umweltbundesamt

Austria's Informative Inventory Report (IIR) 2009

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

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AUSTRIA'S INFORMATIVE INVENTORY REPORT (IIR) 2009

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EXECUTIVE SUMMARY

The report "Austria's Informative Inventory Report (IIR) 2009" 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 2009 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.

This report follows the regulations under the UNECE/LRTAP Convention and its Protocols that define standards for national emission inventories. In 2008 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 (ECE/EB.AIR/2008/4). The emission data presented in this report were compiled according to these guidelines for estimating and reporting emission data, which also define the new 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 new 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 2009 at hand complements the reported emission data by providing background information. It follows the template 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 (UMWELTBUNDESAMT 2009).

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 Category Analysis and gives information on completeness and uncertainty of emission estimates.

Chapter 2 gives on one hand information on reduction or stabilization targets as set out in the Protocols to the Convention compared to actual emission trends and on the other hand a full description of the emission trends by sector.

The third chapter presents major changes (so called "recalculations") related to the previous submission (emission data report 2008 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).

When no changes in methodology and emission factor were made, the relevant chapters were not updated (as outlined in the guidelines).

The annex presents inter alia emission data for all pollutants for the year 2007 in NFR as well as trend tables for these gases and for heavy metals, POPs and particulate matter.

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 IIR 2009 is Traute Köther.

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

Specific responsibilities for the IIR 2009 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 — Katja Pazdernik
- Annexes — Traute Köther.

1 INTRODUCTION

1.1 Institutional Arrangement for Inventory Preparation

Austria's reporting obligations to the United Nations Framework Convention on Climate Change (UNFCCC)[1], UNECE Convention on Long-range Transboundary Air Pollution (LRTAP)[2] and EC (European Commission)[3] are administered by the Federal Ministry of Agriculture, Forestry, Environment and Water Management (BMLFUW)[4]. With the Environmental Control Act[5] that entered into force the 1st of January 1999 the Umweltbundesamt is designated as single national entity with overall responsibility for inventory preparation. This law regulates responsibilities of environmental control in Austria and lists the tasks of the Umweltbundesamt. One task is the preparation of technical expertise and the data basis for fulfilment of the obligations under the UNFCCC and the UNECE LRTAP Convention. Thus the Umweltbundesamt prepares and annually updates the Austrian air emissions inventory ("Österreichische Luftschadstoff-Inventur OLI"), which covers greenhouse gases and emissions of other air pollutants as stipulated in the reporting obligations further explained in chapter 1.1.1.

Within the Umweltbundesamt the department of *Emissions and Climate Change* is responsible for the preparation of the Austrian Air Emission Inventory ("Österreichische Luftschadstoff-Inventur OLI") and all work related to inventory preparation. Responsibilities are divided by sectors between sector experts from Departments within the Umweltbundesamt. The quality system is maintained up to date under the responsibility of the Quality Manager. The Quality Manager has direct access to top management.

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 serve as an important basis for policies to reduce emissions.

The 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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[1] http://unfccc.int/2860.php

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

[3] http://ec.europa.eu/index_en.htm

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

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

[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
1979	Convention on Long-range Transboundary Air Pollution (in Geneva)		16.03.1983	13.11.1979 (s) 16.12.1982 (r)
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)	42	28.01.1988	04.06.1987 (ac)
1985	Helsinki Protocol on the Reduction of Sulphur Emissions or their Transboundary Fluxes by at least 30 per cent	23	02.09.1987	09.07.1985 (s) 04.06.1987 (r)
1988	Sofia Protocol concerning the Control of Nitrogen Oxides or their Transboundary Fluxes	32	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	23	29.09.1997	19.11.1991 (s) 23.08.1994 (r)
1994	Oslo Protocol on Further Reduction of Sulphur Emissions	28	05.08.1998	14.06.1994 (s) 27.08.1998 (r)
1998	Aarhus Protocol on Heavy Metals	29	29.12.2003	24.06.1998 (s) 17.12.2003 (r)
1998	Aarhus Protocol on Persistent Organic Pollutants (POPs)	29	23.10.2003	24.06.1998 (s) 27.08.2002 (r)(1)
1999	The 1999 Gothenburg Protocol to Abate Acidification, Eutrophication and Ground-level Ozone	24	17.05.2005	01.12.1999 (s)

Abbreviation: signed (s) ratified (r) accession (ac) Footnote: (1) with declaration upon ratification

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 is to implement a European Pollutant Emission Register (EPER). Article 15 of the IPPC Directive can be associated with Article 6 of the Aarhus Convention (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.
- 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]. EPER was displaced and upgraded by regulation (EC) No 166/2006[17] concerning the establishment of a European Pollutant Release and Transfer Register (E-PRTR Regulation). EPER and E-PRTR are associated with Article 6 of the Aarhus Convention[18] (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)

History of NISA

As there are so many different obligations which are subject to continuous development, Austria's National Inventory System (NISA) has to be adapted to these changes. A brief history of the development and the activities of NISA is shown here:

- Austria established estimates for SO_2 under EMEP in 1978 (Cooperative Programme for Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe)[19].
- As an EFTA[20] country Austria participated in CORINAIR 90[21/22], which was an air emission inventory for Europe. It was part of the CORINE (Coordination d'Information Environmentale) work plan set up by the European Council of Ministers in 1985. The aim of CORINAIR 90 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.

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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.umweltbundesamt.at/umweltinformation/datenbanken/prtr/ and
http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2007:052:0003:0005:EN:PDF

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

[19] http://projects.dnmi.no/~emep/

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

[21] The CORINAIR system has been integrated into the work programme of the European Environment Agency (EEA) and the work is continuing through the Agency's European Topic Centre on Air Emissions (ETC/ACC)(http://air-climate.eionet.europa.eu/). http://reports.eea.europa.eu/topic_report_1996_21/en/topic_21_1996.pdf

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

- Austria signed the UNFCCC on June 8, 1992 and subsequently submitted its instrument of ratification on February 28, 1994.[23]
- In 1994 the first so-called Austrian Air Emission Inventory (Österreichische Luftschadstoff-Inventur, OLI) was prepared.
- In 1997 a consistent time series for the emission data from 1980 to 1995 was reported for the first time.
- In 1998 also emissions of heavy metals (HM), persistent organic pollutants (POP) and fluorinated compounds (FC) such as SF_6, PFCs, HFCs were included in the inventory.
- Austria signed the KYOTO PROTOCOL on April 4, 1998 and subsequently submitted its instrument of ratification on May 31, 2002.
- Inventory data for particulate matter (PM) were included in the inventory in 2001.
- In 2005 Accreditation according to ISO/IEC 17020 as Inspection Body for Greenhouse Gas Inventories

For more details on NISA see the report "NISA – NATIONAL INVENTORY SYSTEM AUSTRIA – Implementation Report"[24] 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)[25].

Organisation of 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[26] 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 Conventions needs (EB.AIR/GE.1/2002/7[27] and its supporting addendum). In 2008 the Emission Reporting Guidelines are being revised with a view to being applied already for the 2009 reporting review. The revised Guidelines as amended by the Working Group on Strategies and Review (ECE/EB.AIR/2008/4)[28] have been submitted to the Executive Body at its twenty-sixth session (in December 2008) for adoption.

The Austrian air emission inventory (OLI) covers all pollutants, i.e. air pollutants reported to UNECE and greenhouse gases (GHG) 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 1.1.3).

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, accuracy, consistency, comparability, and completeness (TACCC).

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

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

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

[26] http://www.unece.org/env/lrtap/ExecutiveBody/welcome.html

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

[28] http://www.unece.org/env/documents/2008/EB/EB/ece.eb.air.2008.4.e.pdf

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.

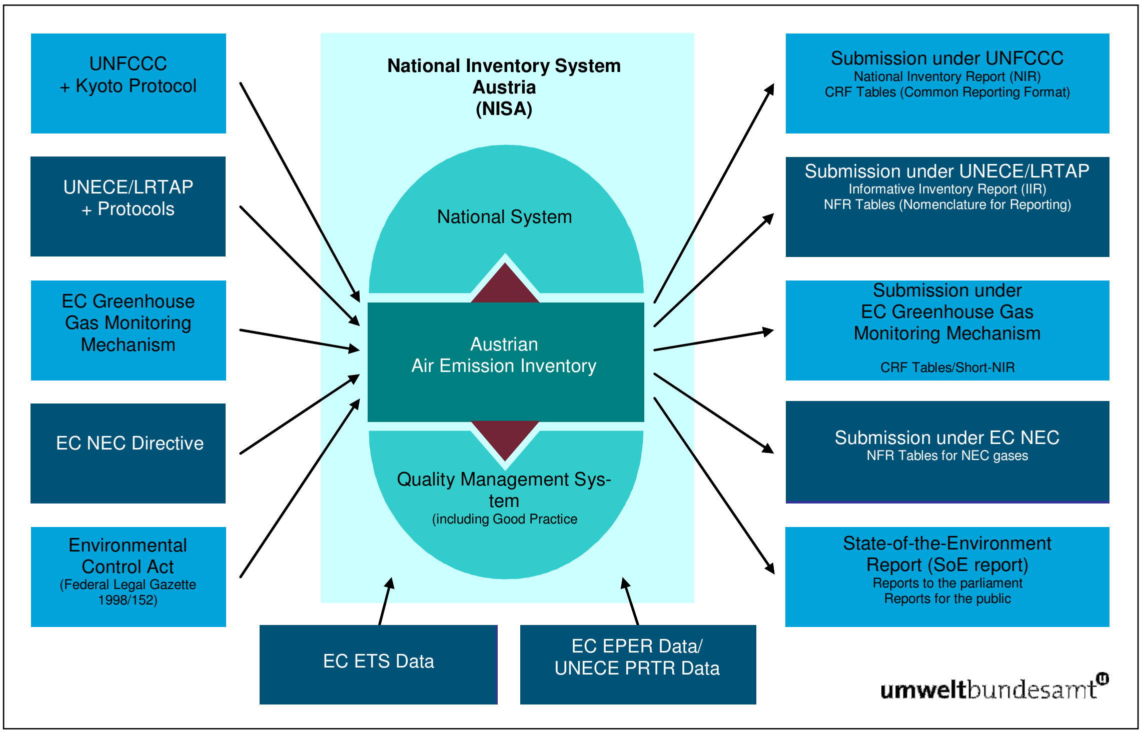

Figure 1: Structure of National Emission Inventory System Austria (NISA).

As illustrated in Figure 1 the Austrian Air Emission Inventory (OLI) 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.

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 2007
2. Particulate matter	PM2.5, PM10, TSP	for 1990, 1995, and for 1999 to 2007
3. Heavy metals	Pb, Cd, Hg, *As, Cr, Cu, Ni, Se, Zn*	from 1985 to 2007
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 1985 to 2007
B. Sector emissions		
1. Main pollutants	SO_x, NO_x, NH_3, NMVOC, CO	from 1980 to 2007
2. Particulate matter	PM2.5, PM10, TSP	for 1990, 1995, and for 1999 to 2007
3. Heavy metals	Pb, Cd, Hg, *As, Cr, Cu, Ni, Se, Zn*	from 1985 to 2007
4. POPs	aldrin, chlordane, chlordecone, DDT, dieldrin, endrin, heptachlor, HCB, mirex, toxaphene, HCH, hexabromobiphenyl, PCBs, PCDD/F, PAHs, SCCP, PCP	from 1985 to 2007

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 km^2 grid		
1. National totals 2. Sector emissions	Main pollutants, PM, Pb, Cd, Hg, PAHs, HCB, dioxins/furans	1990, 1995, 2000, 2005 (PM: 2000)
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 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	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**

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[29]
  - 2006, Technical report No 11/2006[30]
  - 2007, Technical report No 16/2007.[31]
- EEA core set of indicators – Guide, Technical report No 1/2005[32]
- Recommendations for Revised Data Systems for Air Emission Inventories, Topic report No 12/1996[33]
- Guidance Report on preliminary assessment under EC air quality directives, Technical report No 11[34].

Further other internationally applied methodologies and guidelines including:

- Integrated Pollution Prevention and Control (IPPC)[35] and European Pollutant Emission Register (EPER)[36]
- IPPC Best Available Techniques Reference Documents[37]
- Guidelines for Emission Inventory Reporting from the Large Combustion Plant Directive[38]
- Organization for Economic Co-operation and Development (OECD) and Pollution Release and Transfer Register (PRTR) Guidance[39]
- Revised 1996 IPCC[40] Guidelines for National Greenhouse Gas Inventories[41] and the IPCC Good Practice Guidance[42]
- 2000 IPCC Good Practice Guidance (GPG) and Uncertainty Management in National Greenhouse Gas Inventories
- 2006 IPCC Guidelines for National Greenhouse Gas Inventories[43].

