NR	NR	NR	NR	8,73	43,10	NR	NR	NR	NR	NR	NR	NR	NR
1 A 3 a i (i)	(a)	International Aviation (LTO)		0,88	0,83	0,32	0,07	0,00	0,07	0,07	0,07	0,00	0,00	0,00	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NE	NR	NR	NR	NR	NE	NE	NR	NR	NR	NR	NR	NR	NR	NR
1 A 3 a i (ii)	(a)	International Aviation (Cruise)		4,90	0,96	0,43	0,51	0,00	0,55	0,55	0,55	0,00	0,00	0,00	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NE	NR	NR	NR	NR	NE	NE	NR	NR	NR	NR	NR	NR	NR	NR
1 A 3 d i (i)	(a)	International maritime Navigation		NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NO	NR	NR	NR	NR	NO	NO	NR	NR	NR	NR	NR	NR	NR	NR
1 A 3 d i (ii)	(a)	International inland waterways (Included in NEC totals only)		NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NO	NR	NR	NR	NR	NO	NO	NR	NR	NR	NR	NR	NR	NR	NR
5 E	(a)	5 E Other		0,97	NA	124,62	NA	NA	NA	NA	NA	NA	NA	NA	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NA	NR	NR	NR	NR	NA	NA	NR	NR	NR	NR	NR	NR	NR	NR
X		X (11 08 Volcanoes)		NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NO	NR	NR	NR	NR	NO	NO	NR	NR	NR	NR	NR	NR	NR	NR

(a) Sectors already reported to UNFCCC for NO_x, CO, NMVOC, SO_2.
(b) Including Product handling.
(c) Including NH3 from Enteric Fermentation.
(d) Including PM sources.
(e) Excludes waste incineration for energy (this is included in 1 A 1).
(f) Includes accidental fires.
(g) National Total refers to the territory declared upon ratification of the relevant Protocol of the Convention.
(h) EMEP grid domain is defined in the Emission Reporting Guidelines (ECE/EB.AIR/80/Annex V)

Note 1: Main Pollutants should cover the time span from 1980 to latest year.
HM should cover the time span from 1990 to latest year.
POPs should cover the time span from 1990 to the latest year.
PM should cover the time span from 2000 to latest year.

Note 2: The A=Allowable Aggregation illustrates the level of aggregation that can be used if more detailed information is not available.
Grey cells show which sectors can be aggregated into the sector marked A. Black cells occur when two possible levels of aggregation are possible.

Notes 3:
(1): The POPs listed in annex I to the Protocol on POPs are substances scheduled for elimination; DDT and PCBs are also listed in annex I;
(2): The POPs listed in annex II to the Protocol on POPs are substances scheduled for restrictions on use;
(3): The POPs listed in annex III to the Protocol on POPs are substances referred to in article 3, para. 5 (a), of the Protocol. Polycyclic aromatic hydrocarbons (PAHs): For the purpose of the emission inventories, the following four indicator compounds should be used: benzo(b)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene and indeno(1,2,3-cd)pyrene. HCB is also included in annex I to the Protocol as a substance for elimination.
(4): See article 8 of the Protocol (Research, development and monitoring; reporting voluntary).

11.1.2 Footnotes to NFR

FOOTNOTES IV 1: National sector emissions: Main pollutants, particulate matter (PM), heavy metals (HM) and persistent organic pollutants (POP).

Table IV 1 F1: Definition of Notation Keys
See: Chapter 1

Table 1 F2: Explanation to the Notation key NE

NFR code	Substance(s)	Reason for reporting NE
1.A.3.a i	DIOX, PAH, HCB	No measurements or emission factors available
1.A.3.a ii	DIOX, PAH, HCB	No measurements or emission factors available
1.A.3.e i	DIOX	No measurements or emission factors available. However, DIOX emissions from this category seem to be negligible (NA could be reported alternatively)
1.B.2.a.vi	all	No other emission sources from 1.B.2.a are known
4.F	TSP, PM10, PM2.5	No sufficient information
6.C	TSP, PM10, PM2.5	No sufficient information

Table IV 1 F3: Explanation to the Notation key IE

NFR code	Substance(s)	Included in NFR code
1.A.1.b	NMVOC	1 B 2 a iv
1.B.1.b	all	1 A 2 a
1 B 2 c	all	1 B 2 a i
2 A 5	NMVOC	3
2 A 6	NMVOC	3
2 B 1	NMVOC	2 B 5
2 C	NH_3	1 A 2 a
4 B 7 Mules and Asses	NH_3	4 B 6 Horses
4 D 1 ii Animal waste applied to soil	NH_3	4 B 1 to 4 B13
4 D 2 pasture range and paddock	NO_x, NH_3, TSP, PM10, PM2.5	4 D 1

Table IV 1 F4: Sub-sources accounted for in reporting codes „other“

NFR code	Sub-source description	Substance(s) reported
1A2f		NO_x, SO_2, CO, NMVOC, NH_3, TSP, PM10, PM2.5, PAH, HCB, DIOX, Cd, Hg, Pb
1A3 e	1 A 3 e i Pipeline compressors	NO_x, CO, NMVOC, NH_3, TSP, PM10, PM2.5, PAH, HCB
1A5a		
1A5b		
1B1 c		none
1B2 a vi		none
2 A 7	diffuse emissions from construction, mining and food production	TSP, PM10, PM2.5
2 B 5	emissions from other organic and inorganic chemical industries	NO_x, CO, NMVOC, SO_x, NH_3, TSP, PM10, PM2.5, Pb, Cd, Hg
2 G	emissions from use of NH_3 as refrigerant	NH_3
3 D		
4 B 13	wild animals, mainly deer (pasture)	NH_3
4 G	particle emissions from animal husbandry	TSP, PM10, PM2.5
6 D		
7		
5E		

Table IV 1 F5: Basis for estimating emissions from mobile sources. Please tick off with X.

NFR code	Description	Fuel sold	Fuel used	Comment
1 A 3 a i (i)	International Aviation (LTO)	x		
1 A 3 a i (ii)	International Aviation (Cruise)	x		
1 A 3 a ii (i)	1 A 3 a ii Civil Aviation (Domestic, LTO)	x		
1 A 3 a ii (ii)	1 A 3 a ii Civil Aviation (Domestic, Cruise)	x		
1A3b	Road transport	x		
1A3c	Railways	x		
1A3di (i)	International maritime Navigation			
1A3di (ii)	International inland waterways (Included in NEC totals only)			
1A3dii	National Navigation	x		
1A4ci	Agriculture	x		
1A4cii	Off-road Vehicles and Other Machinery	x		
1A4ciii	National Fishing	x		
1 A 5 b	Other, Mobile (Including military)	x		

11.2 Emission Trends per Sector

Table A-1: Emission trends for SO_2 [Gg] 1980–2006.

	NFR-Sectors										
year	**1**	**1 A**	**1 B**	**2**	**3**	**4**	**5**	**6**	**7**		
	ENERGY	**FUEL COMBUSTION ACTIVITIES**	**FUGITIVE EMISSIONS FROM FUELS**	**INDUSTRIAL PROCESSES**	**SOLVENT AND OTHER PRODUCT USE**	**AGRICULTURE**	**LAND USE CHANGE AND FORESTRY**	**WASTE**	**OTHER**	**NATIONAL TOTAL**	**International Bunkers**
1980	331.16	328.60	2.56	13.14	NA	0.04	NE	0.41	NO	345	0.12
1981	289.21	287.31	1.89	13.02	NA	0.04	NE	0.41	NO	302.67	0.13
1982	275.06	273.31	1.75	12.89	NA	0.04	NE	0.41	NO	288.41	0.12
1983	200.36	198.77	1.59	12.77	NA	0.04	NE	0.41	NO	213.59	0.15
1984	183.50	181.83	1.67	12.65	NA	0.04	NE	0.41	NO	196.60	0.20
1985	167.29	165.76	1.53	12.07	NA	0.05	NE	0.41	NO	179.81	0.21
1986	148.72	147.26	1.46	11.28	NA	0.04	NE	0.41	NO	160.46	0.19
1987	127.63	126.11	1.52	10.28	NA	0.04	NE	0.41	NO	138.37	0.21
1988	99.09	97.44	1.65	3.92	NA	0.05	NE	0.22	NO	103.28	0.23
1989	89.24	87.52	1.73	3.31	NA	0.05	NE	0.14	NO	92.74	0.28
1990	72.03	70.03	2.00	2.22	NA	0.00	NE	0.07	NO	74.33	0.28
1991	69.46	68.16	1.30	1.90	NA	0.00	NE	0.06	NO	71.42	0.32
1992	53.32	51.32	2.00	1.67	NA	0.00	NE	0.04	NO	55.03	0.34
1993	51.92	49.82	2.10	1.42	NA	0.00	NE	0.04	NO	53	0.36
1994	46.14	44.86	1.28	1.42	NA	0.00	NE	0.05	NO	47.61	0.38
1995	45.43	43.90	1.53	1.37	NA	0.00	NE	0.05	NO	46.85	0.42
1996	43.27	42.07	1.20	1.29	NA	0.00	NE	0.05	NO	44.61	0.47
1997	38.84	38.78	0.07	1.27	NA	0.00	NE	0.05	NO	40.16	0.48
1998	34.33	34.29	0.04	1.18	NA	0.00	NE	0.05	NO	35.57	0.50
1999	32.62	32.47	0.14	1.12	NA	0.00	NE	0.06	NO	33.79	0.49
2000	30.47	30.33	0.15	1.09	NA	0.00	NE	0.06	NO	31.62	0.53
2001	31.43	31.27	0.16	1.21	NA	0.00	NE	0.06	NO	32.70	0.52
2002	30.37	30.24	0.14	1.21	NA	0.00	NE	0.06	NO	31.64	0.48
2003	31.17	31.02	0.15	1.21	NA	0.00	NE	0.06	NO	32.44	0.41
2004	25.66	25.51	0.14	1.22	NA	0.00	NE	0.06	NO	26.93	0.49
2005	25.37	25.24	0.13	1.22	NA	0.00	NE	0.06	NO	26.65	0.55
2006	27.18	27.01	0.17	1.22	NA	0.00	NE	0.06	NO	28.46	0.57

Table A-2: Emission trends for NO_x [Gg] 1980–2006.

NFR-Sectors												
year	1	1 A	1 B	2	3	4	5	6	7		
	ENERGY	FUEL COMBUSTION ACTIVITIES	FUGITIVE EMISSIONS FROM FUELS	INDUSTRIAL PROCESSES	SOLVENT AND OTHER PRODUCT USE	AGRICULTURE	LAND USE CHANGE AND FORESTRY	WASTE	OTHER	NATIONAL TOTAL	International Bunkers
1980	214.36	214.36	IE	13.98	NA	6.66	NE	0.25	NO	235.26	1.15
1981	203.26	203.26	IE	12.71	NA	6.63	NE	0.25	NO	222.85	1.25
1982	201.14	201.14	IE	11.45	NA	6.80	NE	0.25	NO	219.65	1.15
1983	204.00	204.00	IE	10.27	NA	6.91	NE	0.25	NO	221.44	1.44
1984	206.17	206.17	IE	9.07	NA	7.04	NE	0.25	NO	222.53	1.94
1985	211.53	211.53	IE	7.88	NA	7.06	NE	0.25	NO	226.73	2.11
1986	205.07	205.07	IE	6.68	NA	6.95	NE	0.25	NO	218.95	1.87
1987	201.76	201.76	IE	5.49	NA	7.19	NE	0.25	NO	214.70	2.07
1988	196.90	196.90	IE	5.27	NA	7.14	NE	0.17	NO	209.48	2.28
1989	191.68	191.68	IE	4.99	NA	6.92	NE	0.13	NO	203.73	2.79
1990	181.43	181.43	IE	4.80	NA	6.09	NE	0.10	NO	192.41	2.77
1991	191.77	191.77	IE	4.48	NA	6.31	NE	0.09	NO	202.65	3.12
1992	181.32	181.32	IE	4.55	NA	5.95	NE	0.06	NO	191.89	3.40
1993	178.50	178.50	IE	1.98	NA	5.71	NE	0.05	NO	186.24	3.61
1994	172.61	172.61	IE	1.92	NA	6.12	NE	0.04	NO	180.70	3.77
1995	173.72	173.72	IE	1.46	NA	6.18	NE	0.05	NO	181.40	4.23
1996	196.48	196.48	IE	1.42	NA	5.86	NE	0.05	NO	203.81	4.66
1997	185.57	185.57	IE	1.50	NA	5.91	NE	0.05	NO	193.03	4.85
1998	200.67	200.67	IE	1.46	NA	5.91	NE	0.05	NO	208.09	5.01
1999	191.64	191.64	IE	1.44	NA	5.76	NE	0.05	NO	198.89	4.92
2000	198.16	198.16	IE	1.54	NA	5.60	NE	0.05	NO	205.35	5.36
2001	207.84	207.84	IE	1.57	NA	5.57	NE	0.05	NO	215.03	5.21
2002	217.39	217.39	IE	1.63	NA	5.50	NE	0.05	NO	224.58	4.88
2003	228.75	228.75	IE	1.34	NA	5.40	NE	0.05	NO	235.54	4.17
2004	226.71	226.71	IE	1.28	NA	5.26	NE	0.05	NO	233.29	4.90
2005	229.95	229.95	IE	1.75	NA	5.22	NE	0.05	NO	236.97	5.53
2006	218.27	218.27	IE	1.63	NA	5.21	NE	0.05	NO	225.16	5.79

Table A-3: Emission trends for NMVOC [Gg] 1980–2006.