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

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

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

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

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

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

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

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

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

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

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

[40] Intergovernmental Panel on Climate Change

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

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

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

1.2 Inventory Preparation Process

The present Austrian Air Pollutant Inventory (OLI) for the period 1980 to 2007 was compiled according to the recommendations for inventories as set out by the UNECE Executive Body[44] and in the guidelines mentioned above.

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

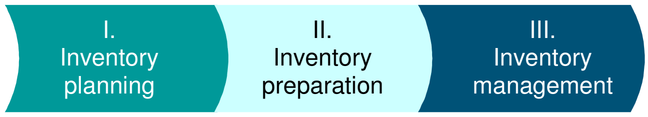

Figure 2: Three stages of inventory preparation.

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 emission reduction limits that are hard to meet. A tool to prioritize between sectors within the inventory is the Key Category 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[45] systematic, which was formerly also used as reporting format under the UNECE. This nomenclature was designed by the ETC/ACC[46] to estimate emissions of all kind of air pollutants as well as greenhouse gases.

The CORINAIR system's nomenclature is called SNAP[47], 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.

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

[45] 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)

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

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

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[48] 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.

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.

[48] **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

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

Sector	Data Sources for Activity Data	Emission Calculation
Energy	• energy balance[49] from STATISTIK AUSTRIA[50] • EU-ETS[51] • steam boiler data base[52] administrated by UMWELTBUNDESAMT • data from industry[53] • national studies	Umweltbundesamt, plant operators
Industry	• national production statistics from STATISTIK AUSTRIA • import/export statistics from STATISTIK AUSTRIA • EU-ETS[51] • 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)[54]
Agriculture	• national agricultural statistics „Grüner Bericht"[55] from STATISTIK AUSTRIA • national report on water protection „Gewässerschutzbe-richt" from LEBENSMINISTERIUM[56] • 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 UMWELTBUN-DESAMT • national report on water protection „Gewässerschutz bericht" from LEBENSMINISTERIUM[56]	Umweltbundesamt

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

[50] 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

[51] European Union Greenhouse Gas Emission Trading Scheme

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

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

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

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

[56] 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*[57], 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[58], „Bundeslastverteiler" and STATISTIK AUSTRIA. Their methodology follows the International Energy Agency (IEA)[59] and Eurostat[60] 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[61] classification.
- Activity data for some sources is obtained from STATISTIK AUSTRIA which provides statistics on production data[62]. 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 are calculated on the basis of these data.

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[57] www.statistik.at

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

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

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

[61] Classification of Economic Activities in the European Community

[62] "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.

- 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)[63], the scope is to provide information to the public[64].

  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.

  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[65]. 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).*

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

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

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

- 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).

  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 Category Analysis

The identification of key categories is described in the "Good Practice Guidance for LRTAP Emission Inventories" (see Part B of the EMEP/CORINAIR Emission Inventory Guidebook, 3rd edition) and IPCC Good Practice Guidance (IPCC-GPG, 2000), Chapter 7. It stipulates that a key category is one that is prioritised within the National System because its estimate has a significant influence on a country's total inventory of air emission inventory in terms of the absolute level of emissions, the trend in emissions, or both.

As stated in the "Good Practice Guidance for LRTAP Emission Inventories", the choice of parameter which is considered as 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. All notations, descriptions of identification and results for key categories included in this chapter are based on the Good Practice Guidance.

The identification includes all NFR categories and all reported gases

- SO_2, NO_x, NMVOC, NH_3
- CO
- PM: TSP, PM10, PM2.5
- HM: Cd, Hg, Pb
- POP: PAH, PCDD/F, HCB.

The presented key category analysis was performed by the Umweltbundesamt with data for air emissions of the submission 2009 to the UNECE/LRTAP and comprises for

- NEC gases a level assessment for all years between 1990 and 2007 and a trend assessment for the trend of the year 1991 to 2007 with respect to the emissions of 1990.
- CO, PM, HM and POP a level assessment for all years between 1990 and 2007.

Identification of Source Categories

This is an important step in terms of correlation of input data, which could otherwise falsify results of a key category 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 category 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.

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 and 1 A 2 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	1 A 2 a	Iron and Steel
				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 & Tobacco
				1 A 2 f 2	Other Stationary in Industry
			Mobile sources	1 A 2 f 1	Other mobile in industry
	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 Pipeline compressors			
	1 A 4 a Other Sectors – Commercial/Institutional		Stationary sources	Liquid Fuels	Biomass
				Solid Fuels	Other
				Gaseous Fuels	
	1 A 4 b Other Sectors – Residential		Stationary sources	Liquid Fuels	Biomass
				Solid Fuels	Other
				Gaseous Fuels	
			Mobile sources	Household and gardening (mobile)	
	1 A 4 c Other Sectors – Agriculture/Forestry/ Fishing		Stationary sources	Liquid Fuels	Biomass
				Solid Fuels	Other
				Gaseous Fuels	
			Mobile sources	Off-road Vehicles and Other Machinery	
				National Fishing	
	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.

2 A	MINERAL PRODUCTS
2 B	CHEMICAL INDUSTRY
2 C	METAL PRODUCTION
2 D	OTHER PRODUCTION
2 G	Other production, consumption, storage, transp. or handling of bulk products

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.

4 B 1	Cattle	4 B 8	Swine
4 B 2	Buffalo	4 B 9	Poultry
4 B 3	Sheep	4 B-13	Other
4 B 4	Goats	4 C	Rice cultivation
4 B 5	Camels and Llamas	4 D	Agricultural soils
4 B 6	Horses	4 F	Field burning of agricultural residues
4 B 7	Mules and Asses	4 G	Other

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.

Table 6: Key sources for the year 2007.

Key Category 2007		**SO_2**	**NO_x**	**NMVOC**	**NH_3**
			[%]		
1 A 1 a	Public Electricity and Heat Production	10.70	4.48		0.41
1 A 1 b	Petroleum refining	12.64	1.39		
1 A 1 c	Manufacture of Solid fuels and Other Energy Industries		0.77		
1 A 2 a	Iron and Steel	21.85	2.32		
1 A 2 b	Non-ferrous Metals				
1 A 2 c	Chemicals	3.10	0.67		
1 A 2 d	Pulp, Paper and Print	4.58	2.25		
1 A 2 e	Food Processing, Beverages and Tobacco	1.40	0.41		
1 A 2 f 1	Stat. Combustion in Manuf. Ind. and Constr.: OTHER		2.93		
1 A 2 f 2	Mobile Combustion in Manuf. Ind. and Constr.: OTHER	12.30	5.98		0.49
1 A 3 b 1	R.T., Passenger cars	0.25	18.67	5.20	2.91
1 A 3 b 2	R.T., Light duty vehicles	0.04	2.84	0.37	0.08
1 A 3 b 3	R.T., Heavy duty vehicles	0.22	40.56	2.74	
1 A 3 b 4	R.T., Mopeds & Motorcycles			1.00	
1 A 3 b 5	R.T., Gasoline evaporation			1.76	
1 A 3 b 7	R.T., Automobile road abrasion				
1 A 3 c	Railways		0.61		
1 A 3 e	Pipeline compressors		0.55		
1 A 4 a biomass				0.83	
1 A 4 a gaseous			0.33		
1 A 4 a liquid		1.26	0.18		
1 A 4 a solid		1.31			
1 A 4 a other					
1 A 4 b 2	Residential: Household and gardening (mobile)			1.44	
1 A 4 b biomass		2.86	3.22	16.84	0.04
1 A 4 b liquid		10.05	1.03	0.03	

Key Category 2007		**SO_2**	**NO_x**	**NMVOC**	**NH_3**
			[%]		
1 A 4 b solid		8.62	0.19		
1 A 4 c liquid		0.33	0.05		
1 A 4 c 2	Agriculture/Forestry/Fishing: Off-road Vehicles and Other Machinery	0.02	4.16	1.89	
1 A 4 c biomass				1.55	
1 B	FUGITIVE EMISSIONS FROM FUELS	0.71		1.52	
2 A	MINERAL PRODUCTS				
2 B	CHEMICAL INDUSTRY	2.99	0.15	0.74	0.11
2 C	METAL PRODUCTION	1.79			
2 D	OTHER PRODUCTION		0.57	1.71	
3 A 1	Decorative coating application			6.79	
3 A 2	Industrial coating application			9.47	
3 B 1	Degreasing			7.65	
3 C	3 C Chemical products			0.31	
3 D 1	Printing			4.91	
3 D 2	Domestic solvent use including fungicides			4.75	
3 D 3	Other product use			13.51	
4 B 1	Cattle			10.51	55.37
4 B 3	Sheep				1.35
4 B 4	Goats				0.23
4 B 6	Horses				1.10
4 B 8	Swine				14.50
4 B 9	Poultry				7.81
4 D	AGRICULTURAL SOILS		2.38	0.94	12.26
4 G	Agriculture OTHER				
6 A	SOLID WASTE DISPOSAL ON LAND				
6 C	WASTE INCINERATION				
6 D	OTHER WASTE				1.63

Key Category 2007		CO	Cd	Hg	Pb	PAH	Diox	HCB	TSP	PM10	PM2.5
						[%]					
1 A 1 a	Public Electricity and Heat Production		8.64	17.86	10.37		1.84		1.52	2.39	3.83
1 A 1 b	Petroleum refining		14.90		1.68						0.35
1 A 1 c	Manufacture of Solid fuels and Other Energy Industries										0.33
1 A 2 a	Iron and Steel	18.06									0.19
1 A 2 b	Non-ferrous Metals				6.86		4.63	2.15			
1 A 2 c	Chemicals		2.10	1.42	4.52		1.96		0.87	1.36	2.16
1 A 2 d	Pulp, Paper and Print		6.96	6.39	4.93		1.32			0.60	0.93
1 A 2 e	Food Processing, Beverages and Tobacco										0.19
1 A 2 f 1	Stat. Combustion in Manuf. Ind. and Constr.: OTHER	2.16	7.53	19.00	5.88	0.81	4.76		3.34	4.05	5.20
1 A 2 f 2	Mobile Combustion in Manuf. Ind. and Constr.: OTHER	0.84							0.63	1.09	2.09
1 A 3 b 1	R.T., Passenger cars	21.95				7.09			2.58	4.46	8.49
1 A 3 b 2	R.T., Light duty vehicles	1.12				1.72			0.59	1.02	1.94
1 A 3 b 3	R.T., Heavy duty vehicles	2.12				8.05	1.43		2.43	4.20	8.00
1 A 3 b 4	R.T., Mopeds & Motorcycles	2.79									
1 A 3 b 5	R.T., Gasoline evaporation										
1 A 3 b 7	R.T., Automobile road abrasion		7.53						14.18	8.17	4.67
1 A 3 c	Railways								2.16	1.33	0.93
1 A 3 e	Pipeline compressors										
1 A 4 a biomass		1.30	3.29		1.87	1.40	3.85	2.44		0.59	0.99
1 A 4 a gaseous											
1 A 4 a liquid											
1 A 4 a solid											0.10
1 A 4 a other							0.92				0.29
1 A 4 b 2	Residential: Household and gardening (mobile)	2.25									0.19
1 A 4 b biomass		32.45	19.22	11.99	11.78	63.06	57.03	67.12	9.60	14.94	25.31
1 A 4 b liquid										0.34	0.57
1 A 4 b solid		2.41	1.50	4.47	2.48	3.21	4.65	5.90	0.68	1.06	1.80
1 A 4 c liquid											

Key Category 2007		CO	Cd	Hg	Pb	PAH	Diox	HCB	TSP	PM10	PM2.5
						[%]					
1 A 4 c 2	Agriculture/Forestry/Fishing: Off-road Vehicles and Other Machinery	2.02							2.49	3.70	6.37
1 A 4 c biomass		2.98	5.10	1.60		6.35	5.79	9.74	0.96	1.49	
1 B	FUGITIVE EMISSIONS FROM FUELS								0.71	0.58	0.35
2 A	MINERAL PRODUCTS	1.27							33.85		6.37
2 B	CHEMICAL INDUSTRY	1.45								0.53	0.53
2 C	METAL PRODUCTION			31.19	45.65	1.98	8.22	8.51	1.07	1.30	1.11
2 D	OTHER PRODUCTION								1.39	0.96	0.73
3 A 1	Decorative coating application										
3 A 2	Industrial coating application										
3 B 1	Degreasing										
3 C	3 C Chemical products										
3 D 1	Printing										
3 D 2	Domestic solvent use including fungicides										
3 D 3	Other product use								0.59	1.02	1.95
4 B 1	Cattle										
4 B 3	Sheep										
4 B 4	Goats										
4 B 6	Horses										
4 B 8	Swine										
4 B 9	Poultry										
4 D	AGRICULTURAL SOILS								14.86	11.56	4.91
4 F	FIELD BURNING OF AGRICULTURAL RESIDUES					2.10					0.59
4 G	Agriculture OTHER								1.28	1.00	0.42
6 A	SOLID WASTE DISPOSAL ON LAND	0.76									0.14
6 C	WASTE INCINERATION			1.95							
6 D	OTHER WASTE										

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*[66]. 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[67].

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. The Umweltbundesamt is an ISO 17020 accredited inspection body for Greenhouse Gas Inventories (Id. No. 241) in accordance with the Austrian Accreditation Law (AkkG)[68] by decree of the Minister of Economics and Labour (BMWA), issued on 19.01.2006, valid from 23.12.2005.[69] The requirements of EN ISO/IEC 17020 (Type A)[70] are fulfilled.[71/72]

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).

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

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

[68] 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

[69] http://www.bmwfj.gv.at/NR/rdonlyres/2EA99992-D224-45CC-90DB-6832B132D4BA/0/akkrd.pdf

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

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

[72] For more information see Austria's National Inventory Report 2009 – Submission under the UNFCCC

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

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.[72]

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[73]	**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

[73] 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.[74]

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)[75] 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.

[74] 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

[75] 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.[76] Twenty-three UNECE 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 23 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 344 Gg, by the year 1993 emissions were reduced to 53 Gg corresponding to a reduction of 84%. In 2007, SO_2 emissions in Austria amounted to 26 Gg, which is a decrease by 93% 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).[77] This Protocol requires as a first step, to freeze emissions of nitrogen oxides or their transboundary fluxes. The general reference year is 1987[78].

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 32 Parties to the 1988 NO_x Protocol have reached the target and stabilized emissions at 1987[79] levels or reduced emissions below that level according to the latest emission data reported.

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

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

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

[79] 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 205 Gg, by the year 1995 emissions were reduced to 179 Gg corresponding to a reduction of 9%. In 2007, NO_x emissions in Austria amounted to 220 Gg, which is an increase by 8% compared to 1987.[80]

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.[81]

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;[82]

(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;[83]

(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.[84]

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[80] 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 2007 based on fuel used amount to 163 Gg (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 A-15 in the Annex). With the emissions calculated based on fuel used Austria is fulfilling the stabilisation target of the protocol in the year 2007.

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

[82] 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

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

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

Austria met the reduction target: in the base year NMVOC emissions amounted to 344 Gg, in 1999 emissions were reduced by 42% to 171 Gg. From 1999 to 2004 a further reduction took place but since 2005 a slight increase can be noted (180 Gg in 2007).

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).[85] 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).

[85] 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

National total emissions and trends (1990–2007) as well as emission targets[86] for air pollutants covered by the Multi-Effect Protocol are shown in Table 11. Please note that emissions from mobile sources are calculated based on fuel sold in Austria, thus national total emissions include 'fuel export'.[87]

Table 11: National total emissions and trends 1990–2007 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	74.34	192.51	273.64	71.18	1.432.55
1991	71.44	202.28	265.27	73.74	1.503.17
1992	55.05	191.32	239.71	72.19	1.470.16
1993	53.41	185.52	239.85	72.93	1.437.57
1994	47.80	179.03	221.99	74.13	1.367.99
1995	47.41	179.18	222.01	75.46	1.256.93
1996	44.66	201.17	213.83	73.22	1.236.32
1997	40.19	189.30	199.69	72.99	1.144.48
1998	35.62	204.30	184.45	73.10	1.100.15
1999	33.86	196.66	171.11	71.23	1.026.79
2000	31.64	204.45	176.04	69.25	955.27
2001	32.79	215.01	180.31	68.90	947.28
2002	31.69	225.27	185.38	67.76	931.18
2003	32.63	236.85	188.77	67.42	953.92
2004	27.58	235.96	170.50	66.64	912.32
2005	27.19	239.62	178.71	66.11	869.75
2006	28.94	227.46	186.70	66.01	838.79
2007	25.60	220.10	179.81	66.41	768.99
Trend 1990–2007	**-66%**	**14%**	**-34%**	**-7%**	**-46%**
Absolute Emission Target 2010	**39.00**	**107.00**	**159.00**	**66.00**	**–**

[86] 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).

[87] 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 A-15 of the Annex. For NO_x the emissions calculated based on fuel used are by 57,5 Gg lower in 2007 and show a 9% decrease from 1990 to 2007.

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 2007 emissions were reduced by 66% mainly due to lower emissions from residential heating, combustion in industries and in energy industries.

As shown in Table 12, the main source for SO_2 emissions in Austria, with a share of 94% in 1990 and 94% in 2007, is Category *1 A Fuel Combustion Activities*. Within this source, the iron and steel industry as well as the residential heating are the highest contributors to total SO_2 emissions.

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 (Table 11). In 2007, Austrian total SO_2 emissions (26 Gg) were well below the ceiling.

Table 12: SO_2 emissions per NFR Category 1990 and 2007, their trend 1990–2007 and their share in total emissions.

NFR Category		**SO_2 Emissions [Gg]**		***Trend***	***Share in National Total***	
		1990	**2007**	***1990–2007***	***1990***	***2007***
1	Energy	72.05	24.31	-66%	97%	95%
1 A	Fuel Combustion Activities	70.05	24.13	-66%	94%	94%
1 A 1	Energy Industries	14.04	5.97	-57%	19%	23%
1 A 2	Manufacturing Industries and Construction	17.89	11.17	-38%	24%	44%
1 A 3	Transport	5.16	0.31	-94%	7%	1%
1 A 4	Other Sectors	32.95	6.66	-80%	44%	26%
1 A 5	Other	0.01	0.01	12%	<1%	<1%
1 B	Fugitive Emissions from Fuels	2.00	0.18	-91%	3%	1%
2	Industrial Processes	2.22	1.22	-45%	3%	5%
2 A	Mineral Products	NA	NA			
2 B	Chemical Industry	1.56	0.77	-51%	2%	3%
2 C	Metal Production	0.66	0.46	-30%	1%	2%
2 D	Other Production	NA	NA			
3	Solvent and Other Product Use	NA	NA			
4	Agriculture	0.00	0.00	-15%	<1%	<1%
4 B	Manure Management	NA	NA			
4 D	Agricultural Soils	NA	NA			
4 F	Field Burning of Agricultural Residues	0.00	0.00	-15%	<1%	<1%
4 G	Agriculture Other	NA	NA			
6	Waste	0.07	0.06	-20%	<1%	<1%
	Total Emissions	**74.34**	**25.60**	**-66%**		

SO_2 Emission Trends in Category 1 A Fuel Combustion Activities

SO_2 emissions from NFR Category 1 A Fuel Combustion Activities were reduced over the period from 1990 to 2007: as can be seen in Table 12 in 1990 emissions amounted to 70 Gg. In 2007, they were 66% lower (24 Gg). The share of SO_2 emissions from this category in national total emissions was about 94% in 1990 and 2007. In 2007, within this source, the main sources for SO_2 emissions are:

- NFR 1 A 1 Energy Industries with a contribution of 23%,
- NFR 1 A 2 Manufacturing Industries and Construction: 44%,
- NFR 1 A 3 Transport: 1%,
- NFR 1 A 4 Other Sectors: 26%,

In all subcategories SO_2 emissions have decreased steadily mainly due to:

- a lowering of the sulphur content in mineral oil products and fuels (e.g. Fuel Ordinance[88]),
- a switch-over from high sulfur fuels to low-sulphur fuels or to even sulphur free fuel (e.g. natural gas),
- implementation of desulfurisation units in power plants (e.g. LCP directive[89]),
- abatement techniques like combined flue gas treatment.

SO_2 Emission Trends in NFR Category 1 B Fugitive Emissions

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 3%. In 2007, these emissions contributed 1% to national total SO_2 emissions. SO_2 emissions from NFR Category 1 B decreased by 91% between 1990 and 2007 due to implementation of desulfurisation units.

SO_2 Emission Trend in NFR Category 2 Industrial Processes

SO_2 emissions from NFR Category *2 Industrial Processes* decreased over the period from 1990 to 2007. As can be seen in Table 12, in 1990, emissions amounted to 2.2 Gg, in 2007, they were 45% lower (1.2 Gg).

The share of SO_2 emissions from this category in national total emissions was about 3% in 1990 and about 5% in 2007 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-categories with a contribution in national total of

- 3% NFR 2 B *Chemical Industry* (covers processes in inorganic chemical industries)
- 2% NFR 2 C *Metal Production.*

In both subcategories SO_2 emissions have decreased steadily mainly caused by a decline in production and, on the other hand, abatement techniques such as systems for purification of waste gases and desulfurisation facilities.

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[88] BGBL_II_417-04_Kraftstoffverordnung; Umsetzung der Richtlinie 2003/30/EG

[89] Luftreinhaltegesetzes für Kesselanlagen (LRG-K) BGBl. I Nr. 150/2004 (older version: BGBl. Nr. 380/1988 idF. BGBl. Nr. 185/1993; Umsetzung der Richtlinie 96/61/EG; Richtlinie 96/82/EG, Richtlinie 88/609/EWG, Richtlinie 2001/80/EG, Richtlinie 2002/49/EG

SO_2 Emission Trend in NFR Category 4 Agriculture

Field Burning of Agricultural Waste (NFR 4 F) is the only emission source for SO_2 emissions of the Sector *Agriculture*. In 2007, 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.

SO_2 Emission Trend in NFR Category 6 Waste

NFR Sector 6 C *Waste incineration (non energy-use)* is the only source of SO_2 emissions. In 1990 national SO_2 emissions of the Sector *Waste* amounted to 0.07 Gg; emissions have decreased until 1992 and then show a steady increase until 1998. Since 1999 emissions are stable at a level of 0.06 Gg.

In the year 2007 the *Sector Waste* contributed only less than 1% to Austria's SO_2 emissions.

2.2.2 NO_x Emissions

In 1990, national total NO_x emissions amounted to 193 Gg; emissions were slightly decreasing until the mid-1990 but have increased in the last years: in 2007, they were about 14% 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 2007, are the *Fuel Combustion Activities.* Within this source, *road transport*, with about 64% 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 220 Gg NO_x emissions in 2007, emissions in Austria are at the moment with 106% 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 2007 based on fuel used amount to 163 Gg, which is about 26% less, but still well above the emission ceiling set out in Annex II of the Multi-Effects Protocol.[90,74]

Table 13: NO_x emissions per NFR Category 1990 and 2007, their trend 1990–2007 and their share in total emissions.

NFR Category		NO_x Emissions [Gg]		*Trend*	*Share in National Total*	
		1990	**2007**	***1990–2007***	***1990***	***2007***
1	Energy	181.51	213.07	17%	94%	97%
1 A	Fuel Combustion Activities	181.51	213.07	17%	94%	97%
1 A 1	Energy Industries	17.78	14.60	-18%	9%	7%
1 A 2	Manufacturing Industries and Construction	32.80	32.29	-2%	17%	15%
1 A 3	Transport	103.18	141.50	37%	54%	64%
1 A 4	Other Sectors	27.68	24.60	-11%	14%	11%
1 A 5	Other	0.07	0.09	15%	<1%	<1%
1 B	Fugitive Emissions from Fuels	IE	IE			
2	Industrial Processes	4.80	1.71	-64%	2%	1%
2 A	Mineral Products	NA	NA			
2 B	Chemical Industry	4.07	0.34	-92%	2%	<1%
2 C	Metal Production	0.17	0.11	-33%	<1%	<1%
2 D	Other Production	0.55	1.26	128%	<1%	1%
3	Solvent and Other Product Use	NA	NA			
4	Agriculture	6.09	5.27	-14%	3%	2%
4 B	Manure Management	NA	NA			
4 D	Agricultural Soils	6.06	5.23	-14%	3%	2%
4 F	Field Burning of Agricultural Residues	0.04	0.03	-15%	<1%	<1%
4 G	Agriculture Other	NA	NA			
6	Waste	0.10	0.05	-50%	<1%	<1%
	Total Emissions	**192.51**	**220.10**	**14%**		

[90] 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 A-15 in the Annex.