	NFR-Sectors										
year	1	1 A	1 B	2	3	4	5	6	7		
	ENERGY	FUEL COMBUSTION ACTIVITIES	FUGITIVE EMISSIONS FROM FUELS	INDUSTRIAL PROCESSES	SOLVENT AND OTHER PRODUCT USE	AGRICULTURE	LAND USE CHANGE AND FORESTRY	WASTE	OTHER	NATIONAL TOTAL	International Bunkers
1980	170.95	158.21	12.74	17.73	210.53	4.55	NE	0.16	NO	403.93	0.13
1981	173.43	161.18	12.24	17.12	187.39	4.48	NE	0.16	NO	382.57	0.14
1982	173.49	161.96	11.53	16.76	184.22	4.60	NE	0.16	NO	379.24	0.13
1983	175.19	163.83	11.35	16.24	181.11	4.51	NE	0.16	NO	377.21	0.16
1984	180.27	168.77	11.50	15.73	178.05	4.57	NE	0.16	NO	378.79	0.22
1985	180.14	168.62	11.52	15.21	172.82	4.61	NE	0.16	NO	372.94	0.24
1986	174.88	163.28	11.60	14.83	171.65	4.52	NE	0.16	NO	366.03	0.21
1987	172.30	160.55	11.76	14.36	170.50	4.54	NE	0.16	NO	361.86	0.23
1988	161.26	149.59	11.67	14.57	169.36	4.66	NE	0.16	NO	350.00	0.26
1989	157.46	145.56	11.91	14.54	148.42	4.61	NE	0.16	NO	325.20	0.32
1990	153.12	140.91	12.22	11.10	116.95	1.85	NE	0.16	NO	283.18	0.31
1991	160.54	147.38	13.16	12.58	100.08	1.84	NE	0.16	NO	275.20	0.35
1992	152.39	139.26	13.12	13.78	82.33	1.78	NE	0.15	NO	250.43	0.38
1993	149.88	137.03	12.86	15.05	82.43	1.75	NE	0.15	NO	249.27	0.41
1994	138.58	128.32	10.26	13.57	77.06	1.81	NE	0.14	NO	231.16	0.44
1995	133.70	124.88	8.83	11.95	81.75	1.82	NE	0.13	NO	229.35	0.48
1996	131.19	123.28	7.90	10.37	78.07	1.80	NE	0.12	NO	221.54	0.57
1997	112.62	105.26	7.37	9.06	82.93	1.88	NE	0.12	NO	206.62	0.63
1998	106.59	100.74	5.85	7.71	75.54	1.84	NE	0.11	NO	191.80	0.69
1999	100.46	95.32	5.13	6.04	69.96	1.88	NE	0.11	NO	178	0.67
2000	92.52	87.36	5.16	4.96	77.74	1.78	NE	0.10	NO	177.11	0.70
2001	89.55	86.23	3.31	4.38	92.36	1.86	NE	0.10	NO	188.25	0.68
2002	85.37	81.89	3.47	4.57	96.90	1.85	NE	0.10	NO	188.79	0.64
2003	83.37	79.93	3.44	4.26	93.55	1.73	NE	0.10	NO	183.01	0.54
2004	77.73	74.46	3.27	4.40	91.83	1.97	NE	0.09	NO	176.02	0.64
2005	75.19	72.10	3.09	4.71	81.80	1.86	NE	0.09	NO	163.65	0.72
2006	70.12	66.99	3.12	4.73	94.92	1.79	NE	0.08	NO	171.63	0.75

Table A-4: Emission trends for NH_3 [Gg] 1980–2006.

	NFR-Sectors										
year	**1**	**1 A**	**1 B**	**2**	**3**	**4**	**5**	**6**	**7**		
	ENERGY	**FUEL COMBUSTION ACTIVITIES**	**FUGITIVE EMISSIONS FROM FUELS**	**INDUSTRIAL PROCESSES**	**SOLVENT AND OTHER PRODUCT USE**	**AGRICULTURE**	**LAND USE CHANGE AND FORESTRY**	**WASTE**	**OTHER**	**NATIONAL TOTAL**	**International Bunkers**
1980	1.39	1.39	IE	0.31	NA	62.09	NE	0.01	NO	63.79	0.001
1981	1.30	1.30	IE	0.30	NA	62.88	NE	0.01	NO	64.48	0.001
1982	1.28	1.28	IE	0.29	NA	63.42	NE	0.01	NO	65.00	0.001
1983	1.25	1.25	IE	0.28	NA	64.86	NE	0.01	NO	66.39	0.001
1984	1.28	1.28	IE	0.29	NA	65.51	NE	0.01	NO	67.08	0.001
1985	1.32	1.32	IE	0.28	NA	65.14	NE	0.01	NO	66.75	0.001
1986	1.34	1.34	IE	0.26	NA	64.47	NE	0.01	NO	66.08	0.001
1987	1.33	1.33	IE	0.26	NA	64.76	NE	0.01	NO	66.36	0.001
1988	2.18	2.18	IE	0.28	NA	63.39	NE	0.01	NO	65.86	0.002
1989	3.29	3.29	IE	0.27	NA	63.54	NE	0.01	NO	67.10	0.002
1990	4.28	4.28	IE	0.27	NA	66.12	NE	0.38	NO	71.05	0.002
1991	5.85	5.85	IE	0.51	NA	66.87	NE	0.39	NO	73.62	0.002
1992	6.67	6.67	IE	0.37	NA	64.57	NE	0.45	NO	72.06	0.002
1993	7.45	7.45	IE	0.22	NA	64.59	NE	0.54	NO	72.80	0.002
1994	7.66	7.66	IE	0.17	NA	65.55	NE	0.62	NO	73.99	0.003
1995	7.49	7.49	IE	0.10	NA	67.12	NE	0.64	NO	75.35	0.003
1996	7.01	7.01	IE	0.10	NA	65.33	NE	0.67	NO	73.11	0.003
1997	6.52	6.52	IE	0.10	NA	65.60	NE	0.65	NO	72.87	0.003
1998	6.55	6.55	IE	0.10	NA	65.66	NE	0.67	NO	72.98	0.003
1999	5.92	5.92	IE	0.12	NA	64.39	NE	0.71	NO	71.13	0.003
2000	5.42	5.42	IE	0.10	NA	62.90	NE	0.72	NO	69.14	0.004
2001	5.28	5.28	IE	0.08	NA	62.68	NE	0.73	NO	68.77	0.004
2002	5.23	5.23	IE	0.06	NA	61.59	NE	0.75	NO	67.62	0.003
2003	5.05	5.05	IE	0.08	NA	61.38	NE	0.76	NO	67.27	0.003
2004	4.55	4.55	IE	0.06	NA	60.90	NE	0.95	NO	66.46	0.003
2005	4.17	4.17	IE	0.07	NA	60.67	NE	1.04	NO	65.95	0.004
2006	3.76	3.76	IE	0.07	NA	60.93	NE	1.04	NO	65.81	0.004

Table A-5: Emission trends for CO [Gg] 1980–2006.

	NFR-Sectors										
year	1	1 A	1 B	2	3	4	5	6	7		
	ENERGY	FUEL COMBUSTION ACTIVITIES	FUGITIVE EMISSIONS FROM FUELS	INDUSTRIAL PROCESSES	SOLVENT AND OTHER PRODUCT USE	AGRICULTURE	LAND USE CHANGE AND FORESTRY	WASTE	OTHER	NATIONAL TOTAL	International Bunkers
1980	1 681.4	1 681.4	IE	52.8	NA	31.1	NE	10.7	NO	1 776.1	0.3
1981	1 675.1	1 675.1	IE	50.7	NA	28.6	NE	10.8	NO	1 765.1	0.4
1982	1 684.3	1 684.3	IE	48.3	NA	32.9	NE	10.8	NO	1 776.3	0.4
1983	1 673.8	1 673.8	IE	47.9	NA	32.8	NE	10.8	NO	1 765.2	0.4
1984	1 724.9	1 724.9	IE	48.1	NA	35.1	NE	10.8	NO	1 818.8	0.6
1985	1 699.4	1 699.4	IE	46.7	NA	36.3	NE	10.7	NO	1 793.2	0.6
1986	1 639.2	1 639.2	IE	44.7	NA	33.2	NE	10.6	NO	1 727.7	0.6
1987	1 577.4	1 577.4	IE	44.9	NA	34.2	NE	10.6	NO	1 667.2	0.6
1988	1 502.0	1 502.0	IE	45.9	NA	38.2	NE	10.9	NO	1 597.0	0.7
1989	1 487.6	1 487.6	IE	46.3	NA	36.4	NE	11.3	NO	1 581.5	0.9
1990	1 385.2	1 385.2	IE	46.4	NA	1.2	NE	11.4	NO	1 444.1	0.8
1991	1 459.7	1 459.7	IE	41.7	NA	1.2	NE	11.3	NO	1 513.9	0.9
1992	1 424.2	1 424.2	IE	45.0	NA	1.1	NE	11.0	NO	1 481.3	1.0
1993	1 389.4	1 389.4	IE	47.2	NA	1.1	NE	10.9	NO	1 448.6	1.1
1994	1 319.3	1 319.3	IE	48.6	NA	1.2	NE	10.3	NO	1 379.4	1.1
1995	1 211.4	1 211.4	IE	45.1	NA	1.2	NE	9.7	NO	1 267.3	1.3
1996	1 196.3	1 196.3	IE	39.4	NA	1.2	NE	9.2	NO	1 246.1	1.4
1997	1 106.7	1 106.7	IE	38.3	NA	1.2	NE	8.7	NO	1 154.9	1.5
1998	1 064.8	1 064.8	IE	34.9	NA	1.2	NE	8.4	NO	1 109.3	1.6
1999	994.5	994.5	IE	30.6	NA	1.2	NE	8.1	NO	1 034.4	1.6
2000	922.8	922.8	IE	27.4	NA	1.1	NE	7.7	NO	959.1	1.7
2001	897.5	897.5	IE	24.2	NA	1.2	NE	7.4	NO	930.4	1.6
2002	866.2	866.2	IE	23.9	NA	1.2	NE	7.3	NO	898.6	1.5
2003	868.0	868.0	IE	23.6	NA	1.1	NE	7.4	NO	900.1	1.3
2004	825.0	825.0	IE	23.9	NA	1.7	NE	6.9	NO	857.5	1.5
2005	791.7	791.7	IE	24.2	NA	1.1	NE	6.4	NO	823.4	1.7
2006	754.1	754.1	IE	24.4	NA	1.0	NE	5.9	NO	785.4	1.8

Table A-6: Emission trends for Cd [Mg] 1985–2006.

	NFR-Sectors										
year	**1**	**1 A**	**1 B**	**2**	**3**	**4**	**5**	**6**	**7**		
	ENERGY	**FUEL COMBUSTION ACTIVITIES**	**FUGITIVE EMISSIONS FROM FUELS**	**INDUSTRIAL PROCESSES**	**SOLVENT AND OTHER PRODUCT USE**	**AGRICULTURE**	**LAND USE CHANGE AND FORESTRY**	**WASTE**	**OTHER**	**NATIONAL TOTAL**	**International Bunkers**
1985	2.08	2.08	NA	0.84	0.00	0.04	NE	0.14	NO	3.10	0.00
1986	1.82	1.82	NA	0.71	0.00	0.04	NE	0.12	NO	2.70	0.00
1987	1.41	1.41	NA	0.65	0.00	0.04	NE	0.10	NO	2.21	0.00
1988	1.19	1.19	NA	0.62	0.00	0.05	NE	0.08	NO	1.94	0.00
1989	1.06	1.06	NA	0.58	0.00	0.04	NE	0.06	NO	1.74	0.00
1990	1.06	1.06	NA	0.46	0.00	0.00	NE	0.06	NO	1.58	0.00
1991	1.09	1.09	NA	0.38	0.00	0.00	NE	0.05	NO	1.53	0.00
1992	0.97	0.97	NA	0.26	0.00	0.00	NE	0.01	NO	1.25	0.00
1993	0.94	0.94	NA	0.22	0.00	0.00	NE	0.00	NO	1.16	0.00
1994	0.88	0.88	NA	0.18	0.00	0.00	NE	0.00	NO	1.06	0.00
1995	0.81	0.81	NA	0.16	0.00	0.00	NE	0.00	NO	0.97	0.00
1996	0.84	0.84	NA	0.15	0.00	0.00	NE	0.00	NO	0.99	0.00
1997	0.80	0.80	NA	0.16	0.00	0.00	NE	0.00	NO	0.97	0.00
1998	0.74	0.74	NA	0.16	0.00	0.00	NE	0.00	NO	0.90	0.00
1999	0.80	0.80	NA	0.17	0.00	0.00	NE	0.00	NO	0.98	0.00
2000	0.76	0.76	NA	0.18	0.00	0.00	NE	0.00	NO	0.95	0.00
2001	0.80	0.80	NA	0.18	0.00	0.00	NE	0.00	NO	0.98	0.00
2002	0.80	0.80	NA	0.19	0.00	0.00	NE	0.00	NO	1.00	0.00
2003	0.83	0.83	NA	0.19	0.00	0.00	NE	0.00	NO	1.03	0.00
2004	0.83	0.83	NA	0.20	0.00	0.00	NE	0.00	NO	1.03	0.00
2005	0.88	0.88	NA	0.22	0.00	0.00	NE	0.00	NO	1.10	0.00
2006	0.90	0.90	NA	0.22	NA	0.00	NE	0.00	NO	1.12	0.00

Table A-7: Emission trends for Hg [Mg] 1985–2006.