NO_x Emission Trends in Category 1 A Fuel Combustion Activities

As can be seen in Table 13, NO_x emissions from the Sector 1 A *Fuel Combustion Activities* increased over the period from 1990 to 2007. In 1990, they amounted to 182 Gg. In 2007, they were about 17% above 1990 levels (213 Gg). Even if efforts were made regarding emission control in combustion plants, this was counterbalanced by an enormous increase in activity of the transport sector.

The share of NO_x emissions from this category in national total NO_x emissions amounted to about 94% in 1990 and about 97% in 2007. The main source for NO_x emissions in NFR 1 A are:

- NFR 1 A 1 Energy Industries, with a contribution of 7%,
- NFR 1 A 2 Manufacturing Industries and Construction: 15%,
- NFR 1 A 3 Transport: 64%, of which 62% for road transport,
- NFR 1 A 4 Other Sectors: 11%.

In all subcategories, except NFR 1 A 3, NO_x emissions have decreased steadily mainly caused by

- increased efficiency,
- implementation/installation of denitrification installations (DENOX plant) and/or low-NOx burners,
- introduction of modern fuel technology, gas-fired equipments and furnances.

The trend of emission reduction is counteracted by an increasing use of coke and natural gas for electricity generation and of biomass in district heating plants.
In NFR 1 A 3 *Transport,* the emission reduction measures were the introduction of modern technologies, abatement technologies for gasoline-powered vehicles such as catalysts, switch to more diesel-powered vehicles as well as a regeneration of the vehicle fleet. But in spite of these measures, NO_x emissions have increased by 37% mainly due to the enormous increase in activity of the transport sector in both passenger and freight transport as well as fuel export.

NO_x Emission Trend in NFR Category 2 Industrial Processes

The share of NO_x emissions from this category in national total emissions was about 2% in 1990 and about 1% in 2007 (see Table 13) because of the strong reduction of NO_x emissions in this category but also because the emissions from combustion processes remained quite stable on a high level. There are no key sources within this category.

As shown in Table 13, NO_x emissions from the Category 2 *industrial processes* decreased over the period from 1990 to 2007. In 1990 they amounted to 4.8 Gg, in the year 2007, they were 64% below 1990 levels (1.71 Gg).

The main source for NO_x emissions of NFR Category 2 Industrial Processes is category 2 D *Other Production* (Chipboard Production) with a contribution of about 2% (1990) and 1% (2007) in the national total, due to increasing production. Category 2 B *Chemical Industry* is, with a contribution of about 2%, the second largest source in NFR 2; however, emissions from this category were reduced due to use of low-emission fuels and energy-savings. Category 2 C Metal Production is only a minor source within this sector.

NO_x Emission Trend in NFR Category 4 Agriculture

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 2007, emissions have decreased by 14% and amounted to 5.3 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.

The main source for NO_x emissions of NFR Category 4 Agriculture is NFR category 4 D *Agricultural Soils*, with a contribution of about 3% (1990) and 2% (2007) in national total NO_x emissions. Emissions result from nitrogen inputs into Agricultural soils. Category 4 F *Field burning of agricultural residues* is only a minor source within this sector.

NO_x Emission Trend in NFR Category 6 Waste

The share of NO_x emissions from this category in national total emissions was less than 1% in 1990 as well as in 2007. As shown in the table above, NO_x emissions from the waste sector decreased by about 50% over the period from 1990 to 2007 to 0.05 Gg. Emissions result from Waste Incineration (non-energy use).

2.2.3 NMVOC Emissions

In 1990, national total NMVOC emissions amounted to 274 Gg; emissions have decreased steadily since then and by the year 2007 emissions were reduced by 34%.

As can be seen in Table 14, the main sources of NMVOC emissions in Austria are *Fuel Combustion Activities* with a share of 37% in 2007, and *Solvent and Other Product Use* with a contribution to the national total of 58% in 2007.

NMVOC emissions decreased considerably in both main categories: 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 2007 Austria's NMVOC emissions amounted to 180 Gg, and thus Austria is 13% above its target.

Table 14: NMVOC emissions per NFR Category 1990 and 2007, their trend 1990–2007 and their share in total emissions.

NFR Category		NO_x Emissions [Gg]		*Trend*	*Share in National Total*	
		1990	**2007**	***1990–2007***	***1990***	***2007***
1	Energy	146.10	68.93	-53%	53%	38%
1 A	Fuel Combustion Activities	133.89	66.19	-51%	49%	37%
1 A 1	Energy Industries	0.42	0.68	60%	<1%	<1%
1 A 2	Manufacturing Industries and Construction	1.73	2.19	26%	1%	1%
1 A 3	Transport	70.44	21.06	-70%	26%	12%
1 A 4	Other Sectors	61.28	42.24	-31%	22%	23%
1 A 5	Other	0.02	0.02	8%	<1%	<1%
1 B	Fugitive Emissions from Fuels	12.22	2.74	-78%	4%	2%
2	Industrial Processes	11.10	4.90	-56%	4%	3%
2 A	Mineral Products	IE	IE			
2 B	Chemical Industry	8.29	1.32	-84%	3%	1%
2 C	Metal Production	0.52	0.49	-5%	<1%	<1%
2 D	Other Production	2.29	3.08	34%	1%	2%
3	Solvent and Other Product Use	114.43	104.09	-9%	42%	58%
3 A	Paint Application	45.79	29.22	-36%	17%	16%
3 B	Degreasing and Dry Cleaning	13.70	14.30	4%	5%	8%
3 C	Chemical Products	12.79	8.83	-31%	5%	5%
3 D	Other including Products Containing HMs and POPs	42.15	51.74	23%	15%	29%
4	Agriculture	1.85	1.81	-2%	1%	1%
4 B	Manure Management	NA	NA			
4 D	Agricultural Soils	1.72	1.70	-1%	1%	1%
4 F	Field Burning of Agricultural Residues	0.14	0.11	-17%	<1%	<1%
4 G	Agriculture Other	NA	NA			
6	Waste	0.16	0.08	-50%	<1%	<1%
	Total Emissions	**273.64**	**179.81**	**-34%**		

NMVOC Emission Trends in NFR Category 1 A Fuel Combustion Activities

In 2007, NFR Category *1 A* was the second largest category regarding NMVOC emissions in Austria. In 1990 the contribution to national total emissions was 49% (134 Gg), compared to 37% (66 Gg) in 2007 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 NFR 1 A are continuously decreasing: in the period from 1990 to 2007 emissions decreased by 34%, mainly due to decreasing emissions from NFR *1 A 3 Transport* and NFR *1 A 4 Other Sectors*.

NMVOC Emission Trends 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%, in the year 2007 it was 2%. Fugitive NMVOC emissions decreased: in 2007, they were 78% below 1990 levels.

NMVOC Emission Trend in NFR Category 2 Industrial Processes

NFR category *2 Industrial processes* is the third largest category regarding NMVOC emissions. In 1990, the contribution to national total emissions was 4% (11.1 Gg) compared to 3% (4.9 Gg). In 2007 due to abatement techniques but also because of decreasing emissions from other categories such as NFR *3 Solvents* or NFR *1 Energy*.

The trend regarding NMVOC emissions from NFR *2 Industrial Processes* shows decreasing emissions: in the period from 1990 to 2007 emissions decreased by 56%, mainly due to decreasing emissions from NFR *2 B Chemical Industry*, which was with a share of 75% in category NFR 2 the main contributor to NMVOC emissions from industrial processes in 1990. The decrease took place primarily from 1993 to 2000, since then the emissions remained quite stable. In 2007, within this source, NFR 2 B has a contribution of 27% in NFR 2.

In 2007, within NFR 2 Industrial Processes, the main sources for NMVOC emissions are:

- NFR 2 C *Metal production,* with a contribution of 10%,
- NFR 2 D *Other* production: 63%,
  - NFR 2 D 1 Pulp and Paper: 19%,
  - NFR 2 D 2 Food and Drink: 14%.
- In both sub-categories, NMVOC emissions increased; in NFR 2 D 1 *Pulp and Paper* by 128%, in 2 D 2 *Food and Drink* by 14% (1990–2007). 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 14 NMVOC emissions of NFR 2 A and NFR 2 B 1 are included 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.

NMVOC Emission Trend in NFR Category 3 Solvent asn Other Product Use

NFR Category 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 42% (114 Gg) compared to 58% (104 Gg) in 2007 due to decreasing emissions from other categories 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 2007 emissions decreased by 9%, mainly due to decreasing emissions from NFR 3 *A Paint Application*. This reduction was primarily achieved from 1990 to 2000 due to various legal and regulatory enforcements.[91]

- NMVOC emissions from NFR *3 A Paint Applications,* which had a share of 28% in NFR 3, 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 and for domestic use (except do-it-yourself). NMVOC emissions decreased by 20% to about 12 Gg in the period 1990–2007 due the reduction of solvents in paint as well as due to substitution of solvent-based paint for paint with less or without solvents,
  - NFR 3 A 2 *Industrial Paint Application,* which covers processes such as car repairing, coil coating, wood conditioning and other industrial paint applications. The NMVOC emissions decreased by 44% to about 17 Gg in the period 1990-2007, but the reduction in emissions occured mainly from 1990 to 1999 due to different enforced laws and regulations various legal and regulatory enforcements anddue to a reduction of solvents in paint as well as due to substitution solvent-based paint for paint with less or without solvents. Since then the emissions remained almost stable.
- NMVOC emissions from sub sector *3 B Degreasing and Dry Cleaning,* which had a share of 13% in NFR 3, arose in 2007 from the following sub categories:
  - NFR 3 B 1 Degreasing, where the emissions increased by 4% to about 14 Gg,
  - NFR 3 B 2 Dry Cleaning, where the emissions increased by 26% to 0.6 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 abatement measures,
- The share of NMVOC emissions from sub sector NFR 3 C *Chemical Products* in national total emissions was about 5% in 1990 and also 2007, whereas an emission reduction of 31% 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 category NFR 3 is about 37% in 1990 and about 50% in 2007, which represents an increase of 23%. In 2007, sub sector *3 D* caused the following emissions:
  - NFR *3 D 1 Printing* with a share of 8% in NFR 3 and an emission reduction of 33% (8.6 Gg);
  - *NFR 3 D 2 Domestic solvent use including fungicides* with a share of about 23% in NFR 3 and an emission increase of 109% (24.3 Gg);
  - *NFR 3 D 3 Other product use* with a share of 6% in NFR 3 and an emission increase of 18% (18.9 Gg).

[91] see chapter 6.1

- 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 2 is due to a considerable increase of do-it-yourself activities.

NMVOC Emission Trend in NFR Category 4 Agriculture

In 2007 NMVOC emissions of category *Agriculture* only contributed 1.0% (1.8 Gg) to the Austrian total NMVOC emissions. From 1990 to 2007 NMVOC from agricultural vegetation – mainly sector *Agricultural Soils* (NFR 4 D) – decreased only by 2% due to an increased harvest of agricultural crops.

NMVOC Emission Trend in NFR Category 6 Waste

In 2007, NMVOC emissions from category *Waste* contributed less than 0.1% (0.08 Gg) to Austria's total NMVOC emissions. From 1990 to 2007 NMVOC from NFR Sector 6 *Waste* decreased by 50%.

In 2007, 96% of the NMVOC emissions from the Sector W*aste* arose from NFR Sector 6 A *Solid Waste Disposal on Land*.

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 2007. In 2007, 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 2007. Within this source manure management – cattle has the highest contribution to national total NH_3 emissions: the share in national total emissions of manure management of cattle was 55% in 2007.

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 2007, Austria's total NH_3 emissions (66 Gg) were just above this ceiling.

Table 15: NH_3 emissions per NFR Category 1990 and 2007, their trend 1990–2007 and their share in total emissions.

NFR Category		NH_3 Emissions [Gg]		*Trend*	*Share in National Total*	
		1990	**2007**	***1990–2007***	***1990***	***2007***
1	Energy	4.40	3.59	-19%	6%	5%
1 A	Fuel Combustion Activities	4.40	3.59	-19%	6%	5%
1 A 1	Energy Industries	0.20	0.38	85%	<1%	1%
1 A 2	Manufacturing Industries and Construction	0.33	0.50	50%	<1%	1%
1 A 3	Transport	3.24	2.06	-36%	5%	3%
1 A 4	Other Sectors	0.63	0.65	3%	1%	1%
1 A 5	Other	0.00	0.00	13%	<1%	<1%
1 B	Fugitive Emissions from Fuels	IE	IE			
2	Industrial Processes	0.27	0.08	-71%	<1%	<1%
2 A	Mineral Products	NA	NA			
2 B	Chemical Industry	0.27	0.08	-72%	<1%	<1%
2 C	Metal Production	IE	IE			
2 D	Other Production	NA	NA			
3	Solvent and Other Product Use	NA	NA			
4	Agriculture	66.13	61.66	-7%	93%	93%
4 B	Manure Management	58.00	53.47	-8%	81%	81%
4 D	Agricultural Soils	8.08	8.14	1%	11%	12%
4 F	Field Burning of Agricultural Residues	0.05	0.04	-15%	<1%	<1%
4 G	Agriculture Other	NA	NA			
6	Waste	0.38	1.09	187%	1%	2%
	Total Emissions	**71.18**	**66.41**	**-7%**		

NH_3 Emission Trends in NFR Category 1 A Fuel Combustion Activities

NH_3 emissions from NFR *1 A* is the second largest category regarding NH_3 emissions but this category is only a minor source of NH_3 emissions with a contribution to national total NH_3 emissions of 5% in 2007. NH_3 emissions from NFR *1* A are decreasing: in 1990, emissions amounted to about 4.4 Gg. In the year 2007, they were about 19% lower than 1990 levels and amounted to about 3.6 Gg.

NH_3 Emission Trend in NFR Category 2 Industrial Processes

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 2007 respectively.

The trend concerning NH_3 emissions from NFR 2 *Industrial Processes* is generally decreasing: in the period from 1990 to 2007 emissions decreased by 71% from 0.27 Gg in 1990 to 0.08 Gg (see Table 15). Extensive abatement techniques are the reasons for the emission reduction.

NH_3 emissions of NFR 2 C are included in NFR 1 A 2 a.

NH_3 Emission Trend in NFR Category 4 Agriculture

In 1990 national NH_3 emissions from the Sector *Agriculture* amounted to 66 Gg; emissions have decreased since then and by the year 2007 emissions were reduced by 7% to 62 Gg mainly due to reduced dairy cattle rearing (see Table 15). In 1990 and 2007 the category *Agriculture* contributed 93% to Austria's NH_3 emissions. Within this category:

- *Manure Management* (NFR 4 B), with a share of 81%, has the highest contribution to national total NH_3 emissions in 2007. The agricultural NH_3 emissions result from animal husbandry, the storage of manure as well as the application of organic manure. The decreasing or increasing emissions are mainly due to declining or increasing lifestook.
  - NFR *4 B 1* *Cattle:* share of 60% in NFR 4 and an emission reduction of 9% (37.8 Gg);
  - NFR *4 B 8* *Swine:* share of 16% in NFR 4 and an emission reduction of 9% (9.6 Gg);
  - NFR *4 B 9* *Poultry:* share of 8% in NFR 4 and an emissions reduction of 5% (5.2 Gg);
  - All other categories, NFR *4 B 3 Sheep,* NFR *4 B 4 Goats,* NFR *4 B 6 Horses,* NFR *4 B 13 Other, have together* a share of 3% in NFR 4.
- *Agricultural Soils* (NFR 4 D) has a share of 12% in national total NH_3 emissions in 2007. 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.
  - 4 D 1 *Direct Soil Emissions*: share of 7% in NFR 4 and an emissions increase of 14% (4.3 Gg);
  - 4 D 2 *Soil operations*: share of 6% in NFR 4 and an emissions reduction of 11% (3.8 Gg);
- *Field burning of agricultural residues* (NFR 4 F): NH_3 emissions are negligible low (0.1% to total NH_3 emissions in 2007).

NH_3 Emission Trend in NFR Category 6 Waste

In 1990 national NH_3 emissions of the Sector *Waste* amounted to about 0.4 Gg; emissions increased by about 187% to 1.1 Gg in 2007 mainly due to increasing mechanical biological treatment of waste and collection of bio-waste, lopping, etc. In the year 2007 the Sector W*aste* contributed 2% to Austria's NH_3 emissions.

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 1 433 Gg; emissions have considerably decreased over the period from 1990 to 2007. In 2007, 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 2007. Emissions decreased mainly due to decreasing emissions from road transport and residential heating, which is due to the switch-over to improved technologies.

Table 16: CO emissions per NFR Category 1990 and 2007, their trend 1990–2007 and their share in total emissions.

NFR Category		**NO_x Emissions [Gg]**		***Trend***	***Share in National Total***	
		1990	**2007**	***1990–2007***	***1990***	***2007***
1	Energy	1 373.56	737.36	-46%	96%	96%
1 A	Fuel Combustion Activities	1 373.56	737.36	-46%	96%	96%
1 A 1	Energy Industries	6.10	4.38	-28%	<1%	1%
1 A 2	Manufacturing Industries and Construction	230.67	166.12	-28%	16%	22%
1 A 3	Transport	654.36	222.05	-66%	46%	29%
1 A 4	Other Sectors	482.22	344.54	-29%	34%	45%
1 A 5	Other	0.22	0.27	22%	<1%	<1%
1 B	Fugitive Emissions from Fuels	IE	IE			
2	Industrial Processes	46.37	24.70	-47%	3%	3%
2 A	Mineral Products	9.78	9.78	0%	1%	1%
2 B	Chemical Industry	12.67	11.15	-12%	1%	1%
2 C	Metal Production	23.52	2.85	-88%	2%	<1%
2 D	Other Production	0.40	0.91	128%	<1%	<1%
3	Solvent and Other Product Use	NA	NA			
4	Agriculture	1.25	1.07	-15%	<1%	<1%
4 B	Manure Management	NA	NA			
4 D	Agricultural Soils	NA	NA			
4 F	Field Burning of Agricultural Residues	1.25	1.07	-15%	<1%	<1%
4 G	Agriculture Other	NA	NA			
6	Waste	11.37	5.86	-48%	1%	1%
	Total Emissions	**1 432.55**	**768.99**	**-46%**		

CO Emission Trends in Category 1 A Fuel Combustion Activities

NFR 1 A Fuel Combustion Activities is the largest category regarding CO emissions. As can be seen in Table 16, CO emissions from Fuel Combustion Activities decreased by 46% over the period 1990–2007. CO emissions amounted to about 1 374 Gg in 1990 and to about 737 Gg in 2007. Within this source, the main sources of CO emissions are in 2007:

- NFR 1 A 2 Manufacturing Industries and Construction, with a contribution of 22%,
- NFR 1 A 3 Transport: 29%, here especially road transport (62%),
- NFR 1 A 4 Other Sectors: 45%,
- NFR 1 A 1 Energy Industries and 1 A 5 Other: 1%.

In the period 1990–2007, the share of CO emissions from this category in national total emissions has been stable in spite of growing activites because of considerable efforts regarding abatement techniques and improved combustion efficiency in all sub-sectors. The emission reduction is mainly possible due to optimised combustion technology and introduction of catalyst (transport sector).

CO Emission Trend in NFR Category 2 Industrial Processes

The share of CO emissions from this category in national total emissions was about 3% in 1990 and about 3% in 2007 (see Table 16) because of the strong reduction measures for CO emissions in this category but also because the emissions from combustion processes remained on a relatively high level.

As it can be seen in Table 16, CO emissions from the *industrial processes sector* decreased over the period from 1990 to 2007. In 1990, they amounted to 46 Gg. In the year 2007, they were 47% below 1990 levels (25 Gg). Whereas in 1990, NFR *2 C Metal Production* was with a contribution of 51% the main source within NFR 2 *industrial processes,* emissions from this sector were reduced due to abatement techniques. In 2007, NFR *2 C Metal Production* had a share of 12% in NFR 2.

In 2007, within this source the main sources for CO emissions were:

- NFR 2 A *Mineral Products,* with a contribution of 40% ,
- NFR 2 B Chemical Industry: 45% ,
- NFR 2 C Metal Production: 12% .

Extensive technical abatement techniques as well as energy-saving technology are reasons for the emission reduction.

CO Emission Trend in NFR Category 4 Agriculture

Field Burning of Agricultural Waste (NFR 4 F) is the only emission source for CO emissions of the Sector *Agriculture*. In 2007, emissions only contribute less than 0.1% (1.1 Gg) to national total emissions. Emissions vary on a very small scale with the area of stubble fields burnt each year.

CO Emission Trend in NFR Category 6 Waste

In 2007, CO emissions of category *Waste* only contributeed about 1% (5.9 Gg) to the Austrian total CO emissions. From 1990 to 2007, CO emissions from NFR Sector 6 *WASTE* decreased by about 46%.

In 2007, within this source, NFR Sector 6 A *Managed Waste Disposal* has a share of 99.8% in total CO emissions.

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.

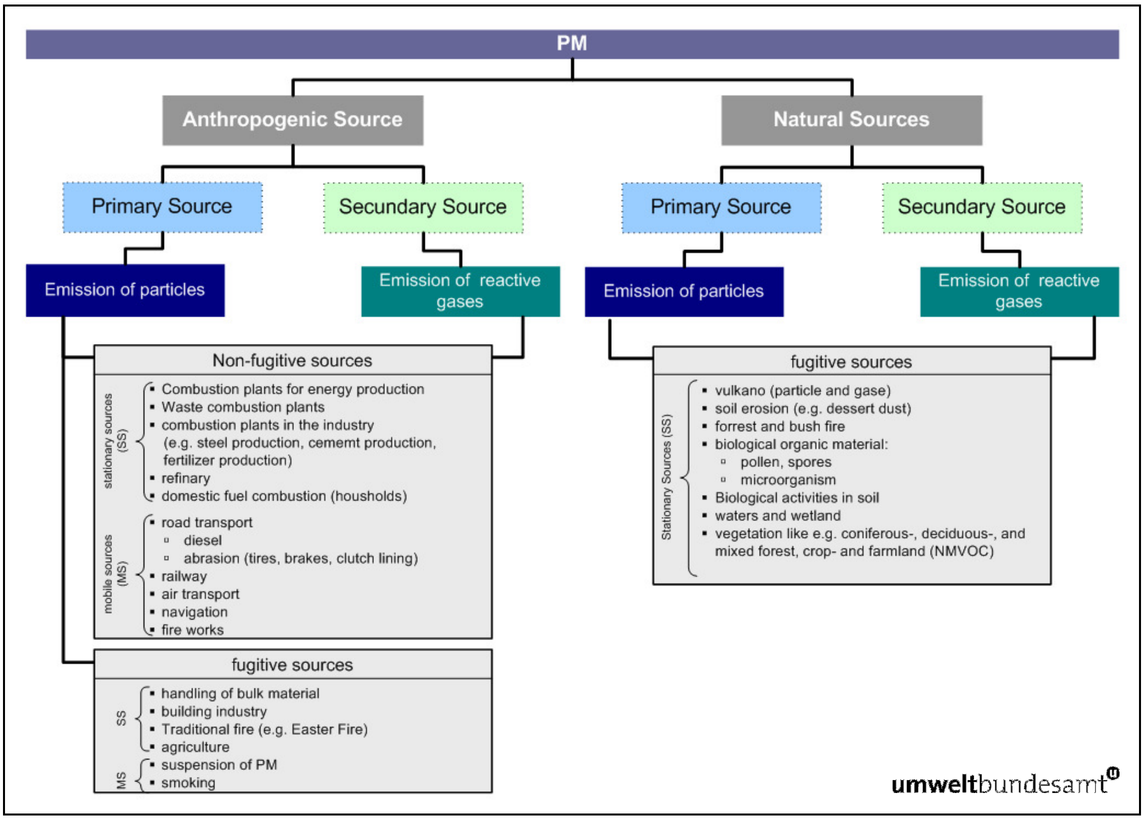

Figure 4: Schematic classification of PM sources.

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).

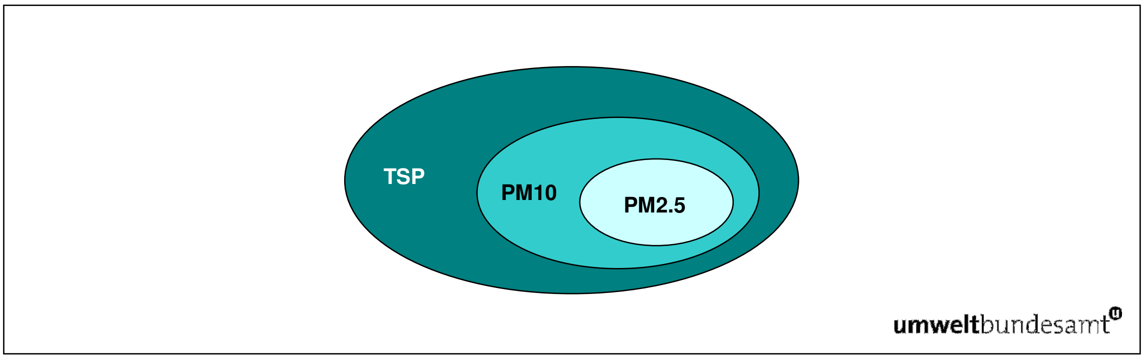

Figure 5: Distribution of TSP, PM10 and PM2.5 (schematic).