	NFR-Sectors										
year	**1**	**1 A**	**1 B**	**2**	**3**	**4**	**5**	**6**	**7**		
	ENERGY	**FUEL COMBUSTION ACTIVITIES**	**FUGITIVE EMISSIONS FROM FUELS**	**INDUSTRIAL PROCESSES**	**SOLVENT AND OTHER PRODUCT USE**	**AGRICULTURE**	**LAND USE CHANGE AND FORESTRY**	**WASTE**	**OTHER**	**NATIONAL TOTAL**	**International Bunkers**
1985	2.98	2.98	NA	0.67	NA	0.01	NE	0.09	NO	3.74	0.00
1986	2.60	2.60	NA	0.63	NA	0.01	NE	0.08	NO	3.32	0.00
1987	2.16	2.16	NA	0.61	NA	0.01	NE	0.07	NO	2.84	0.00
1988	1.78	1.78	NA	0.59	NA	0.01	NE	0.06	NO	2.45	0.00
1989	1.59	1.59	NA	0.58	NA	0.01	NE	0.06	NO	2.24	0.00
1990	1.56	1.56	NA	0.53	NA	0.00	NE	0.05	NO	2.14	0.00
1991	1.50	1.50	NA	0.49	NA	0.00	NE	0.05	NO	2.04	0.00
1992	1.18	1.18	NA	0.44	NA	0.00	NE	0.02	NO	1.64	0.00
1993	0.96	0.96	NA	0.41	NA	0.00	NE	0.02	NO	1.39	0.00
1994	0.76	0.76	NA	0.40	NA	0.00	NE	0.02	NO	1.18	0.00
1995	0.71	0.71	NA	0.47	NA	0.00	NE	0.02	NO	1.20	0.00
1996	0.71	0.71	NA	0.43	NA	0.00	NE	0.02	NO	1.16	0.00
1997	0.68	0.68	NA	0.43	NA	0.00	NE	0.02	NO	1.13	0.00
1998	0.60	0.60	NA	0.33	NA	0.00	NE	0.01	NO	0.95	0.00
1999	0.65	0.65	NA	0.28	NA	0.00	NE	0.01	NO	0.94	0.00
2000	0.64	0.64	NA	0.24	NA	0.00	NE	0.01	NO	0.89	0.00
2001	0.70	0.70	NA	0.24	NA	0.00	NE	0.01	NO	0.95	0.00
2002	0.66	0.66	NA	0.26	NA	0.00	NE	0.01	NO	0.94	0.00
2003	0.70	0.70	NA	0.26	NA	0.00	NE	0.01	NO	0.98	0.00
2004	0.65	0.65	NA	0.27	NA	0.00	NE	0.02	NO	0.94	0.00
2005	0.67	0.67	NA	0.30	NA	0.00	NE	0.02	NO	1.00	0.00
2006	0.69	0.69	NA	0.31	NA	0.00	NE	0.02	NO	1.02	0.00

Table A-8: Emission trends for Pb [Mg] 1985–2006.

	NFR-Sectors										
year	1	1 A	1 B	2	3	4	5	6	7		
	ENERGY	FUEL COMBUSTION ACTIVITIES	FUGITIVE EMISSIONS FROM FUELS	INDUSTRIAL PROCESSES	SOLVENT AND OTHER PRODUCT USE	AGRICULTURE	LAND USE CHANGE AND FORESTRY	WASTE	OTHER	NATIONAL TOTAL	International Bunkers
1985	258.20	258.20	NA	62.45	0.06	0.23	NE	5.85	NO	326.79	0.00
1986	255.11	255.11	NA	52.38	0.06	0.21	NE	5.27	NO	313.03	0.00
1987	249.29	249.29	NA	47.85	0.06	0.22	NE	4.69	NO	302.13	0.00
1988	224.14	224.14	NA	45.16	0.07	0.24	NE	2.59	NO	272.20	0.00
1989	195.66	195.66	NA	41.74	0.07	0.23	NE	1.64	NO	239.34	0.00
1990	174.17	174.17	NA	32.09	0.07	0.01	NE	1.02	NO	207.35	0.00
1991	143.81	143.81	NA	27.09	0.06	0.01	NE	0.78	NO	171.75	0.00
1992	100.67	100.67	NA	18.61	0.06	0.01	NE	0.49	NO	119.83	0.00
1993	70.61	70.61	NA	15.15	0.05	0.01	NE	0.38	NO	86.20	0.00
1994	47.31	47.31	NA	12.03	0.05	0.01	NE	0.27	NO	59.66	0.00
1995	11.33	11.33	NA	4.68	0.04	0.01	NE	0.01	NO	16.07	0.00
1996	11.18	11.18	NA	4.26	0.04	0.01	NE	0.01	NO	15.50	0.00
1997	9.64	9.64	NA	4.79	0.04	0.01	NE	0.01	NO	14.49	0.00
1998	8.23	8.23	NA	4.70	0.04	0.01	NE	0.01	NO	12.99	0.00
1999	7.53	7.53	NA	4.91	0.04	0.01	NE	0.01	NO	12.50	0.00
2000	6.42	6.42	NA	5.48	0.04	0.01	NE	0.01	NO	11.96	0.00
2001	6.70	6.70	NA	5.35	0.03	0.01	NE	0.01	NO	12.10	0.00
2002	6.76	6.76	NA	5.65	0.03	0.01	NE	0.01	NO	12.46	0.00
2003	6.95	6.95	NA	5.68	0.03	0.01	NE	0.01	NO	12.68	0.00
2004	7.12	7.12	NA	5.90	0.03	0.01	NE	0.01	NO	13.07	0.00
2005	7.16	7.16	NA	6.49	0.03	0.01	NE	0.01	NO	13.71	0.00
2006	7.49	7.49	NA	6.61	NA	0.01	NE	0.01	NO	14.12	0.00

Table A-9: Emission trends for PAH [Mg] 1985–2006.

NFR-Sectors												
year	**1**	**1 A**	**1 B**	**2**	**3**	**4**	**5**	**6**	**7**			
	ENERGY	**FUEL COMBUSTION ACTIVITIES**	**FUGITIVE EMISSIONS FROM FUELS**	**INDUSTRIAL PROCESSES**	**SOLVENT AND OTHER PRODUCT USE**	**AGRICULTURE**	**LAND USE CHANGE AND FORESTRY**	**WASTE**	**OTHER**	**NATIONAL TOTAL**	**International Bunkers**
1985	11.95	11.95	NA	7.88	0.15	7.07	NE	0.00	NO	27.05	NE
1986	11.29	11.29	NA	7.82	0.15	7.06	NE	0.00	NO	26.32	NE
1987	11.11	11.11	NA	7.91	0.15	7.06	NE	0.00	NO	26.23	NE
1988	9.97	9.97	NA	7.46	0.15	7.06	NE	0.00	NO	24.65	NE
1989	9.48	9.48	NA	7.57	0.15	7.06	NE	0.00	NO	24.26	NE
1990	9.47	9.47	NA	7.44	0.15	0.24	NE	0.00	NO	17.30	NE
1991	10.32	10.32	NA	7.18	0.15	0.24	NE	0.00	NO	17.89	NE
1992	9.40	9.40	NA	3.59	0.11	0.24	NE	0.00	NO	13.33	NE
1993	9.28	9.28	NA	0.52	0.07	0.24	NE	0.00	NO	10.12	NE
1994	8.40	8.40	NA	0.59	0.06	0.24	NE	0.00	NO	9.28	NE
1995	8.85	8.85	NA	0.49	0.04	0.24	NE	0.00	NO	9.62	NE
1996	9.57	9.57	NA	0.90	0.02	0.24	NE	0.00	NO	10.72	NE
1997	8.58	8.58	NA	0.47	0.01	0.23	NE	0.00	NO	9.29	NE
1998	8.30	8.30	NA	0.41	NE	0.23	NE	0.00	NO	8.94	NE
1999	8.32	8.32	NA	0.25	NE	0.23	NE	0.00	NO	8.80	NE
2000	7.78	7.78	NA	0.19	NE	0.23	NE	0.00	NO	8.21	NE
2001	8.47	8.47	NA	0.18	NE	0.23	NE	0.00	NO	8.89	NE
2002	8.29	8.29	NA	0.19	NE	0.23	NE	0.00	NO	8.71	NE
2003	8.62	8.62	NA	0.19	NE	0.23	NE	0.00	NO	9.04	NE
2004	8.50	8.50	NA	0.20	NE	0.29	NE	0.00	NO	8.99	NE
2005	8.77	8.77	NA	0.22	NE	0.21	NE	0.00	NO	9.19	NE
2006	8.31	8.31	NA	0.22	NE	0.20	NE	0.00	NO	8.73	NE

Table A-10:Emission trends for Dioxin [g] 1985–2006.

	NFR-Sectors										
year	**1**	**1 A**	**1 B**	**2**	**3**	**4**	**5**	**6**	**7**		
	ENERGY	**FUEL COMBUSTION ACTIVITIES**	**FUGITIVE EMISSIONS FROM FUELS**	**INDUSTRIAL PROCESSES**	**SOLVENT AND OTHER PRODUCT USE**	**AGRICULTURE**	**LAND USE CHANGE AND FORESTRY**	**WASTE**	**OTHER**	**NATIONAL TOTAL**	**International Bunkers**
1985	109.69	109.69	NA	51.30	5.19	5.05	NE	15.90	NO	187.13	NE
1986	107.87	107.87	NA	51.02	6.20	5.05	NE	15.89	NO	186.04	NE
1987	115.94	115.94	NA	50.81	0.24	5.05	NE	15.89	NO	187.93	NE
1988	110.02	110.02	NA	41.60	1.06	5.05	NE	15.48	NO	173.21	NE
1989	101.74	101.74	NA	41.13	1.06	5.05	NE	15.29	NO	164.27	NE
1990	101.84	101.84	NA	39.00	1.06	0.18	NE	18.19	NO	160.27	NE
1991	80.87	80.87	NA	35.15	1.04	0.18	NE	17.75	NO	134.99	NE
1992	53.86	53.86	NA	21.89	0.02	0.18	NE	0.53	NO	76.47	NE
1993	49.34	49.34	NA	17.01	0.02	0.18	NE	0.22	NO	66.77	NE
1994	44.54	44.54	NA	11.26	NE	0.18	NE	0.08	NO	56.06	NE
1995	45.79	45.79	NA	12.23	NE	0.18	NE	0.08	NO	58.27	NE
1996	48.22	48.22	NA	11.17	NE	0.18	NE	0.08	NO	59.64	NE
1997	46.92	46.92	NA	12.15	NE	0.17	NE	0.08	NO	59.33	NE
1998	44.45	44.45	NA	11.45	NE	0.17	NE	0.08	NO	56.15	NE
1999	40.74	40.74	NA	12.60	NE	0.17	NE	0.08	NO	53.59	NE
2000	37.69	37.69	NA	14.05	NE	0.17	NE	0.08	NO	51.99	NE
2001	40.55	40.55	NA	13.55	NE	0.17	NE	0.08	NO	54.35	NE
2002	39.08	39.08	NA	3.24	NE	0.17	NE	0.08	NO	42.57	NE
2003	40.04	40.04	NA	2.98	NE	0.17	NE	0.12	NO	43.31	NE
2004	39.08	39.08	NA	3.30	NE	0.21	NE	0.16	NO	42.75	NE
2005	40.31	40.31	NA	4.02	NE	0.15	NE	0.17	NO	44.65	NE
2006	38.62	38.62	NA	4.76	NE	0.15	NE	0.17	NO	43.69	NE

Table A-11:Emission trends for HCB [kg] 1985–2006.

	NFR-Sectors										
year	1	1 A	1 B	2	3	4	5	6	7		
	ENERGY	FUEL COMBUSTION ACTIVITIES	FUGITIVE EMISSIONS FROM FUELS	INDUSTRIAL PROCESSES	SOLVENT AND OTHER PRODUCT USE	AGRICULTURE	LAND USE CHANGE AND FORESTRY	WASTE	OTHER	NATIONAL TOTAL	International Bunkers
1985	83.21	83.21	NA	13.27	7.71	1.01	NE	1.11	NO	106.31	NE
1986	80.31	80.31	NA	13.21	8.12	1.01	NE	1.11	NO	103.76	NE
1987	83.14	83.14	NA	13.18	8.11	1.01	NE	1.11	NO	106.55	NE
1988	76.86	76.86	NA	11.16	8.22	1.01	NE	0.70	NO	97.96	NE
1989	72.79	72.79	NA	11.06	9.34	1.01	NE	0.52	NO	94.72	NE
1990	72.57	72.57	NA	9.71	9.05	0.04	NE	0.39	NO	91.77	NE
1991	69.71	69.71	NA	8.03	6.39	0.04	NE	0.28	NO	84.44	NE
1992	56.94	56.94	NA	4.94	7.49	0.04	NE	0.11	NO	69.51	NE
1993	53.58	53.58	NA	3.70	6.47	0.04	NE	0.04	NO	63.84	NE
1994	48.04	48.04	NA	2.45	1.25	0.04	NE	0.02	NO	51.79	NE
1995	50.20	50.20	NA	2.67	0.00	0.04	NE	0.02	NO	52.93	NE
1996	53.15	53.15	NA	2.44	0.00	0.04	NE	0.02	NO	55.64	NE
1997	49.07	49.07	NA	2.65	0.00	0.03	NE	0.02	NO	51.78	NE
1998	46.45	46.45	NA	2.50	0.00	0.03	NE	0.02	NO	49.01	NE
1999	44.75	44.75	NA	2.76	0.00	0.03	NE	0.02	NO	47.56	NE
2000	41.02	41.02	NA	3.07	0.00	0.03	NE	0.02	NO	44.15	NE
2001	44.32	44.32	NA	2.98	0.00	0.03	NE	0.02	NO	47.35	NE
2002	41.80	41.80	NA	3.17	NE	0.03	NE	0.02	NO	45.02	NE
2003	42.36	42.36	NA	3.18	NE	0.03	NE	0.02	NO	45.60	NE
2004	40.48	40.48	NA	3.30	NE	0.04	NE	0.03	NO	43.86	NE
2005	41.82	41.82	NA	3.69	NE	0.03	NE	0.03	NO	45.58	NE
2006	39.27	39.27	NA	3.76	NE	0.03	NE	0.03	NO	43.10	NE

Table A-12:Emission trends for TSP [Mg] 1990–2006.