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.

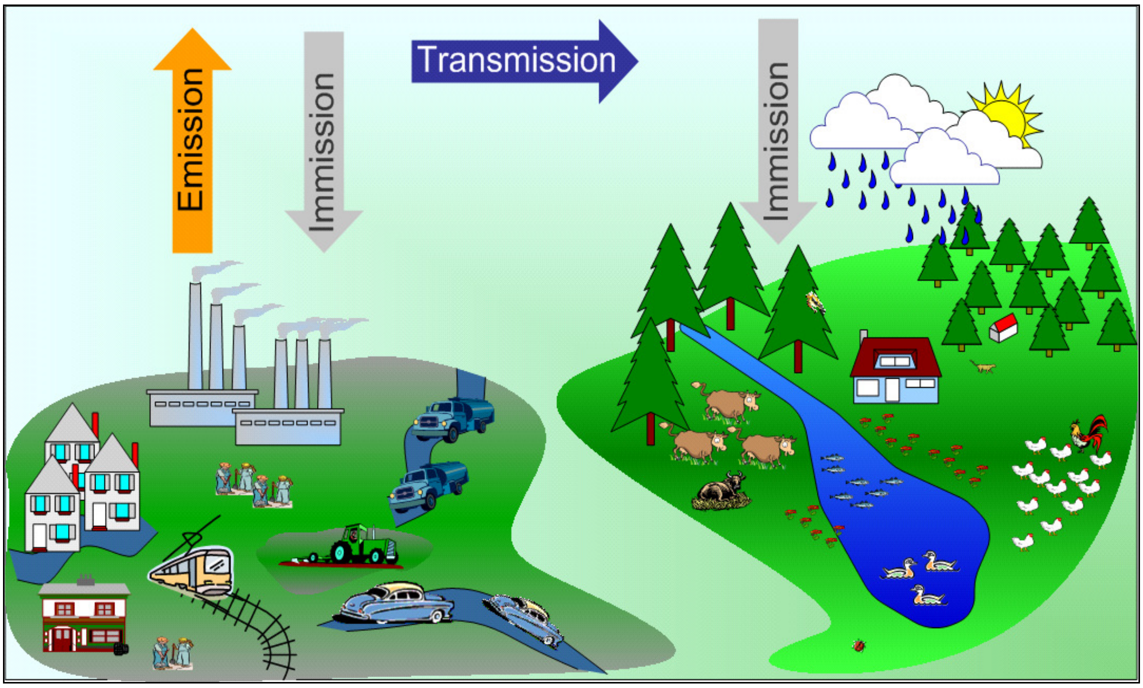

Figure 6: Interrelation of emission, transmission and immission.

Particulate matter (PM) emissions remained quite stable over the period 1990 to 2007: TSP emission increased by 10%, PM10 emission were about 3% above the level of 1990, and PM2.5 emissions decreased by 7% (see Table 17). Apart from industry and road transport, private households and the agricultural sector are considerable contributors to emissions of PM. The explanations for these trends are given in the following chapters.

Table 17: National total emissions and emission trends for particulate matter (PM) 1990–2007.

Year	Emissions [Mg]		
	TSP	**PM10**	**PM2.5**
1990	67 352	41 904	24 158
:	NR	NR	NR
1995	70 606	42 560	23 526
:	NR	NR	NR
1999	69 461	41 797	23 063
2000	73 652	43 435	22 984
2001	74 118	44 186	23 972
2002	74 191	43 956	23 815
2003	75 024	44 723	24 578
2004	75 784	44 873	24 336
2005	74 666	44 267	24 216
2006	76 987	45 027	23 888
2007	74 409	43 036	22 577
Trend 1990–2007	***10%***	***3%***	***-7%***

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 42 Gg in 1990 and were almost on the same level as 2007 (emissions in 2007 amounted to 43 Gg – see Table 18).

As shown in Table 18, the main sources for PM10 emissions in Austria are combustion processes in the NFR Category 1 A *Fuel Combustion Activities* (55% in national total emissions in 2007) as well as handling of bulk materials like mineral products and the activities in the field of civil engineering of Category 2 *Industrial Processes* especially NFR 2 A *Mineral products* (28% in national total PM10 emissions in 2007).

Table 18: PM10 emissions per NFR Category 1990 and 2007, their trend 1990–2007 and their share in total emissions.

NFR Category		PM10 Emissions [Mg]		Trend	Share in National Total	
		1990	2007	1990–2007	1990	2007
1	Energy	22 743.62	23 736.73	4%	54%	55%
1 A	Fuel Combustion Activities	22 438.91	23 485.41	5%	54%	55%
1 A 1	*Energy Industries*	*997.35*	*1 196.62*	*20%*	*2%*	*3%*
1 A 2	*Manufacturing Industries and Construction*	*2 429.80*	*3 145.22*	*29%*	*6%*	*7%*
1 A 3	*Transport*	*6 119.83*	*8 478.36*	*39%*	*15%*	*20%*
1 A 4	*Other Sectors*	*12 875.66*	*10 648.61*	*-17%*	*31%*	*25%*
1 A 5	*Other*	*16.27*	*16.59*	*2%*	*0%*	*0%*
1 B	Fugitive Emissions from Fuels	304.71	251.33	-18%	1%	1%
2	Industrial Processes	12 902.99	13 214.13	2%	31%	31%
2 A	Mineral Products	7 408.72	12 011.29	62%	18%	28%
2 B	Chemical Industry	565.22	228.72	-60%	1%	1%
2 C	Metal Production	4 560.81	560.32	-88%	11%	1%
2 D	Other Production	368.24	413.80	12%	1%	1%
3	Solvent and Other Product Use	406.93	439.84	8%	1%	1%
4	Agriculture	5 781.06	5 544.25	-4%	14%	13%
4 D	Agricultural Soils	5 126.36	4 976.39	-3%	12%	12%
4 G	Agriculture Other	493.93	430.26	-13%	1%	1%
6	Waste	69.63	100.76	45%	<1%	<1%
	Total Emissions	**41 904.24**	**43 035.73**	**3%**		

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 especially for 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 24 Gg in 1990 and have decreased steadily so that by the year 2007 emissions were reduced by 7% (to 23 Gg).

As shown in Table 19, PM2.5 emissions in Austria mainly arose from combustion processes in the energy sector with a share of 83% in the total emissions in 2007. 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 9% and the agricultural sector had a share of 6% 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 2007, their trend 1990–2007 and their share in total emissions.

NFR Category		PM2.5 Emissions [Mg]		Trend	Share in National Total	
		1990	2007	1990–2007	1990	2007
1	Energy	18 821.72	18 793.88	0%	78%	83%
1 A	Fuel Combustion Activities	18 726.75	18 714.54	0%	78%	83%
1 A 1	Energy Industries	850.22	1 015.33	19%	4%	4%
1 A 2	Manufacturing Industries and Construction	2 026.24	2 437.06	20%	8%	11%
1 A 3	Transport	4 159.26	5 652.28	36%	17%	25%
1 A 4	Other Sectors	11 675.21	9 593.71	-18%	48%	42%
1 A 5	Other	15.82	16.16	2%	<1%	<1%
1 B	Fugitive Emissions from Fuels	94.96	79.33	-16%	<1%	<1%
2	Industrial Processes	3 500.06	1 973.81	-44%	14%	9%
2 A	Mineral Products	984.83	1 437.14	46%	4%	6%
2 B	Chemical Industry	301.97	120.63	-60%	1%	1%
2 C	Metal Production	2 065.90	250.58	-88%	9%	1%
2 D	Other Production	147.36	165.46	12%	1%	1%
3	Solvent and Other Product Use	406.93	439.84	8%	2%	2%
4	Agriculture	1 406.33	1 337.34	-5%	6%	6%
4 D	Agricultural Soils	1 140.71	1 108.32	-3%	5%	5%
4 G	Agriculture Other	109.76	95.61	-13%	<1%	<1%
6	Waste	22.82	31.71	39%	<1%	<1%
	Total Emissions	**24 157.86**	**22 576.58**	**-7%**		

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 67 Gg in 1990 and mounted to 74 Gg in 2007, which is an increase of about 10% (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 2007, their trend 1990–2007 and their share in total emissions.

NFR Category		TSP Emissions [Mg]		Trend	Share in National Total	
		1990	**2007**	**1990–2007**	**1990**	**2007**
1	Energy	30 418.07	34 201.05	12%	45%	46%
1 A	Fuel Combustion Activities	29 771.03	33 669.68	13%	44%	45%
1 A 1	*Energy Industries*	*1 053.64*	*1 301.43*	*24%*	*2%*	*2%*
1 A 2	*Manufacturing Industries and Construction*	*2 818.70*	*3 991.29*	*42%*	*4%*	*5%*
1 A 3	*Transport*	*11 720.79*	*16 551.54*	*41%*	*17%*	*22%*
1 A 4	*Other Sectors*	*14 160.89*	*11 808.11*	*-17%*	*21%*	*16%*
1 A 5	*Other*	*17.02*	*17.31*	*2%*	*0%*	*0%*
1 B	Fugitive Emissions from Fuels	647.03	531.37	-18%	1%	1%
2	Industrial Processes	23 733.09	27 405.68	15%	35%	37%
2 A	Mineral Products	15 420.63	25 188.56	63%	23%	34%
2 B	Chemical Industry	957.60	390.09	-59%	1%	1%
2 C	Metal Production	6 434.81	792.89	-88%	10%	1%
2 D	Other Production	920.06	1 034.15	12%	1%	1%
3	Solvent and Other Product Use	406.93	439.84	8%	1%	1%
4	Agriculture	12 648.53	12 149.49	-4%	19%	16%
4 D	Agricultural Soils	11 390.12	11 055.76	-3%	17%	15%
4 G	Agriculture Other	1 097.63	956.13	-13%	2%	1%
6	Waste	145.41	212.99	46%	0%	0%
	Total Emissions	**67 352.03**	**74 409.05**	**10%**		

2.3.4 Particle Matter (PM) Emission Trends by Source category

PM Emission Trends in Category 1 A Fuel Combustion Activities

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 18 for the period from 1990 to 2007:

- TSP emissions increased by about 13% to 34 Gg, which is a share of 45% in total TSP emissions in 2007.
- PM10 emissions increased by about 5% to 23 Gg, which is a share of 54% in total PM10 emissions in 2007.
- PM2.5 emissions were with 19 Gg in 2007 almost on the same level as 1990, which is a share of 83% in total PM2.5 emissions in 2007.

In 2007 within this category NFR *1 A 3 Transport* and *1 A 4 Other Sectors* have the highest contribution to TSP, PM10 and PM2.5 emissions: 38% of the national TSP emissions, 45% of the national PM10 emissions and 67% 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.

The emissions in the following categories are largely due to fuel combustion activities:

- NFR 1 A 4 *Other Sectors* includes fuel combustion in commercial and institutional buildings, households and in the area of agriculture and fishery and has a contribution of 16% TSP, 25% PM10 and 42% PM2.5 emission of the respective national totals. PM emissions arose from:
  - *NFR 1 A 4 b Households* (residential plants); small combustion plants and household ovens and stoves are large sources of TSP, PM10 and PM2.5,
  - *NFR 1 A 4 c* Agriculture and Forestry; Off Road Vehicles and Other Machinery are important sources of PM2.5.
- NFR 1 A 3 *Transport* which includes transportation activities, mechanical abrasion from road surfaces, and re-suspended dust from roads and has a contribution of 22% TSP, 20% PM10 and 25% PM2.5 emissions of the respective national totals. PM emissions arose from:
  - *Automobile Road Abrasion,*
  - Road transport activities with *Passenger cars* and *Heavy duty vehicles* represents the majority of PM sources.
- NFR 1 A 2 *Manufacturing Industries and Construction* has a contribution of 5% TSP, 7% of PM10 and 11% of PM2.5 emissions of the respective national totals.
- NFR 1 A 1 *Energy Industrie*s has a contribution of 2% TSP, 3% of PM10 and 4% of PM2.5 emissions of the respective national totals.

As presented in Table 18, the emissions of PM2.5 decreased by 7% and PM10 are almost on the same level as in 1990. However, the achievements made by several appropriate measures in this category are the following :

- *Energy Industry* and *Manufacturing Industries and Construction:*
  - 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.

  The measures are more than counterbalanced in the last decade by the enourmous increase in energy consumption. Another reason of increasing PM 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:*
  - substitution of old installations 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 saving and environmental task.
  - This downward trend counteracted 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.