	NFR-Sectors										
year	**1**	**1 A**	**1 B**	**2**	**3**	**4**	**5**	**6**	**7**		
	ENERGY	**FUEL COMBUSTION ACTIVITIES**	**FUGITIVE EMISSIONS FROM FUELS**	**INDUSTRIAL PROCESSES**	**SOLVENT AND OTHER PRODUCT USE**	**AGRICULTURE**	**LAND USE CHANGE AND FORESTRY**	**WASTE**	**OTHER**	**NATIONAL TOTAL**	**International Bunkers**
1990	31 812	31 165	647	23 769	407	12 453	NE	145	NO	68 587	307
1995	32 200	31 655	545	26 514	421	12 274	NE	159	NO	71 568	456
1999	32 714	32 215	500	24 874	424	12 169	NE	59	NO	70 240	530
2000	32 098	31 540	558	29 341	425	12 100	NE	91	NO	74 055	576
2001	32 929	32 343	585	28 406	426	12 099	NE	87	NO	73 946	560
2002	33 010	32 412	599	28 009	428	12 069	NE	110	NO	73 626	524
2003	33 726	33 084	642	27 436	430	12 153	NE	130	NO	73 875	448
2004	33 402	32 797	605	28 211	433	12 139	NE	170	NO	74 355	526
2005	33 536	32 924	612	27 069	436	11 966	NE	188	NO	73 196	595
2006	33 224	32 635	589	29 202	439	11 944	NE	191	NO	75 001	622

Table A-13:Emission trends for PM10 [Mg] 1990–2006.

NFR-Sectors												
year	**1**	**1 A**	**1 B**	**2**	**3**	**4**	**5**	**6**	**7**			
	ENERGY	**FUEL COMBUSTION ACTIVITIES**	**FUGITIVE EMISSIONS FROM FUELS**	**INDUSTRIAL PROCESSES**	**SOLVENT AND OTHER PRODUCT USE**	**AGRICULTURE**	**LAND USE CHANGE AND FORESTRY**	**WASTE**	**OTHER**	**NATIONAL TOTAL**	**International Bunkers**
1990	23 962	23 658	305	12 920	407	5 604	NE	70	NO	42 963	307
1995	23 717	23 460	257	13 693	421	5 523	NE	75	NO	43 430	456
1999	23 798	23 563	236	12 855	424	5 476	NE	28	NO	42 581	530
2000	23 105	22 842	263	14 901	425	5 445	NE	43	NO	43 918	576
2001	23 771	23 495	276	14 453	426	5 444	NE	41	NO	44 136	560
2002	23 717	23 435	282	13 911	428	5 431	NE	52	NO	43 539	524
2003	24 200	23 898	303	13 636	430	5 469	NE	61	NO	43 797	448
2004	23 744	23 459	285	13 969	433	5 463	NE	81	NO	43 690	526
2005	23 748	23 459	289	13 383	436	5 385	NE	89	NO	43 042	595
2006	23 340	23 062	278	14 206	439	5 375	NE	90	NO	43 450	622

Table A-14:Emission trends for PM2.5 [Mg] 1990–2006.

NFR-Sectors												
year	**1**	**1 A**	**1 B**	**2**	**3**	**4**	**5**	**6**	**7**			
	ENERGY	**FUEL COMBUSTION ACTIVITIES**	**FUGITIVE EMISSIONS FROM FUELS**	**INDUSTRIAL PROCESSES**	**SOLVENT AND OTHER PRODUCT USE**	**AGRICULTURE**	**LAND USE CHANGE AND FORESTRY**	**WASTE**	**OTHER**	**NATIONAL TOTAL**	**International Bunkers**
1990	19 942	19 847	95	3 505	407	1 245	NE	23	NO	25 122	307
1995	19 662	19 582	80	3 020	421	1 227	NE	24	NO	24 354	456
1999	19 618	19 544	74	2 597	424	1 217	NE	9	NO	23 864	530
2000	18 942	18 859	82	2 938	425	1 210	NE	13	NO	23 528	576
2001	19 511	19 424	86	2 870	426	1 210	NE	13	NO	24 030	560
2002	19 418	19 329	88	2 470	428	1 207	NE	16	NO	23 540	524
2003	19 770	19 675	95	2 430	430	1 215	NE	19	NO	23 865	448
2004	19 282	19 192	90	2 433	433	1 214	NE	25	NO	23 387	526
2005	19 237	19 146	91	2 329	436	1 197	NE	28	NO	23 227	595
2006	18 764	18 676	87	2 241	439	1 194	NE	28	NO	22 667	622

11.3 Austria's emissions for SO_2, NO_x, NMVOC and NH_3 according to the submission under NEC directive

The following table presents Austria's emissions based on fuel used – thus excluding 'fuel export'[129] – as submitted under Directive 2001/81/EC.

Table A-15:Austria's emissions 1990–2006 without 'fuel export' according to Directive 2001/81/EC, Article 8 (1).

	SO_2 [Gg]	NO_x [Gg]	NMVOC [Gg]	NH_3 [Gg]
1990	74.73	200.06	283.52	71.04
1991	71.44	199.90	272.14	73.21
1992	55.08	192.10	249.61	71.91
1993	53.29	184.92	249.65	72.89
1994	47.72	183.56	233.00	74.38
1995	46.79	180.96	231.25	75.83
1996	44.19	180.98	223.16	73.84
1997	40.04	185.67	209.22	73.69
1998	35.14	182.57	191.73	73.31
1999	33.54	182.30	179.47	71.66
2000	31.25	178.78	177.25	69.54
2001	32.20	179.61	187.01	68.86
2002	31.06	178.54	185.53	67.20
2003	31.76	179.73	178.68	66.62
2004	26.88	176.92	171.72	65.81
2005	26.60	175.62	159.34	65.36
2006	28.42	173.11	168.00	65.32
Ceilings 2010	39.00	103.00	159.00	66.00

[129] For information regarding fuel export please refer to Chapter 1.7 Completeness

Table A-16:SO_2 Emissions trends and source categories 1990–2006 without ‘fuel export’ according to Directive 2001/81/EC, Article 8 (1).

NFR	Total	1	1 A	1 A 1	1 A 2	1 A 3	1 A 4	1 A 5	1 B	2	3	4	6
						Gg							
1990	**74.73**	72.44	70.44	14.04	18.49	4.48	33.41	0.01	2.00	2.22	NA	0.00	0.07
1991	**71.44**	69.48	68.18	15.42	17.76	4.79	30.19	0.01	1.30	1.90	NA	0.00	0.06
1992	**55.08**	53.37	51.37	8.58	11.19	5.07	26.52	0.01	2.00	1.67	NA	0.00	0.04
1993	**53.29**	51.83	49.73	10.06	11.79	5.31	22.55	0.01	2.10	1.42	NA	0.00	0.04
1994	**47.72**	46.25	44.97	7.72	11.43	5.64	20.16	0.01	1.28	1.42	NA	0.00	0.05
1995	**46.79**	45.37	43.84	8.92	10.76	5.11	19.04	0.01	1.53	1.37	NA	0.00	0.05
1996	**44.19**	42.85	41.65	7.80	12.19	2.27	19.38	0.01	1.20	1.29	NA	0.00	0.05
1997	**40.04**	38.72	38.66	9.09	13.89	2.14	13.52	0.01	0.07	1.27	NA	0.00	0.05
1998	**35.14**	33.91	33.87	7.33	11.84	2.09	12.59	0.01	0.04	1.18	NA	0.00	0.05
1999	**33.54**	32.37	32.23	7.24	10.30	1.99	12.68	0.01	0.14	1.12	NA	0.00	0.06
2000	**31.25**	30.11	29.96	7.11	9.84	1.88	11.12	0.01	0.15	1.09	NA	0.00	0.06
2001	**32.20**	30.93	30.77	7.96	9.56	1.82	11.41	0.01	0.16	1.21	NA	0.00	0.06
2002	**31.06**	29.79	29.65	7.69	9.80	1.64	10.51	0.01	0.14	1.21	NA	0.00	0.06
2003	**31.76**	30.49	30.34	7.92	10.01	1.58	10.80	0.03	0.15	1.21	NA	0.00	0.06
2004	**26.88**	25.60	25.46	7.30	9.11	0.29	8.72	0.03	0.14	1.22	NA	0.00	0.06
2005	**26.60**	25.32	25.19	6.80	9.49	0.24	8.62	0.04	0.13	1.22	NA	0.00	0.06
2006	**28.42**	27.14	26.97	7.85	10.29	0.23	8.55	0.04	0.17	1.22	NA	0.00	0.06
Trend													
1990–2006	*-62.0%*	*-62.5%*	*-61.7%*	*-44.1%*	*-44.3%*	*-94.8%*	*-74.4%*	*223.1%*	*-91.7%*	*-45.1%*		*-16.4%*	*-20.4%*
2005–2006	*6.8%*	*7.2%*	*7.1%*	*15.5%*	*8.5%*	*-2.9%*	*-0.8%*	*4.6%*	*25.6%*	*0.2%*		*-10.5%*	*0.0%*
Share in NFR 1 A													
1990				*19.9%*	*26.3%*	*6.4%*	*47.4%*	*0.0%*	*2.8%*	*3.2%*		*0.0%*	*0.1%*
2006				*29.1%*	*38.2%*	*0.9%*	*31.7%*	*0.1%*	*0.6%*	*4.5%*		*0.0%*	*0.2%*
Share in National Total													
1990		*96.9%*	*94.3%*	*18.8%*	*24.7%*	*6.0%*	*44.7%*	*0.0%*	*2.7%*	*3.0%*		*0.0%*	*0.1%*
2006		*95.5%*	*94.9%*	*27.6%*	*36.2%*	*0.8%*	*30.1%*	*0.1%*	*0.6%*	*4.3%*		*0.0%*	*0.2%*

Table A-17:NFR 1 A 3 Transport: SO_2 emissions trends and source categories 1990–2006 without 'fuel export' according to Directive 2001/81/EC, Article 8 (1).

NFR	Total	1	1 A 3	1 A 3 a	1 A 3 b	1 A 3 b 1	1 A 3 b 2	1 A 3 b 3	1 A 3 b 4	1 A 3 b 5	1 A 3 b 7	1 A 3 c	1 A 3 d	1 A 3 e
							Gg							
1990	**74.73**	72.44	4.48	0.01	4.17	1.62	0.65	1.89	0.00	NA	IE	0.26	0.04	NA
1991	**71.44**	69.48	4.79	0.01	4.49	1.74	0.71	2.03	0.00	NA	IE	0.25	0.03	NA
1992	**55.08**	53.37	5.07	0.01	4.77	1.89	0.77	2.10	0.00	NA	IE	0.26	0.03	NA
1993	**53.29**	51.83	5.31	0.01	5.02	2.05	0.81	2.16	0.00	NA	IE	0.24	0.03	NA
1994	**47.72**	46.25	5.64	0.02	5.35	2.26	0.87	2.22	0.00	NA	IE	0.24	0.04	NA
1995	**46.79**	45.37	5.11	0.02	4.84	2.11	0.77	1.95	0.00	NA	IE	0.22	0.04	NA
1996	**44.19**	42.85	2.27	0.02	2.08	1.05	0.30	0.73	0.00	NA	IE	0.15	0.02	NA
1997	**40.04**	38.72	2.14	0.02	1.99	1.02	0.29	0.68	0.00	NA	IE	0.11	0.02	NA
1998	**35.14**	33.91	2.09	0.02	1.95	1.00	0.29	0.66	0.00	NA	IE	0.10	0.02	NA
1999	**33.54**	32.37	1.99	0.02	1.84	0.95	0.28	0.61	0.00	NA	IE	0.11	0.02	NA
2000	**31.25**	30.11	1.88	0.02	1.73	0.89	0.27	0.57	0.00	NA	IE	0.10	0.02	NA
2001	**32.20**	30.93	1.82	0.02	1.68	0.87	0.26	0.55	0.00	NA	IE	0.10	0.02	NA
2002	**31.06**	29.79	1.64	0.02	1.50	0.79	0.22	0.48	0.00	NA	IE	0.10	0.02	NA
2003	**31.76**	30.49	1.58	0.05	1.42	0.76	0.21	0.46	0.00	NA	IE	0.09	0.02	NA
2004	**26.88**	25.60	0.29	0.06	0.12	0.07	0.02	0.03	0.00	NA	IE	0.10	0.01	NA
2005	**26.60**	25.32	0.24	0.07	0.10	0.06	0.01	0.03	0.00	NA	IE	0.06	0.01	NA
2006	**28.42**	27.14	0.23	0.07	0.09	0.06	0.01	0.02	0.00	NA	IE	0.06	0.01	NA
Trend														
1990–2006	***-62.0%***	*-62.5%*	*-94.8%*	*708.6%*	*-97.8%*	*-96.5%*	*-98.3%*	*-98.7%*	*-100.0%*			*-77.8%*	*-59.5%*	
2005–2006	***6.8%***	*7.2%*	*-2.9%*	*4.6%*	*-10.7%*	*-6.6%*	*-15.4%*	*-17.2%*				*0.6%*	*4.6%*	
Share in NFR 1 A														
1990			*6.4%*	*0.0%*	*5.9%*	*2.3%*	*0.9%*	*2.7%*	*0.0%*			*0.4%*	*0.1%*	
2006			*0.9%*	*0.3%*	*0.3%*	*0.2%*	*0.0%*	*0.1%*	*0.0%*			*0.2%*	*0.1%*	
Share in National Total														
1990	***100.0%***	*96.9%*	*6.0%*	*0.0%*	*5.6%*	*2.2%*	*0.9%*	*2.5%*	*0.0%*			*0.3%*	*0.0%*	
2006	***100.0%***	*95.5%*	*0.8%*	*0.2%*	*0.3%*	*0.2%*	*0.0%*	*0.1%*	*0.0%*			*0.2%*	*0.1%*	

Table A-18:NO_x Emissions trends and source categories 1990–2006 without 'fuel export' according to Directive 2001/81/EC, Article 8 (1).

NFR	Total	1	1 A	1 A 1	1 A 2	1 A 3	1 A 4	1 A 5	1 B	2	3	4	6
						Gg							
1990	**200.06**	189.07	189.07	17.78	44.31	89.94	36.96	0.08	IE	4.80	NA	6.09	0.10
1991	**199.90**	189.02	189.02	17.20	45.41	90.41	35.91	0.09	IE	4.48	NA	6.31	0.09
1992	**192.10**	181.53	181.53	14.71	41.98	89.19	35.57	0.08	IE	4.55	NA	5.95	0.06
1993	**184.92**	177.18	177.18	12.10	42.05	87.96	34.98	0.09	IE	1.98	NA	5.71	0.05
1994	**183.56**	175.47	175.47	11.09	42.29	87.32	34.68	0.09	IE	1.92	NA	6.12	0.04
1995	**180.96**	173.28	173.28	12.70	40.11	85.41	34.99	0.08	IE	1.46	NA	6.18	0.05
1996	**180.98**	173.65	173.65	11.04	39.55	84.86	38.11	0.09	IE	1.42	NA	5.86	0.05
1997	**185.67**	178.21	178.21	11.93	42.21	84.54	39.44	0.09	IE	1.50	NA	5.91	0.05
1998	**182.57**	175.14	175.14	10.83	40.64	85.12	38.46	0.10	IE	1.46	NA	5.91	0.05
1999	**182.30**	175.05	175.05	10.89	38.72	86.23	39.12	0.09	IE	1.44	NA	5.76	0.05
2000	**178.78**	171.59	171.59	11.00	37.57	87.03	35.90	0.10	IE	1.54	NA	5.60	0.05
2001	**179.61**	172.42	172.42	12.61	36.26	85.62	37.84	0.09	IE	1.57	NA	5.57	0.05
2002	**178.54**	171.35	171.35	12.87	36.67	84.58	37.15	0.09	IE	1.63	NA	5.50	0.05
2003	**179.73**	172.94	172.94	14.27	35.78	85.22	37.51	0.16	IE	1.34	NA	5.40	0.05
2004	**176.92**	170.34	170.34	15.14	34.36	84.86	35.80	0.18	IE	1.28	NA	5.26	0.05
2005	**175.62**	168.60	168.60	14.53	34.52	84.44	34.92	0.20	IE	1.75	NA	5.22	0.05
2006	**173.11**	166.22	166.22	15.37	35.37	81.65	33.62	0.21	IE	1.63	NA	5.21	0.05
Trend													
1990–2006	***-13.5%***	*-12.1%*	*-12.1%*	*-13.5%*	*-20.2%*	*-9.2%*	*-9.0%*	*154.7%*		*-66.0%*		*-14.5%*	*-49.6%*
2005–2006	***-1.4%***	*-1.4%*	*-1.4%*	*5.8%*	*2.5%*	*-3.3%*	*-3.7%*	*3.3%*		*-6.7%*		*-0.2%*	*0.0%*
Share in NFR 1 A													
1990			*100.0%*	*9.4%*	*23.4%*	*47.6%*	*19.5%*	*0.0%*					
2006			*100.0%*	*9.2%*	*21.3%*	*49.1%*	*20.2%*	*0.1%*					
Share in National Total													
1990	***100.0%***	*94.5%*	*94.5%*	*8.9%*	*22.1%*	*45.0%*	*18.5%*	*0.0%*		*2.4%*		*3.0%*	*0.1%*
2006	***100.0%***	*96.0%*	*96.0%*	*8.9%*	*20.4%*	*47.2%*	*19.4%*	*0.1%*		*0.9%*		*3.0%*	*0.0%*

Table A-19:NFR 1 A 3 Transport: NO_x emissions trends and source categories 1990–2006 without 'fuel export' according to Directive 2001/81/EC, Article 8 (1).

NFR	Total	1	1 A 3	1 A 3 a	1 A 3 b	1 A 3 b 1	1 A 3 b 2	1 A 3 b 3	1 A 3 b 4	1 A 3 b 5	1 A 3 b 7	1 A 3 c	1 A 3 d	1 A 3 e
							Gg							
1990	**200.06**	189.07	89.94	0.08	86.79	43.46	7.78	35.42	0.13	NA	IE	1.95	0.52	0.61
1991	**199.90**	189.02	90.41	0.10	87.21	41.75	7.75	37.57	0.14	NA	IE	2.03	0.47	0.61
1992	**192.10**	181.53	89.19	0.12	86.03	39.90	7.71	38.27	0.15	NA	IE	1.99	0.45	0.60
1993	**184.92**	177.18	87.96	0.14	84.88	38.11	7.60	39.00	0.17	NA	IE	1.92	0.45	0.58
1994	**183.56**	175.47	87.32	0.16	84.15	37.69	7.54	38.73	0.19	NA	IE	1.90	0.54	0.57
1995	**180.96**	173.28	85.41	0.18	82.28	35.99	7.32	38.75	0.22	NA	IE	1.75	0.59	0.61
1996	**180.98**	173.65	84.86	0.20	81.87	35.78	7.10	38.75	0.24	NA	IE	1.55	0.60	0.63
1997	**185.67**	178.21	84.54	0.23	81.57	35.67	6.93	38.71	0.26	NA	IE	1.53	0.59	0.63
1998	**182.57**	175.14	85.12	0.25	81.81	35.73	6.82	38.96	0.30	NA	IE	1.49	0.63	0.95
1999	**182.30**	175.05	86.23	0.26	82.38	36.13	6.76	39.17	0.33	NA	IE	1.81	0.60	1.18
2000	**178.78**	171.59	87.03	0.27	82.89	36.00	6.71	39.83	0.35	NA	IE	1.77	0.65	1.46
2001	**179.61**	172.42	85.62	0.25	81.74	35.70	6.54	39.14	0.37	NA	IE	1.72	0.66	1.24
2002	**178.54**	171.35	84.58	0.25	81.21	35.77	6.34	38.71	0.39	NA	IE	1.66	0.72	0.74
2003	**179.73**	172.94	85.22	0.54	81.51	35.85	6.22	39.04	0.41	NA	IE	1.60	0.57	0.99
2004	**176.92**	170.34	84.86	0.64	80.96	35.75	6.14	38.65	0.42	NA	IE	1.63	0.44	1.19
2005	**175.62**	168.60	84.44	0.73	80.43	35.07	6.27	38.66	0.43	NA	IE	1.37	0.44	1.48
2006	**173.11**	166.22	81.65	0.76	77.86	34.43	5.97	37.04	0.43	NA	IE	1.36	0.45	1.22
Trend														
1990–2006	***-13.5%***	*-12.1%*	*-9.2%*	*890.1%*	*-10.3%*	*-20.8%*	*-23.2%*	*4.6%*	*233.3%*			*-30.0%*	*-14.6%*	*101.4%*
2005–2006	***-1.4%***	*-1.4%*	*-3.3%*	*4.6%*	*-3.2%*	*-1.8%*	*-4.8%*	*-4.2%*	*0.0%*			*-0.6%*	*2.6%*	*-17.1%*
Share in NFR 1 A														
1990			*47.6%*	*0.0%*	*45.9%*	*23.0%*	*4.1%*	*18.7%*	*0.1%*			*1.0%*	*0.3%*	*0.3%*
2006			*49.1%*	*0.5%*	*46.8%*	*20.7%*	*3.6%*	*22.3%*	*0.3%*			*0.8%*	*0.3%*	*0.7%*
Share in National Total														
1990		*94.5%*	*45.0%*	*0.0%*	*43.4%*	*21.7%*	*3.9%*	*17.7%*	*0.1%*			*1.0%*	*0.3%*	*0.3%*
2006		*96.0%*	*47.2%*	*0.4%*	*45.0%*	*19.9%*	*3.4%*	*21.4%*	*0.2%*			*0.8%*	*0.3%*	*0.7%*

Table A-20:NMVOC Emissions trends and source categories 1990–2006 without 'fuel export' according to Directive 2001/81/EC, Article 8 (1).

NFR	Total	1	1 A	1 A 1	1 A 2	1 A 3	1 A 4	1 A 5	1 B	2	3	4	6
						Gg							
1990	**283.52**	153.46	141.24	0.42	4.09	69.61	67.11	0.02	12.22	11.10	116.95	1.85	0.16
1991	**272.14**	157.48	144.32	0.49	4.23	69.52	70.05	0.02	13.16	12.58	100.08	1.84	0.16
1992	**249.61**	151.56	138.44	0.41	4.20	69.23	64.59	0.02	13.12	13.78	82.33	1.78	0.15
1993	**249.65**	150.27	137.42	0.42	4.07	68.33	64.58	0.02	12.86	15.05	82.43	1.75	0.15
1994	**233.00**	140.42	130.17	0.39	3.98	65.26	60.51	0.02	10.26	13.57	77.06	1.81	0.14
1995	**231.25**	135.61	126.78	0.39	3.86	60.58	61.95	0.01	8.83	11.95	81.75	1.82	0.13
1996	**223.16**	132.80	124.90	0.42	3.73	55.30	65.44	0.02	7.90	10.37	78.07	1.80	0.12
1997	**209.22**	115.23	107.86	0.41	3.74	50.21	53.48	0.02	7.37	9.06	82.93	1.88	0.12
1998	**191.73**	106.52	100.67	0.43	3.55	45.31	51.36	0.02	5.85	7.71	75.54	1.84	0.11
1999	**179.47**	101.49	96.35	0.38	3.30	40.77	51.89	0.02	5.13	6.04	69.96	1.88	0.11
2000	**177.25**	92.66	87.50	0.38	3.15	36.10	47.86	0.02	5.16	4.96	77.74	1.78	0.10
2001	**187.01**	88.31	84.99	0.50	3.10	32.02	49.35	0.02	3.31	4.38	92.36	1.86	0.10
2002	**185.53**	82.11	78.64	0.48	2.99	28.44	46.71	0.02	3.47	4.57	96.90	1.85	0.10
2003	**178.68**	79.04	75.61	0.55	3.00	25.52	46.50	0.03	3.44	4.26	93.55	1.73	0.10
2004	**171.72**	73.43	70.16	0.54	3.02	22.93	43.62	0.04	3.27	4.40	91.83	1.97	0.09
2005	**159.34**	70.88	67.79	0.51	3.06	20.73	43.44	0.04	3.09	4.71	81.80	1.86	0.09
2006	**168.00**	66.48	63.36	0.71	3.06	18.68	40.86	0.05	3.12	4.73	94.92	1.79	0.08
Trend													
1990–2006	***-40.7%***	*-56.7%*	*-55.1%*	*68.1%*	*-25.1%*	*-73.2%*	*-39.1%*	*183.1%*	*-74.4%*	*-57.4%*	*-18.8%*	*-3.4%*	*-49.8%*
2005–2006	***5.4%***	*-6.2%*	*-6.5%*	*37.9%*	*0.1%*	*-9.9%*	*-5.9%*	*3.9%*	*0.9%*	*0.4%*	*16.0%*	*-4.2%*	*-7.0%*
Share in NFR 1 A													
1990				*0.3%*	*2.9%*	*49.3%*	*47.5%*	*0.0%*	*8.6%*				
2006				*1.1%*	*4.8%*	*29.5%*	*64.5%*	*0.1%*	*4.9%*				
Share in National Total													
1990		*54.1%*	*49.8%*	*0.1%*	*1.4%*	*24.6%*	*23.7%*	*0.0%*	*4.3%*	*3.9%*	*41.3%*	*0.7%*	*0.1%*
2006		*39.6%*	*37.7%*	*0.4%*	*1.8%*	*11.1%*	*24.3%*	*0.0%*	*1.9%*	*2.8%*	*56.5%*	*1.1%*	*0.0%*

Table A-21: NFR 1 A 3 Transport: NMVOC emissions trends and source categories 1990–2006 without 'fuel export' according to Directive 2001/81/EC, Article 8 (1).