- *Transport:*
  - All the above mentioned measures but also all technical improvements of the engines of the vehicles are almost completely compensated by enormously increasing PM 2.5 and PM10 emissions of this category 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 emissions from automobile tyre and brake wear as well as mechanical abrasion from road surfaces, and re-suspended dust from roads.

PM Emission Trends in Category 1 B Fugitive Emissions

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 about 1% to national totals and could be reduced by over 16% between 1990 and 2007.

PM Emission Trend in NFR Category 2 Industrial Processes

- The Sector *Industrial Processes* had, in 2007, a share of 31% in national total PM10 emissions, 9% in national total PM2.5 emissions and 37% in national total TSP emissions.
- *NFR 2 A Mineral products*

  Whithin the NFR category 2, the subcategory NFR 2 A is responsible for more than 90% of the national total TSP and PM10 emission, respectively. The handling of bulk materials like mineral products and the activities in the field of civil engineering represent the majority of PM sources.

  The significant increase in PM emission subcategory NFR 2 A *Mineral products* is a result of increased activities due to manifold construction activities.
- *NFR 2 B Chemical Industry*

  Whithin the NFR category 2, the subcategory NFR 2 B is only responsible for about 1 % of the national total PM emissions. The handling of bulk materials like mineral products and the activities in the field of civil engineering represents the majority of PM sources.

  Also, in NFR 2 B considerable efforts were made in reducing PM emissions due to protective enclosure process lines and bulk materials.
- *NFR 2 C Metal Production*

  The activities in subcategory NFR 2 C *Metal Production* (mainly Iron and Steel production) are responsible for about 1% TSP, 1% PM10 and 1% PM2.5 emissions of the respective national totals.

  In the NFR subcategory 2 C, a decreasing trend of about 88 % of all PM fractions can be noted for the period 1990 to 2007 because considerable efforts were made by introducing low-PM technologies, abatement techniques, flue gas collection and flue gas cleaning systems etc.
- *NFR 2 D Other Production*

  The activities in the subcategory NFR 2 D, which comprise wood processing as well as food and drink production, are responsible for about 1% TSP, 1% PM10 and 1% PM2.5 emissions of the respective national totals.

  In the NFR subcategory 2 D, an increasing trend of about 12 % of all PM fractions can be noted for the period 1990 to 2007 because of increasing activities.

PM Emission trend in NFR Category 3 Solvents and Other Product Use

In the NFR Category 3 *Solvent and Other Product Use*, which includes fireworks and smoking of tobacco, an increasing emission trend of 8% in PM10 emission can be noted for the period 1990 to 2007. This category is a minor PM source.

PM Emission trend in NFR Category 4 Agriculture

The NFR category 4 *Agriculture* has a contribution to the national total PM10, PM2.5 and TSP emissions of 13%, 6% and 6%, in 2007. Within this category NFR subcategory 4 D *Agricultural Soils*, which consider tillage operations and harvesting activities, is the main source of PM emissions.

The decrease in agricultural production (soil cultivation, harvesting, etc.) is responsible for the decrease of about 3% of the national total PM10, pm 2.5 and TSP emissions over the period 1990 to 2007.

A comparatively small amount of the agricultural PM10 emissions results from animal husbandry (NFR 4 G), where a decreasing trend of 14% can be noted.

PM Emission trend in NFR Category 6 Waste

Within the NFR category 6 *Waste,* the subcategory NFR 6 A *Solid Waste Disposal on Land* is the only source. PM10 and TSP emissions each increased by more than 45% and PM2.5 emissions increased by about 39 % in the period 1990 to 2007 due to underlying activity data. The increase of activity data and PM emissions were mainly in the period 1998 to 2007.

2.4 Emission Trends for Heavy Metals

In general emissions of heavy metals decreased remarkably from 1985 to 2007. Emission trends for heavy metals from 1985 to 2007 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 1985–2007.

Year	Emissions [Mg]		
	Cd	Hg	Pb
1985	3.10	3.74	326.72
1986	2.70	3.32	312.86
1987	2.21	2.84	301.89
1988	1.94	2.45	271.89
1989	1.74	2.24	238.96
1990	1.58	2.14	207.21
1991	1.53	2.04	171.61
1992	1.25	1.64	119.71
1993	1.16	1.39	86.10
1994	1.06	1.18	59.59
1995	0.98	1.20	16.06
1996	1.00	1.16	15.49
1997	0.97	1.13	14.47
1998	0.90	0.95	12.99
1999	0.98	0.94	12.49
2000	0.95	0.90	11.97
2001	1.00	0.97	12.27
2002	1.04	0.95	12.73
2003	1.09	1.01	13.11
2004	1.09	0.98	13.53
2005	1.17	1.03	14.14
2006	1.21	1.06	14.82
2007	1.22	1.05	15.33
Trend 1985–2007	***-61%***	***-72%***	***-95%***
Trend 1990–2007	***-23%***	***-51%***	***-93%***

2.4.1 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. 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.

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 populati<on 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 2007 emissions were reduced by 61% (1.22 Mg) in the period 1985–2007 (see Table 21).

The overall reduction from 1985 to 2007 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.

Table 22: Cd emissions per NFR Category 1990 and 2007, their trend 1990–2007 and their share in total emissions.

NFR Category		Cd Emissions [Mg]		Trend	Share in National Total	
		1990	2007	1990–2007	1990	2007
1	Energy	1.060	0.980	-8%	67%	80%
1 A	Fuel Combustion Activities	1.060	0.980	-8%	67%	80%
1 A 1	Energy Industries	0.197	0.287	46%	12%	24%
1 A 2	Manufacturing Industries and Construction	0.383	0.224	-42%	24%	18%
1 A 3	Transport	0.061	0.099	63%	4%	8%
1 A 4	Other Sectors	0.419	0.370	-12%	27%	30%
1 A 5	Other	0.000	0.000	27%	<1%	<1%
1 B	Fugitive Emissions from Fuels	NA	NA			
2	Industrial Processes	0.457	0.235	-48%	29%	19%
2 A	Mineral Products	NA	NA			
2 B	Chemical Industry	0.001	0.001	-40%	<1%	<1%
2 C	Metal Production	0.456	0.235	-48%	29%	19%
2 D	Other Production	NA	NA			
3	Solvent and Other Product Use	0.000	0.000	<1%	<1%	<1%
4	Agriculture	0.002	0.002	-14%	<1%	<1%
4 F	Field Burning of Agricultural Residues	0.002	0.002	-14%	<1%	<1%
6	Waste	0.059	0.001	-98%	4%	<1%
	Total Emissions	**1.578**	**1.219**	**-23%**		

Cd Emission Trends in NFR Category 1 A Fuel Combustion Activities

NFR category 1 A is an important source for Cd emissions because of the combustion of a considerable amount of solid fuels (fossil and biogenic). In the period from 1990 to 2007 Cd emissions decreased by 8% to 0.98 Mg, which is a share of 80% in national total Cd emission in 2007 (see Table 22). The main sources for Cd emissions in NFR 1 A are with a contribution in national total of

- 24% NFR 1 A 1 Energy Industries
- 18% NFR 1 A 2 Manufacturing Industries and Construction
- 8% NFR 1 A 3 Transport, here especially road transport
- 30% NFR 1 A 4 Other Sectors

In all subcategories, except NFR 1 A 1 and NFR 1 A 3, Cd emissions have decreased steadily mainly due to an increase in efficiency, implementation and installation of flugas treatment system as well as by dust removal systems.

In NFR 1 A 1 the increasing Cd-emission in last five years were due to 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.

In NFR 1 A 3 transport sector an increase of Cd emission could be noted because of the enormous increasing activity of the transport sector in passenger and freight transport. Cd emissions arise from tire and brake abrasion.

Cd Emission Trends in NFR Category 2 Industrial Processes

As shown in Table 22 in the period from 1990 to 2007 the Cd emissions decreased by 48% to 0.23 Mg, which is a share of 19% to the total Cd emission. The sub sector 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 Cd emission 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.

Cd Emission trend in NFR Category 3 Solvents and Other Product Use

NFR Cateogy 3 is because of the ban of Cd in paints a minor source of Cd emission. The share of this category in national total Cd emission is less than 1%.

Cd Emission trend in NFR Category 4 Agriculture

Field Burning of Agricultural Waste (NFR 4 F) is the only emission source for Cd emissions of the Sector Agriculture. In 2007, emissions only contribute less than 0.1% (0.1 Mg) to national total emissions. Emissions vary on a very small scale with the area of stubble fields burnt each year.

Cd Emission trend in NFR Category 6 Waste

NFR 6 A Solid Waste Disposal on Land and NFR 6 C Waste Incineration are with a share of less than 1% in national total Cd emission minor sources.

2.4.2 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 $4 \cdot 10^{-5}$%. 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 2007 emissions were reduced by 51%.

The overall reduction of about 72% for the period 1985 to 2007 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 1990 and 2007, their trend 1990–2007 and their share in total emissions.

NFR Category		Hg Emissions [Mg]		Trend	Share in National Total	
		1990	**2007**	**1990–2007**	**1990**	**2007**
1	Energy	1.561	0.704	-55%	73%	67%
1 A	Fuel Combustion Activities	1.561	0.704	-55%	73%	67%
1 A 1	Energy Industries	0.335	0.198	-41%	16%	19%
1 A 2	Manufacturing Industries and Construction	0.796	0.292	-63%	37%	28%
1 A 3	Transport	0.002	0.002	21%	<1%	<1%
1 A 4	Other Sectors	0.427	0.212	-50%	20%	20%
1 A 5	Other	0.000	0.000	27%	<1%	<1%
1 B	Fugitive Emissions from Fuels	NA	NA			
2	Industrial Processes	0.528	0.329	-38%	25%	31%
2 A	Mineral Products	NA	NA			
2 B	Chemical Industry	0.270	0.000	-100%	13%	<1%
2 C	Metal Production	0.257	0.329	28%	12%	31%
2 D	Other Production	NA	NA			
3	Solvent and Other Product Use	NA	NA			
4	Agriculture	0.000	0.000	-14%	<1%	<1%
4 F	Field Burning of Agricultural Residues	0.000	0.000	-14%	<1%	<1%
6	Waste	0.054	0.021	-62%	3%	2%
	Total Emissions	**2.142**	**1.054**	**-51%**		

Hg Emission Trends in NFR Category 1 A Fuel Combustion Activities

Hg emissions mainly arise from NFR category 1 A 1 by combustion processes with a share of 67% of the total emissions in 2007 (see Table 23). In 2007, Hg emissions amounted to 0.7 Mg. These emissions are composed of emissions from combustion of coal, heavy fuel oil and waste in manufacturing industries 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. The main sources for Hg emissions in NFR 1 A are:

- NFR 1 A 1 Energy Industries, with a contribution in national total of 19%,
- NFR 1 A 2 Manufacturing Industries and Construction: 28%,
- NFR 1 A 3 Transport: <1%,
- NFR 1 A 4 Other Sectors: 20%.

Overall Hg emissions could be reduced significantly by different abatement techniques such as filter installation and wet flue gas treatment in industry and due to decreasing coal consumption in the residential sector. In subcategories NFR 1 A 3 and NFR 1 A 5 increasing Hg emissions could be noted due to increasing activities.

Hg Emission Trends in NFR Category 2 Industrial Processes

Process related emissions in the NFR category 2 *Industrial Processes* (especially metal industries) account for about 31% of national total Hg emissions in 2007. As shown in Table 23, in the period from 1990 to 2007, the Hg emissions decreased by 38% to 0.33 Mg.

The sub category 2 C *Metal Production* covers activities reported under NFR 2 C 1 *Iron and steel*. However, emissions from this sub sector increased significantly due to increasing activities whereas in the past decade also extensive abatement measures were implemented.

A small source for Hg emissions of NFR Category 2 *Industrial Processes* was the sub sector 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 process substitution and product substitution. Furthermore, in 1999, the process of chlorine production was changed from mercury cell to membrane cell.

Hg Emission trend in NFR Category 4 Agriculture

Field Burning of Agricultural Waste (NFR 4 F) is the only emission source for Cd emissions of the Sector *Agriculture*. In 2007, emissions only contributed less than 1% (3 kg) to national total emissions. Emissions vary on a very small scale with the area of stubble fields burnt each year.

Hg Emission trend in NFR Category 6 Waste

NFR Category 6 *Waste* was with a share of about 2% in national total Hg emission a small source. The main category was sub category 6 C *Waste Incineration* which covers activities reported under NFR 2 C d *Cremation*.