NFR	Total	1	1 A 3	1 A 3 a	1 A 3 b	1 A 3 b 1	1 A 3 b 2	1 A 3 b 3	1 A 3 b 4	1 A 3 b 5	1 A 3 b 7	1 A 3 c	1 A 3 d	1 A 3 e
							Gg							
1990	**283.52**	153.46	69.61	0.09	68.50	39.88	4.05	3.23	2.23	19.12	IE	0.30	0.72	0.00
1991	**272.14**	157.48	69.52	0.09	68.42	41.00	3.84	3.30	2.13	18.15	IE	0.30	0.71	0.00
1992	**249.61**	151.56	69.23	0.08	68.13	42.12	3.61	3.25	2.08	17.08	IE	0.30	0.71	0.00
1993	**249.65**	150.27	68.33	0.08	67.26	42.70	3.39	3.22	2.03	15.93	IE	0.28	0.71	0.00
1994	**233.00**	140.42	65.26	0.08	64.18	41.16	3.12	3.18	2.00	14.72	IE	0.28	0.72	0.00
1995	**231.25**	135.61	60.58	0.07	59.54	38.14	2.79	3.18	2.00	13.43	IE	0.25	0.72	0.00
1996	**223.16**	132.80	55.30	0.08	54.28	34.64	2.50	3.04	1.99	12.11	IE	0.23	0.71	0.00
1997	**209.22**	115.23	50.21	0.10	49.19	31.32	2.22	2.88	2.00	10.77	IE	0.22	0.71	0.00
1998	**191.73**	106.52	45.31	0.12	44.28	28.07	1.97	2.73	2.02	9.48	IE	0.21	0.70	0.00
1999	**179.47**	101.49	40.77	0.13	39.70	25.04	1.76	2.59	2.06	8.26	IE	0.25	0.69	0.00
2000	**177.25**	92.66	36.10	0.12	35.05	21.97	1.56	2.51	2.04	6.97	IE	0.24	0.69	0.00
2001	**187.01**	88.31	32.02	0.11	31.00	19.13	1.37	2.43	2.02	6.05	IE	0.23	0.68	0.00
2002	**185.53**	82.11	28.44	0.12	27.43	16.56	1.19	2.38	2.00	5.29	IE	0.22	0.67	0.00
2003	**178.68**	79.04	25.52	0.21	24.45	14.37	1.04	2.39	1.97	4.68	IE	0.21	0.65	0.00
2004	**171.72**	73.43	22.93	0.23	21.85	12.39	0.90	2.43	1.94	4.20	IE	0.21	0.63	0.00
2005	**159.34**	70.88	20.73	0.27	19.66	10.68	0.84	2.41	1.92	3.82	IE	0.17	0.62	0.00
2006	**168.00**	66.48	18.68	0.28	17.61	9.21	0.67	2.35	1.86	3.52	IE	0.17	0.62	0.00
Trend														
1990–2006	***-40.7%***	*-56.7%*	*-73.2%*	*215.3%*	*-74.3%*	*-76.9%*	*-83.4%*	*-27.2%*	*-16.4%*	*-81.6%*		*-42.3%*	*-14.1%*	*101.4%*
2005–2006	***5.4%***	*-6.2%*	*-9.9%*	*4.3%*	*-10.4%*	*-13.7%*	*-19.7%*	*-2.5%*	*-2.7%*	*-8.0%*		*-1.5%*	*-1.1%*	*-17.1%*
Share in NFR 1 A														
1990			*49.3%*	*0.1%*	*48.5%*	*28.2%*	*2.9%*	*2.3%*	*1.6%*	*13.5%*		*0.2%*	*0.5%*	*0.0%*
2006			*29.5%*	*0.4%*	*27.8%*	*14.5%*	*1.1%*	*3.7%*	*2.9%*	*5.5%*		*0.3%*	*1.0%*	*0.0%*
Share in National Total														
1990		*54.1%*	*24.6%*	*0.0%*	*24.2%*	*14.1%*	*1.4%*	*1.1%*	*0.8%*	*6.7%*		*0.1%*	*0.3%*	*0.0%*
2006		*39.6%*	*11.1%*	*0.2%*	*10.5%*	*5.5%*	*0.4%*	*1.4%*	*1.1%*	*2.1%*		*0.1%*	*0.4%*	*0.0%*

Table A-22: NH_3 Emissions trends and source categories 1990–2006 without 'fuel export' according to Directive 2001/81/EC, Article 8 (1).

NFR	Total	1	1 A	1 A 1	1 A 2	1 A 3	1 A 4	1 A 5	1 B	2	3	4	6
						Gg							
1990	**71.04**	4.27	4.27	0.20	0.22	3.21	0.63	0.00	IE	0.27	NA	66.12	0.38
1991	**73.21**	5.44	5.44	0.21	0.24	4.29	0.69	0.00	IE	0.51	NA	66.87	0.39
1992	**71.91**	6.52	6.52	0.21	0.22	5.44	0.66	0.00	IE	0.37	NA	64.57	0.45
1993	**72.89**	7.54	7.54	0.24	0.25	6.39	0.67	0.00	IE	0.22	NA	64.59	0.54
1994	**74.38**	8.05	8.05	0.24	0.26	6.92	0.62	0.00	IE	0.17	NA	65.55	0.62
1995	**75.83**	7.97	7.97	0.23	0.25	6.80	0.68	0.00	IE	0.10	NA	67.12	0.64
1996	**73.84**	7.75	7.75	0.26	0.25	6.49	0.75	0.00	IE	0.10	NA	65.33	0.67
1997	**73.69**	7.34	7.34	0.26	0.28	6.10	0.70	0.00	IE	0.10	NA	65.60	0.65
1998	**73.31**	6.88	6.88	0.28	0.25	5.66	0.69	0.00	IE	0.10	NA	65.66	0.67
1999	**71.66**	6.45	6.45	0.25	0.29	5.19	0.72	0.00	IE	0.12	NA	64.39	0.71
2000	**69.54**	5.82	5.82	0.23	0.26	4.67	0.66	0.00	IE	0.10	NA	62.90	0.72
2001	**68.86**	5.36	5.36	0.25	0.27	4.12	0.72	0.00	IE	0.08	NA	62.68	0.73
2002	**67.20**	4.80	4.80	0.26	0.25	3.59	0.70	0.00	IE	0.06	NA	61.59	0.75
2003	**66.62**	4.39	4.39	0.28	0.26	3.10	0.76	0.00	IE	0.08	NA	61.38	0.76
2004	**65.81**	3.90	3.90	0.31	0.25	2.64	0.70	0.00	IE	0.06	NA	60.90	0.95
2005	**65.36**	3.58	3.58	0.33	0.26	2.26	0.73	0.00	IE	0.07	NA	60.67	1.04
2006	**65.32**	3.28	3.28	0.37	0.29	1.91	0.71	0.00	IE	0.07	NA	60.93	1.04
Trend													
1990–2006	**-8.0%**	*-23.3%*	*-23.3%*	*82.7%*	*27.4%*	*-40.6%*	*12.4%*	*227.5%*		*-72.4%*		*-7.9%*	*176.6%*
2005–2006	**-0.1%**	*-8.5%*	*-8.5%*	*12.5%*	*9.1%*	*-15.5%*	*-2.7%*	*4.6%*		*9.4%*		*0.4%*	*0.2%*
Share in NFR 1 A													
1990				*4.8%*	*5.3%*	*75.1%*	*14.8%*	*0.0%*		*6.3%*		*1548.1%*	*8.8%*
2006				*11.4%*	*8.7%*	*58.1%*	*21.7%*	*0.0%*		*2.3%*		*1858.7%*	*31.9%*
Share in National Total													
1990		*6.0%*	*6.0%*	*0.3%*	*0.3%*	*4.5%*	*0.9%*	*0.0%*		*0.4%*		*93.1%*	*0.5%*
2006		*5.0%*	*5.0%*	*0.6%*	*0.4%*	*2.9%*	*1.1%*	*0.0%*		*0.1%*		*93.3%*	*1.6%*

Table A-23:NFR 1 A 3 Transport: NH_3 emissions trends and source categories 1990–2006 without 'fuel export' according to Directive 2001/81/EC, Article 8 (1).

NFR	Total	1	1 A 3	1 A 3 a	1 A 3 b	1 A 3 b 1	1 A 3 b 2	1 A 3 b 3	1 A 3 b 4	1 A 3 b 5	1 A 3 b 7	1 A 3 c	1 A 3 d	1 A 3 e
							Gg							
1990	**71.04**	4.27	3.21	0.00	3.20	3.06	0.10	0.04	0.00	NA	IE	0.00	0.00	0.00
1991	**73.21**	5.44	4.29	0.00	4.29	4.12	0.12	0.04	0.00	NA	IE	0.00	0.00	0.00
1992	**71.91**	6.52	5.44	0.00	5.43	5.24	0.15	0.04	0.00	NA	IE	0.00	0.00	0.00
1993	**72.89**	7.54	6.39	0.00	6.38	6.17	0.17	0.04	0.00	NA	IE	0.00	0.00	0.00
1994	**74.38**	8.05	6.92	0.00	6.92	6.71	0.16	0.04	0.00	NA	IE	0.00	0.00	0.00
1995	**75.83**	7.97	6.80	0.00	6.80	6.60	0.16	0.04	0.00	NA	IE	0.00	0.00	0.00
1996	**73.84**	7.75	6.49	0.00	6.49	6.30	0.15	0.04	0.00	NA	IE	0.00	0.00	0.00
1997	**73.69**	7.34	6.10	0.00	6.09	5.92	0.14	0.04	0.00	NA	IE	0.00	0.00	0.00
1998	**73.31**	6.88	5.66	0.00	5.65	5.48	0.13	0.04	0.00	NA	IE	0.00	0.00	0.01
1999	**71.66**	6.45	5.19	0.00	5.18	5.02	0.12	0.03	0.00	NA	IE	0.00	0.00	0.01
2000	**69.54**	5.82	4.67	0.00	4.66	4.52	0.11	0.03	0.00	NA	IE	0.00	0.00	0.01
2001	**68.86**	5.36	4.12	0.00	4.11	3.98	0.10	0.03	0.00	NA	IE	0.00	0.00	0.01
2002	**67.20**	4.80	3.59	0.00	3.58	3.46	0.09	0.03	0.00	NA	IE	0.00	0.00	0.00
2003	**66.62**	4.39	3.10	0.00	3.09	2.99	0.08	0.03	0.00	NA	IE	0.00	0.00	0.01
2004	**65.81**	3.90	2.64	0.00	2.63	2.53	0.07	0.03	0.00	NA	IE	0.00	0.00	0.01
2005	**65.36**	3.58	2.26	0.00	2.24	2.15	0.06	0.03	0.00	NA	IE	0.00	0.00	0.01
2006	**65.32**	3.28	1.91	0.00	1.90	1.81	0.05	0.03	0.00	NA	IE	0.00	0.00	0.01
Trend														
1990–2006	***-8.0%***	*-23.3%*	*-40.6%*	*329.5%*	*-40.8%*	*-40.7%*	*-51.1%*	*-27.1%*	*140.0%*			*-42.3%*	*-24.2%*	*101.4%*
2005–2006	***-0.1%***	*-8.5%*	*-15.5%*	*4.3%*	*-15.5%*	*-15.5%*	*-20.9%*	*-2.2%*	*0.0%*			*-1.5%*	*1.7%*	*-17.1%*
Share in NFR 1 A														
1990			*75.1%*	*0.0%*	*75.0%*	*71.5%*	*2.4%*	*1.0%*	*0.0%*			*0.1%*	*0.0%*	*0.1%*
2006			*58.1%*	*0.0%*	*57.8%*	*55.3%*	*1.6%*	*0.9%*	*0.0%*			*0.0%*	*0.0%*	*0.2%*
Share in National Total														
1990		*6.0%*	*4.5%*	*0.0%*	*4.5%*	*4.3%*	*0.1%*	*0.1%*	*0.0%*			*0.0%*	*0.0%*	*0.0%*
2006		*5.0%*	*2.9%*	*0.0%*	*2.9%*	*2.8%*	*0.1%*	*0.0%*	*0.0%*			*0.0%*	*0.0%*	*0.0%*

11.4 Annex: Extracts from Austrian Legislation

Extracts from Austrian legislation, which regulate monitoring, reporting and verification of emissions at plant level

Cement production

BGBl 1993/ 63 Verordnung für Anlagen zur Zementerzeugung

§ 5. Der Betriebsanlageninhaber hat

1. kontinuierliche Messungen der Emissionskonzentrationen an Gesamtstaub, SO_2 und Stickstoffoxiden (berechnet als NO_2) der Ofenanlage entsprechend der Z 1 der Anlage zu dieser Verordnung durchzuführen ...

Zur Durchführung der Messungen gemäß Z 2 und 3 sind Anstalten des Bundes oder eines Bundeslandes, staatlich autorisierte Anstalten, Ziviltechniker oder Gewerbebetreibende, jeweils im Rahmen ihrer Befugnisse, heranzuziehen.

§ 6 Die Ergebnisse der Messungen gemäß § 5 sind in einem Messbericht festzuhalten, welcher

1. bei Messungen gemäß § 5 Z 1 die Messwerte in Form von Aufzeichnungen eines kontinuierlich registrierenden Messgerätes und die gemäß § 4 Abs. 1 zu führenden Aufzeichnungen über Grenzwertüberschreitungen, zu enthalten hat. Der Messbericht ist mindestens fünf Jahre in der Betriebsanlage derart aufzubewahren, dass er den behördlichen Organen jederzeit zur Einsicht vorgewiesen werden kann.

Anlage

(§ 5)

Emissionsmessungen

1. Kontinuierliche Messungen

a) Die Datenaufzeichnung hat durch automatisch registrierende Messgeräte in Form von Halbstundenmittelwerten unter Angabe von Datum, Uhrzeit und Messstelle zu erfolgen. Die Verfügbarkeit der Daten hat mindestens 90 % zu betragen. Als Bezugszeitraum gilt ein Monat.

b) Registrierende Emissionsmessgeräte sind im Abnahmeversuch und alle drei Jahre durch einen Sachverständigen aus dem im § 5 letzter Satz angeführten Personenkreis zu kalibrieren.

c) Jährlich ist eine Funktionskontrolle an registrierenden Emissionsmessgeräten durch Sachverständige aus dem im § 5 letzter Satz angeführten Personenkreis vorzunehmen.

Foundries

BGBl 1994/ 447 Verordnung für Gießereien

§ 5 (1) Der Betriebsanlageninhaber hat Einzelmessungen der Emissionskonzentration der im § 3 Abs. 1 angeführten Stoffe entsprechend der Z 1 lit. A bis c der Anlage 2 dieser Verordnung in regelmäßigen, drei Jahre nicht übersteigenden Zeitabständen durchführen zu lassen (wiederkehrende Emissionsmessungen).

(2) Der Betriebsanlageninhaber hat kontinuierliche Messungen der Emissionskonzentrationen ... entsprechend der Z2 der Anlage 2 zu dieser Verordnung durchzuführen.

(3) Zur Durchführung der Messungen gemäß Abs. 1 sowie zur Funktionskontrolle und Kalibrierung von Messgeräten für Messungen gemäß Abs. 2 sind Anstalten des Bundes oder eines Bundeslandes, staatlich autorisierte Anstalten, Ziviltechniker oder Gewerbebetreibende, jeweils im Rahmen ihrer Befugnisse, oder akkreditierte Stellen im Rahmen des fachlichen Umfangs ihrer Akkreditierung (§ 11 Abs. 2 des Akkreditierungsgesetzes, BGBl Nr 468/ 1992) heranzuziehen.

§ 6 Die Ergebnisse der Messungen gemäß § 5 sind in einem Messbericht festzuhalten, welcher

1. bei Messungen gemäß § 5 Abs. 1 die Messwerte und die Betriebsbedingungen während der Messungen (Betriebszustand, Verbrauch an Brennstoff, Rohmaterial und Zuschlagstoffen),

2. bei Messungen gemäß § 5 Abs. 2 die Messwerte in Form von Aufzeichnungen eines kontinuierlich registrierenden Messgerätes und die gemäß § 4 Abs. 2 zu führenden Aufzeichnungen über Grenzwertüberschreitungen, zu enthalten hat. Der Messbericht ist mindestens drei Jahre, bei Messungen gemäß § 5 Abs. 1 jedenfalls bis zur jeweils nächsten Messung, in der Betriebsanlage derart aufzubewahren, dass er den behördlichen Organen jederzeit zur Einsicht vorgewiesen werden kann.

<u>Anlage 2</u>

(§ 5)

Emissionsmessungen

1. Einzelmessungen

a) Einzelmessungen sind für alle im § 3 Abs. 1 angeführten Stoffe bei jenem Betriebzustand durchzuführen, in dem nachweislich die Anlagen vorwiegende betrieben werden. Die Durchführung der Messungen hat nach den Regeln der Technik zu erfolgen.

c) Die Abgasmessungen sind an einer repräsentativen Entnahmestelle im Kanalquerschnitt, die vor Aufnahme der Messungen zu bestimmen ist, vorzunehmen. Es sind innerhalb eines Zeitraumes von drei Stunden drei Messwerte als Halbstundenmittelwerte zu bilden, deren einzelne Ergebnisse zu beurteilen sind.

2. Kontinuierliche Messungen

a) Die Datenaufzeichnung hat durch automatisch registrierende Messgeräte in Form von Halbstundenmittelwerte unter Angabe von Datum, Uhrzeit und Messstelle zu erfolgen. Die Verfügbarkeit der Daten hat mindestens 90 % zu betragen. Als Bezugszeitraum gilt ein Monat.

b) Registrierende Emissionsmessgeräte sind im Abnahmeversuch und alle drei Jahre durch einen Sachverständigen aus dem im § 5 Abs. 3 angeführten Personenkreis zu kalibrieren.

c) Jährlich ist eine Funktionskontrolle an registrierenden Emissionsmessgeräten durch Sachverständige aus dem im § 5 Abs. 3 angeführten Personenkreis vorzunehmen.

Glass production

<u>BGBl 1994/ 498 Verordnung für Anlagen zur Glaserzeugung</u>

§ 5 (2) Zur Kontrolle der Einhaltung der im § 3 festgelegten Emissionsgrenzwerte sind unter Beachtung des § 4 jeweils mindestens drei Messwerte als Halbstundenmittelwerte zu bestimmen.

(4) Die Durchführung der Emissionsmessungen hat nach den Regeln der Technik (z.B. nach den vom Verein deutscher Ingenieure herausgegebenen und beim Österreichischen Normungs-

institut, Heinestraße 38, 1021 Wien, erhältlichen Richtlinien VDI 2268, Blätter 1, 2 und 4, VDI 2462, Blätter 1 bis 5 und 8, und VDI 2456, Blätter 1, 2, 8 und 10) zu erfolgen.

§ 7 (1) Der Betriebsanlageninhaber hat in regelmäßigen, ein Jahr, bei Schmelzeinrichtungen gemäß § 3 Z 5 lit. D drei Jahre, nicht übersteigenden Zeitabständen Messungen zur Kontrolle der Einhaltung der im § 3 festgelegten Emissionsgrenzwerte entsprechend den §§ 4 bis 6 durchführen zu lassen.

(2) Zur Durchführung der Messungen sind Anstalten des Bundes oder eines Bundeslandes, staatlich autorisierte Anstalten, Ziviltechniker oder Gewerbebetreibende, jeweils im Rahmen ihrer Befugnisse, oder akkreditierte Stellen im Rahmen des fachlichen Umfangs ihrer Akkreditierung (§ 11 Abs. 2 des Akkreditierungsgesetzes, BGBl Nr 468/ 1992) heranzuziehen.

(3) Die Messwerte für die im § 3 angeführten Stoffe sowie der während der Messung herrschenden Betriebszustände sind zusammen mit den Kriterien, nach denen der Zeitraum für die Messung, der stärksten Emission festgelegt worden ist, in einem Messbericht festzuhalten. Im Messbericht sind auch die verwendeten Messverfahren zu beschreiben. Der Messbericht und sonstige zum Nachweis der Einhaltung der im § 3 festgelegten Emissionsgrenzwerte dienende Unterlagen sind bis zur nächsten Messung in der Betriebsanlage derart aufzubewahren, dass sie den behördlichen Organen jederzeit zur Einsicht vorgewiesen werden können.

Iron and steel production

BGBl II 1997/ 160 Verordnung für Anlagen zur Erzeugung von Eisen und Stahl

§ 6 (1) Der Betriebsanlageninhaber hat, soweit die Absätze 3 und 4 nicht anderes bestimmen, Einzelmessungen der Emissionskonzentrationen der im § 3 Abs. 1 und im § 4 (mit Ausnahme des § 4 Abs. 3 lit. c) angeführten Stoffe entsprechend der Z 1 lit. a bis c der Anlage zu dieser Verordnung in regelmäßigen, drei Jahre nicht übersteigenden Zeitabständen, durchführen zu lassen (wiederkehrende Emissionsmessungen).

(3) Der Betriebsinhaber hat, soweit Abs. 4 oder 5 nicht anderes bestimmt. Entweder kontinuierliche Messungen der Emissionskonzentrationen ... entsprechend der Z 2 der Anlage zu dieser Verordnung durchzuführen oder kontinuierliche Funktionsprüfungen der rauchgas- und bzw. oder Abluftfilteranlagen von Einrichtungen gemäß § 4 durchzuführen, wenn sich durch diese Prüfungen mit hinreichender Sicherheit die Einhaltung der vorgeschriebenen Emissionsgrenzwerte für Staub festgestellt werden kann.

§ 6 (6) Zur Durchführung der Messungen gemäß Abs. 1 und 2 sowie zur Funktionskontrolle und Kalibrierung von Messgeräten für Messungen gemäß Abs. 3 sind akkreditierte Stellen im Rahmen des fachlichen Umfangs ihrer Akkreditierung (§ 11 Abs. 2 des Akkreditierungsgesetzes, BGBl Nr 468/ 1992), Anstalten des Bundes oder eines Bundeslandes, staatlich autorisierte Anstalten, Ziviltechniker oder Gewerbebetreibende, jeweils im Rahmen ihrer Befugnisse, heranzuziehen.

§ 7 Die Ergebnisse der Messungen gemäß § 6 sind in einem Messbericht festzuhalten, der zu enthalten hat:

1. bei Messungen gemäß § 6 Abs. 1 und 2 die Messwerte und die Betriebsbedingungen während der Messungen (Betriebszustand, Verbrauch Brennstoff, Rohmaterial und Zuschlagstoffen),

2. bei Messungen gemäß § 6 Abs. 3 und 4 die Messwerte in Form von Aufzeichnungen eines kontinuierlich registrierenden Messgerätes,

3. bei Funktionsprüfungen gemäß § 6 Abs. 3 die gemessenen Parameter in Form von Aufzeichnungen eines kontinuierlich registrierenden Messgerätes.

Der Messbericht ist mindestens drei Jahre, bei Messungen gemäß § 6 Abs. 1 und 2 jedenfalls bis zur jeweils nächsten Messung, in der Betriebsanlage derart aufzubewahren, dass er den behördlichen Organen zur Einsicht vorgewiesen werden kann.

Anlage

(§ 6)

Emissionsmessungen

1. Einzelmessungen

a) Einzelmessungen sind für alle im § 3 Abs. 1 und 3 und im § 4 angeführten Stoffe bei jenem Betriebszustand durchzuführen, in dem nachweislich die Anlagen vorwiegend betrieben werden. Die Durchführung der Messungen hat nach den Regeln der Technik zu erfolgen.

2. Kontinuierliche Messungen

a) Die Datenaufzeichnung hat durch ein automatisch registrierendes Messgerät in Form von Halbstundenmittelwerten unter Angabe von Datum, Uhrzeit und Messstelle zu erfolgen. Die Verfügbarkeit der Daten hat mindestens 90 % zu betragen. Als Bezugszeitraum gilt ein Monat.

b) Das registrierende Messgerät ist im Abnahmeversuch und alle drei Jahre durch einen Sachverständigen aus dem im § 6 Abs. 5 angeführten Personenkreis zu kalibrieren.

c) Jährlich ist eine Funktionskontrolle des registrierenden Messgerätes durch einen Sachverständigen aus dem im § 6 Abs. 5 angeführten Personenkreis vorzunehmen.

Sinter plants

BGBl II 1997/ 163 Verordnung für Anlagen zum Sintern von Eisenerzen

§ 5 (1) Der Betriebanlageninhaber hat Einzelmessungen der Emissionskonzentration der im § 3 Abs. 1 Z 2 lit. a und b und Z 3 angeführten Stoffe entsprechend der Z 1 in der Anlage zu dieser Verordnung in regelmäßigen, drei Jahre nicht übersteigenden Zeitabständen, durchzuführen zu lassen (wiederkehrende Emissionsmessungen).

(2) Der Betriebanlageninhaber hat kontinuierliche Messungen der Emissionskonzentrationen von Staub, Stickstoffoxiden und Schwefeldioxid entsprechend der Z 2 der Anlage dieser Verordnung durchzuführen.

(3) Zur Durchführung der Messungen gemäß Abs. 1 sowie zur Funktionskontrolle und Kalibrierung von Messgeräten für Messungen gemäß Abs. 2 sind akkreditierte Stellen im Rahmen des fachlichen Umfangs ihrer Akkreditierung (§ 11 Abs. 2 des Akkreditierungsgesetzes, BGBl Nr 468/ 1992), Anstalten des Bundes oder eines Bundeslandes, staatlich autorisierte Anstalten, Ziviltechniker oder Gewerbebetreibende, jeweils im Rahmen ihrer Befugnisse, heranzuziehen.

§ 6 Die Ergebnisse der Messungen gemäß § 5 sind in einem Messbericht festzuhalten, der zu enthalten hat:

1. bei Messungen gemäß § 5 Abs. 1 die Messwerte und die Betriebsbedingungen während der Messungen (Betriebszustand, Verbrauch an Brennstoff und Einsatzmaterial),

2. bei Messungen gemäß § 5 Abs. 2 die Messwerte in Form von Aufzeichnungen eines kontinuierlich registrierenden Messgerätes.

Der Messbericht ist mindestens drei Jahre, bei Messungen gemäß § 5 Abs. 1 jedenfalls bis zur jeweils nächsten Messung, in der Betriebsanlage derart aufzubewahren, dass er den behördlichen Organen jederzeit zur Einsicht vorgewiesen werden kann.

Anlage

(§ 5)

Emissionsmessungen

1. Einzelmessungen

a) Einzelmessungen sind für die im § 3 Abs. 1 Z 2 lit. a und b und Z 3 angeführten Stoffe bei jenem Betriebszustand durchzuführen, in dem nachweislich die Anlagen vorwiegend betrieben werden. Die Durchführung der Messungen hat nach den Regeln der Technik zu erfolgen.

2. Kontinuierliche Messungen

a) Die Datenaufzeichnung hat durch ein automatisch registrierendes Messgerät in Form von Halbstundenmittelwerten unter Angabe von Datum, Uhrzeit und Messstelle zu erfolgen. Die Verfügbarkeit der Daten hat mindestens 90 % zu betragen. Als Bezugszeitraum gilt ein Monat.

b) Das registrierende Messgerät ist im Abnahmeversuch und alle drei Jahre durch einen Sachverständigen aus dem im § 5 Abs. 3 angeführten Personenkreis zu kalibrieren. Die Kalibrierung hat nach den Regeln der Technik zu erfolgen.

c) Jährlich ist eine Funktionskontrolle des registrierenden Messgerätes durch einen Sachverständigen aus dem im § 5 Abs. 3 angeführten Personenkreis vorzunehmen.

Combustion plants

BGBl II 1997/ 331 Feuerungsanlagen-Verordnung

Emissionsmessungen

§ 4 (1) Der Betriebsanlageninhaber hat Emissionsmessungen sowie die Bestimmung des Abgasverlustes entsprechend der Anlage 1 zu dieser Verordnung durchzuführen bzw. durchführen zu lassen.

(2) Zur Durchführung der Emissionseinzelmessungen sowie zur Bestimmung des Abgasverlustes ist ein Sachverständiger aus dem im § 2 Abs. 2 zweiter Satz genannten Personenkreis heranzuziehen.

§ 5 (1) Der Betriebsanlageninhaber hat, sofern in dieser Verordnung nicht anderes bestimmt ist,

1. kontinuierliche Messungen der Emissionskonzentrationen, abhängig von der jeweiligen Brennstoffwärmeleistung und dem eingesetzten Brennstoff, entsprechende der folgenden Tabelle durchzuführen

Brennstoff	Staub	CO	SO_2	NO_x	
fest	> 10	> 10	> 30	> 30	MW
flüssig	> 10	> 10	> 50	> 30	MW
gasförmig	-	> 10	-	> 30	MW

Prüfungen

Erstmalige Prüfung

§ 23 (1) Feuerungsanlagen sind anlässlich ihrer Inbetriebnahme einer erstmaligen Prüfung zu unterziehen.

(2) Die erstmalige Prüfung hat in der Erbringung des Nachweises zu bestehen, dass die Feuerungsanlage den Anforderungen dieser Verordnung entspricht.

Wiederkehrende Prüfungen

§ 25 (1) Feuerungsanlagen sind jährlich zu prüfen. Bei dieser jährlichen Prüfung sind die Feuerungsanlagen hinsichtlich jener Anlagenteile, die für die Emissionen oder deren Begrenzung von Bedeutung sind, zu besichtigen und auf etwaige Mängel zu kontrollieren... Weiters sind jährlich die Ergebnisse der gemäß § 5 durchgeführten kontinuierlichen Messungen zu beurteilen.

Prüfbescheinigung

§ 27 Das Ergebnis jeder Prüfung muss in einer Prüfbescheinigung festgehalten sein, die insbesondere festgestellte Mängel sowie Vorschläge zu deren Behebung zu enthalten hat. Die Prüfbescheinigung ist im Original in der Betriebsanlage zumindest fünf Jahre so aufzubewahren, dass sie den behördlichen Organen jederzeit zur Einsicht vorgewiesen werden kann.

Anlage 1

(§§ 4 und 25)

Emissionsmessungen

1. Die Messungen sind

1.3 für gasförmige Emissionen nach den Regeln der Technik, oder nach einem diesen Verfahren gleichwertigen Verfahren durchzuführen.

2. Die Messstellen sind so festzulegen, dass eine repräsentative und messtechnisch einwandfreie Emissionsmessung gewährleistet ist.

3. Einzelmessungen

3.2 Die Einzelmessungen sind an einer repräsentativen Entnahmestelle im Kanalquerschnitt vorzunehmen. Es sind innerhalb eines Zeitraumes von drei Stunden drei messwerte als Halbstundenmittelwerte zu bilden.

4. Kontinuierliche Messungen

4.1 Die Datenaufzeichnung hat durch automatisch registrierende Messgeräte in Form von Halbstundenmittelwerten unter Angabe von Datum, Uhrzeit und Messstelle zu erfolgen. Die Verfügbarkeit der Daten hat mindestens 90 % zu betragen. Als Bezugszeitraum gilt ein Monat. Die Messergebnisse müssen mit dem einzuhaltenden Grenzwert vergleichbar sein.

4.2 Registrierende Emissionsmessgeräte sind im Abnahmeversuch und mindestens alle drei Jahre durch einen Sachverständigen aus dem im § 2 Abs. 2 zweiter Satz angeführten Personenkreis zu kalibrieren. Die Kalibrierung hat nach den Regeln der Technik (z.B. nach den vom Verein Deutscher Ingenieure herausgegebenen und beim Österreichischen Normungsinstitut, Heinestraße 38, 1021 Wien, erhältlichen Richtlinien VDI 2066, Blatt 4 und Blatt 6, und VDI 3950, Blatt 1E) zu erfolgen.

4.3 Jährlich ist eine Funktionskontrolle an registrierenden Emissionsmessgeräten durch Sachverständige aus dem im § 2 Abs. 2 zweiter Satz angeführten Personenkreis vorzunehmen.

Non-ferrous metal production

BGBl II 1998/ 1 Verordnung zur Erzeugung von Nichteisenmetallen

§ 6 (1) Der Betriebsanlageninhaber hat Einzelmessungen der Emissionskonzentration der im § 3 Abs. 1 und im § 4 angeführten Stoffe entsprechend der Z 1 lit. a bis c der Anlage zu dieser Verordnung in regelmäßigen, drei Jahre nicht übersteigenden Zeitabständen durchführen zu lassen (wiederkehrende Emissionsmessungen).

(2) Der Betriebsanlageninhaber hat kontinuierliche Messungen ... entsprechend der Z 2 der Anlage zu dieser Verordnung reingasseitig (im Kamin) durchzuführen.

(3) Zur Durchführung der Messungen gemäß Abs. 1 sowie zur Funktionskontrolle und Kalibrierung von Messgeräten für Messungen gemäß Abs. 2 sind akkreditierte Stellen im Rahmen des fachlichen Umfangs ihrer Akkreditierung (§ 11 Abs. 2 des Akkreditierungsgesetzes, BGBl Nr 468/ 1992), Anstalten des Bundes oder eines Bundeslandes, staatlich autorisierte Anstalten, Ziviltechniker oder Gewerbebetreibende, jeweils im Rahmen ihrer Befugnisse, heranzuziehen.

§ 7 Die Ergebnisse der Messungen gemäß § 6 sind in einem Messbericht festzuhalten, der zu enthalten hat:

1. bei Messungen gemäß § 6 Abs. 1 die Messwerte und die Betriebsbedingungen während der Messungen (Betriebszustand, Verbrauch an Brennstoff, Rohmaterial und Zuschlagstoffen),

2. bei Messungen gemäß § 6 Abs. 2 die Messwerte in Form von Aufzeichnungen eines kontinuierlich registrierenden Messgerätes und die gemäß § 5 Abs. 2 zu führenden Aufzeichnungen über Grenzwertüberschreitungen.

Der Messbericht ist mindestens drei Jahre, bei Messungen gemäß § 6 Abs. 1 jedenfalls bis zur jeweils nächsten Messung, in der Betriebsanlage derart aufzubewahren, dass er den behördlichen Organen jederzeit zur Einsicht vorgewiesen werden kann.

Anlage

(§ 6)

Emissionsmessungen

1. Einzelmessungen

a) Einzelmessungen sind für alle im § 3 Abs. 1 und 4 angeführten Stoffe bei jenem Betriebszustand durchzuführen, in dem nachweislich die Anlagen vorwiegend betrieben werden. Die Durchführung der Messungen hat nach den Regeln der Technik zu erfolgen.

2. Kontinuierliche Messungen

a) Die Datenaufzeichnung hat durch ein automatisch registrierendes Messgerät in Form von Halbstundenmittelwerten unter Angabe von Datum, Uhrzeit und Messstelle zu erfolgen. Die Verfügbarkeit der Daten hat mindestens 90 % zu betragen. Als Bezugszeitraum gilt ein Monat.

b) Das registrierende Messgerät ist im Abnahmeversuch und alle drei Jahre durch einen Sachverständigen aus dem im § 6 Abs. 3 angeführten Personenkreis zu kalibrieren.

c) Die Wartung des registrierende Messgerätes ist durch einen Sachverständigen aus dem im § 6 Abs. 3 angeführten Personenkreis mindestens einmal jährlich vornehmen zu lassen.

Steam boilers

<u>BGBl 1988/ 380 idF (BGBl 1993/ 185, BGBl I 1997/ 115, BGBl I 1998/ 158) Luftreinhaltegesetz für Kesselanlagen</u>

Überwachung

§ 7 (1) Die in Betrieb befindlichen Dampfkesselanlagen ... sind einmal jährlich durch einen befugten Sachverständigen auf die Einhaltung der Bestimmungen dieses Bundesgesetzes zu überprüfen. Die Überprüfung umfasst die Besichtigung der Anlage und deren Komponenten, soweit sie für die Emissionen oder deren Begrenzung von Bedeutung sind, verbunden mit der Kontrolle vorhandener Messergebnisse oder Messregistrierungen.

§ 8 (1) Die Behörde hat im Genehmigungsbescheid festzulegen, ob und in welchem Umfange Abnahmemessungen sowie wiederkehrende Emissionsmessungen an der Dampfkesselanlage durchzuführen sind. Emissionsmessungen sind ferner durchzuführen, wenn der befugte Sachverständige anlässlich einer Überprüfung gemäß § 7 Grund zur Annahme hat, dass die einzuhaltenden Emissionsgrenzwerte im Betrieb überschritten werden.

Pflichten des Betreibers

§ 10 (3) Der Betreiber hat der Behörde oder dem hierzu beauftragten Sachverständigen während der Betriebszeit den Zutritt zu der Anlage zu gestatten und Einsicht in alle die Emissionen der Dampfkesselanlage betreffenden Aufzeichnungen zu gewähren, die in einem Dampfkesselanlagenbuch zusammenzufassen sind.

<u>BGBl 1989/ 19 idF (BGBl 1990/ 134, BGBl 1994/ 785, BGBl II 1997/ 324) Luftreinhalteverordnung für Kesselanlagen</u>

Emissionseinzelmessungen

§ 2 a (1) Die Durchführung der Emissionsmessungen hat nach den Regeln der Technik zu erfolgen.

(2) Die in Anlage 7 wiedergegebene ÖNORM M 9415-1, Ausgabe Mai 1991, und die in Anlage 8 wiedergegebene ÖNORM 9415-3, Ausgabe Mai 1991, sind verbindlich anzuwenden.

§ 3 (1) Emissionseinzelmessungen sind für jede Schadstoffkomponente bei jenem feuerungstechnisch stationären Betriebzustand durchzuführen, bei dem nachweislich die Anlage vorwiegend betrieben wird.

(2) Für die Durchführung der Emissionseinzelmessungen ist die in Anlage 9 wiedergegebene ÖNORM M 9415-2, Ausgabe Mai 1991, verbindlich anzuwenden.

Kontinuierliche Emissionsmessungen

§ 4 (3) Kontinuierliche Emissionsmessungen der Massekonzentration einer Emission (§ 8 Abs. 1 LRG-K) haben i der Regel in Halbstundenmittelwerten zu erfolgen.

(5) Die Messstellen sind auf Grund des Gutachtens eines befugten Sachverständigen (§ 7 Abs. 2 LRG-K) von der Behörde derart festzulegen, dass eine repräsentative und messtechnisch einwandfreie Emissionsmessung gewährleistet ist.

§ 5. Für kontinuierliche Emissionsmessungen hat die Datenaufzeichnung zu erfolgen:

1. Durch automatisch registrierende Messgeräte in Form von Halbstundenmittelwerten unter Angabe von Datum, Uhrzeit und Messstelle. Die Verfügbarkeit der Daten hat mindestens 90 % zu betragen. Als Bezugszeitraum gilt ein Monat.

3. Die Auswertung der Messdaten aus registrierenden Messgeräten hat mittels Auswertegeräten zu erfolgen, die dafür geeignet sind und die dem Stand der Technik entsprechen.

5. Registrierende Emissionsmessgeräte und Auswertegeräte sind im Abnahmeversuch und danach alle drei Jahre durch einen Sachverständigen zu kalibrieren. Die Kalibrierung hat nach den geltenden einschlägigen technischen Regelwerken zu erfolgen.

6. Jährlich ist eine Funktionskontrolle an registrierenden Emissionsmessgeräten durch Sachverständige vorzunehmen.

§ 7 (1) Der Betreiber hat während des Betriebes der Anlage an den Messgeräten mindestens einmal wöchentlich zu kontrollieren, ob der Nullpunkt einjustiert ist und die erforderliche Messfunktion gegeben ist.

(2) Die Messgeräte und alle dazuhörenden Komponenten sind mindestens alle drei Monate zu warten. Hierüber hat der Betreiber Aufzeichnungen zu führen.

(3) Der Sachverständige hat im Rahmen der Überwachung die Aufzeichnungen gemäß Abs. 2 zu kontrollieren und in begründeten Fällen die Richtigkeit der Anzeige der Messgeräte zu überprüfen.

umweltbundesamt

Umweltbundesamt GmbH
Spittelauer Lände 5
1090 Wien/Österreich

Tel.: +43-(0)1-313 04
Fax: +43-(0)1-313 04/5400

office@umweltbundesamt.at
www.umweltbundesamt.at

Der Informative Inventory Report 2008 (IIR 2008) präsentiert die umfassende und detaillierte Methodikbeschreibung der Österreichischen Luftschadstoff-Inventur (OLI) für die Luftschadstoffe

- Schwefeldioxid (SO_2), Stickstoffoxide (NO_x), flüchtige organische Verbindungen ohne Methan (NMVOC), Ammoniak (NH_3)
- Kohlenmonoxid (CO)
- Staub (TSP, PM10, PM2.5)

sowie für die Luftschadstoffgruppen

- Schwermetalle: Cadmium (Cd), Quecksilber (Hg), Blei (Pb) und
- persistente organische Schadstoffe (POP): polyzyklische aromatische Kohlenwasserstoffe (PAH), Dioxine und Furane (PCDD/F) sowie Hexachlorbenzol (HCB).

Mit dem IIR erfüllt Österreich die Anforderungen an die Dokumentation hinsichtlich Transparenz und Nachvollziehbarkeit, die für die Berichterstattung zum Genfer Luftreinhalteabkommen (LRTAP – Convention on Long-range Transboundary Air Pollution) notwendig sind.

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