2.4.3 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 2007 emissions were reduced by 93% (15 Mg). As it is shown in Table 24 today's Pb emissions mainly arise from the energy sector by combustion processes with a share of about 54% 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 1990 and 2007, their trend 1990–2007 and their share in total emissions.

NFR Category		Pb Emissions [Mg]		Trend	Share in National Total	
		1990	2007	1990–2007	1990	2007
1	Energy	174.07	8.29	-95%	84%	54%
1 A	Fuel Combustion Activities	174.07	8.29	-95%	84%	54%
1 A 1	Energy Industries	1.10	1.85	68%	1%	12%
1 A 2	Manufacturing Industries and Construction	9.64	3.62	-62%	5%	24%
1 A 3	Transport	155.81	0.01	-100%	75%	0%
1 A 4	Other Sectors	7.51	2.81	-63%	4%	18%
1 A 5	Other	0.00	0.00	27%	<1%	<1%
1 B	Fugitive Emissions from Fuels	NA	NA			
2	Industrial Processes	32.09	7.00	-78%	15%	46%
2 A	Mineral Products	NA	NA			
2 B	Chemical Industry	0.00	0.00	-40%	<1%	<1%
2 C	Metal Production	32.09	7.00	-78%	15%	46%
2 D	Other Production	NA	NA			
3	Solvent and Other Product Use	0.02	0.02	0%	<1%	<1%
4	Agriculture	0.01	0.01	-14%	<1%	<1%
4 F	Field Burning of Agricultural Residues	0.01	0.01	-14%	<1%	<1%
6	Waste	1.02	0.01	-99%	<1%	<1%
	Total Emissions	**207.21**	**15.33**	**-93%**		

Pb Emission Trends in NFR Category 1 A Fuel Combustion Activities

NFR category 1 A is an important source for Pb emissions because of the combustion of a considerable amount of solid fuels (fossil and biogenic). In the period from 1990 to 2007, Pb emissions decreased by 95% to 8.3 Mg, which is a share of 54% in national total Pb emission in 2007 (see Table 24). The main sources for Pb emissions in NFR 1 A are:

- NFR 1 A 1 Energy Industries, with a contribution in national total of 12%,
- NFR 1 A 2 Manufacturing Industries and Construction: 24%,
- NFR 1 A 4 Other Sectors: 18%.

In all subcategories, except NFR 1 A 1 and NFR 1 A 5, Pb emissions have decreased steadily mainly due to an increase in efficiency, implementation and installation of flue gas treatment system as well as due to dust removal systems. The enormous reduction was achieved by elimination of Pb in motor gasoline. In NFR 1 A 1 *Energy Industries* increasing Cd-emissions could be noted in the last decade due to increasing activities.

Pb Emission Trends in NFR Category 2 Industrial Processes

As shown in Table 24 in the period from 1990 to 2007, the Pb emissions decreased by 78% to 7 Mg, which is a share of 46% to the total Pb emission. The sub sector 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 due to production process substitution and product substitution.

- A small source for Pb emissions of NFR Category 2 *Industrial Processes* was the sub sector 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 due to production process substitution and product substitution. Furthermore, in 1999, the process of chlorine production was changed from mercury cell to membrane cell.

Pb Emission trend in NFR Category 4 Agriculture

Field Burning of Agricultural Waste (NFR 4 F) is the only emission source for Pb emissions of the Sector *Agriculture*. In 2007, emissions only contributed less than 1% (0.01 Mg) to national total emissions. Emissions vary on a very small scale with the area of stubble fields burnt each year.

Pb Emission trend in NFR Category 6 Waste

NFR 6 A *Solid Waste Disposal on Land* and NFR 6 C *Waste Incineration* are minor sources with a share of less than 1% in national total Pb emissions.

2.5 Emission Trends for POPs

Emissions of Persistent Organic Pollutants (POPs) decreased remarkably from 1985 to 2007. 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.

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.

Table 25: Emissions and emission trends for POPs 1985–2007.

Year	**Emission**		
	PAH [Mg]	**Dioxin [g]**	**HCB [kg]**
1985	27.05	187.13	106.31
1986	26.33	186.04	103.76
1987	26.23	187.94	106.55
1988	24.67	173.27	98.06
1989	24.28	164.34	94.83
1990	17.33	160.36	91.88
1991	17.92	135.09	84.57
1992	13.37	76.57	69.65
1993	10.16	66.88	63.99
1994	9.31	56.16	51.93
1995	9.65	58.39	53.08
1996	10.75	59.76	55.79
1997	9.32	59.41	51.93
1998	8.98	56.29	49.17
1999	8.83	53.69	47.67
2000	8.24	52.15	44.38
2001	9.53	57.18	50.53
2002	9.85	47.56	50.32
2003	10.85	51.27	53.92
2004	10.99	51.66	52.96
2005	11.07	52.80	53.60
2006	10.76	52.71	51.85
2007	9.78	47.98	46.45
Trend 1985–2007	*-64%*	*-74%*	*-56%*
Trend 1990–2007	*-44%*	*-70%*	*-49%*

2.5.1 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 2007 emissions were reduced by about 68% (to 9 Mg in 2007) in the period 1985–2007.

In 1985 the main emission sources for PAH emissions were the Sectors Energy (44%), Industrial processes (29%) and Agriculture (26%). In 2007 the main source regarding PAH emissions is *Energy* with a share in the national total of 95%. From 1985 to 2007 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 1990 and 2007, their trend 1990–2007 and their share in total emissions.

NFR Category		PAH Emissions [Mg]		Trend	Share in National Total	
		1990	2007	1990–2007	1990	2007
1	Energy	9,50	9,35	-2%	55%	96%
1 A	Fuel Combustion Activities	9,50	9,35	-2%	55%	96%
1 A 1	Energy Industries	0,01	0,02	208%	<1%	<1%
1 A 2	Manufacturing Industries and Construction	0,06	0,19	197%	0%	2%
1 A 3	Transport	0,90	1,72	92%	5%	18%
1 A 4	Other Sectors	8,53	7,41	-13%	49%	76%
1 A 5	Other	0,00	0,00	-4%	<1%	<1%
1 B	Fugitive Emissions from Fuels	NA	NA			
2	Industrial Processes	7,44	0,23	-97%	43%	2%
2 B	Chemical Industry	0,45	NA	-100%	3%	
2 C	Metal Production	6,44	0,19	-97%	37%	2%
2 D	Other Production	0,55	0,04	-93%	3%	<1%
3	Solvent and Other Product Use	0,15	NO	-100%	1%	
4	Agriculture	0,25	0,21	-18%	1%	2%
4 F	Field Burning of Agricultural Residues	0,25	0,21	-18%	1%	2%
6	Waste	0,00	0,00	-89%	<1%	<1%
	Total Emissions	**17,33**	**9,78**	**-44%**		

PAH Emission Trends in NFR Category 1 A Fuel Combustion Activities

The Sector *Energy* is 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 26 in the period from 1990 to 2007 PAH emissions decreased by only about 2% to 9.4 Mg, which is a share of 96% in national total PAH emission in 2007.

In 2007 within the NFR category *1 A 4 Other Sectors* has the highest contribution (76%) 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.

PAH Emission Trends in NFR Category 2 Industrial Processes

The PAH emissions are rated as key sources in NFR Category *2 Industrial Processes*. As shown in Table 26 in the period 1990 to 2007 the PAH emissions decreased by 97% to 0.23 Mg, which is a share of about 2% to the total PAH emissions. The emission trend from 2005 to 2007 amount to 3%. The main source for PAH emissions of NFR Category 2 *Industrial Processes* was the sub sectors NFR *2 C Metal Production*. 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.

PAH Emission trend in NFR Category 4 Agriculture

As shown in Table 26 in 2007 in national PAH emissions of the sector *Agriculture* amounted to 0.2 Mg, which is a share of 2% of total PAH emission; emissions decreased by 18% mainly due to reduced burning of agricultural wastes (straw, residual wood) on fields. Within this source *Field burning of agricultural residues* (NFR 4 F) is the only source.

PAH Emission trend in NFR Category 6 Waste

Emissions of PAH from Sector NFR *6 Waste* is only a minor source with the share of less than 1% in total PAH emissions.

2.5.2 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 2007 emissions were reduced by about 70% (to 48 g in 2007).

In 1985 the main sources for dioxin/furan emissions were the Sectors *Energy* (59%) and *Industrial Processes* (especially iron and steel production) (27%). In 2007 the main sector regarding dioxin/furan emissions is *Energy* with a share in National Total of 91%.

From 1985 to 2007 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 significantly due to prohibition of open field burning and improved emission abatement technologies in iron and steel industries.

Table 27: Dioxin/Furan emissions per NFR Category 1990 and 2007, their trend 1990–2007 and their share in total emissions.

NFR Category		Dioxin Emissions [g]		Trend	Share in National Total	
		1990	2007	1990–2007	1990	2007
1	Energy	101.92	43.58	-57%	64%	91%
1 A	Fuel Combustion Activities	101.92	43.58	-57%	64%	91%
1 A 1	Energy Industries	0.82	0.90	10%	1%	2%
1 A 2	Manufacturing Industries and Construction	51.98	6.22	-88%	32%	13%
1 A 3	Transport	3.65	1.22	-67%	2%	3%
1 A 4	Other Sectors	45.46	35.25	-22%	28%	73%
1 A 5	Other	0.00	0.00	-4%	<1%	<1%
1 B	Fugitive Emissions from Fuels	NA	NA			
2	Industrial Processes	39.00	4.08	-90%	24%	8%
2 C	Metal Production	37.21	3.95	-89%	23%	8%
2 D	Other Production	1.79	0.13	-93%	1%	<1%
3	Solvent and Other Product Use	1.06	NO	-100%	1%	
4	Agriculture	0.18	0.15	-18%	<1%	<1%
4 F	Field burning of agricultural residues	0.18	0.15	-18%	<1%	<1%
6	Waste	18.19	0.17	-99%	11%	<1%
	Total Emissions	160.36	47.98	-70%		

Dioxin/Furan Emission Trends in NFR Category 1 A Fuel Combustion Activities

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 27 in the period from 1990 to 2007 dioxin/furan emissions decreased by about 57% to 44 g, which is a share of 88% in national total dioxin/furan emissions in 2007.

Within this source NFR *1 A 4 Other Sectors* has the highest contribution (73%) to dioxin/furan emissions due to biomass heatings. Emissions of NFR *1 A 2 Manufacturing Industries and Constrution* amount to 13% of national dioxin/furan emissions.

Dioxin/Furan Emission Trends in NFR Category 2 Industrial Processes

The dioxin/furan emissions are rated as key sources in NFR Category *2 Industrial Processes*. As shown in Table 27 in the period 1990 to 2007 the dioxin/furan emissions decreased by 90% to 4.1 g, which is a share of 8% to the total dioxin/furan emissions. The main source for POP emissions of NFR Category 2 *Industrial Processes* was the sub sectors NFR *2 C Metal Production.* Dioxin/furan emissions decreased significantly due to extensive abatement measures.

Small source for persistent organic pollutant dioxin/furan emissions of NFR Category *2 Industrial Processes* were the sub sector NFR 2 D *Other Production* which covers activities of NFR 2 D 2 *Food and Drink* (meat and fish smoking).

Dioxin/Furan Emission trend in NFR Category 4 Agriculture

As shown in Table 27 in the period from 1990 to 2007 dioxin/furan emissions decreased by 18% to 0.15 g, which is a share of less than 1% in total dioxin emission, mainly due to reduced burning of agricultural wastes (straw, residual wood) on fields. Within this source *Field burning of agricultural residues* (NFR 4 F) is the only source.

Dioxin/Furan Emission trend in NFR Category 6 Waste

Emissions of dioxin/furan from Sector NFR *6 Waste* are not rated as key sources of the Austrian Inventory. As shown in Table 27 in the period from 1990 to 2007 dioxin/furan emissions decreased by about 99% to 0.17 g, which is a share of about 1% in total dioxin/furan emissions, whereas in 1990 dioxin/furan emissions contribute 11% to the total dioxin/furan emissions.

Within this source the NFR Sector 6 C *waste incineration* is the only source of POP emissions.

2.5.3 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 2007 emissions were reduced by about 56% (to 46 g in 2007) in the period from 1985 to 2007.

In 1985 the two main sources for HCB emissions were the sectors *Energy* (78%) and *Industrial processes* (12%). In 2007 the main sector of HCB emissions is *Energy* with a share in National Total of 91%.

From 1985 to 2007 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 2007.

Table 28: Hexachlorbenzene (HCB) emissions per NFR Category 1990 and 2007, their trend 1990–2007 and their share in total emissions.

NFR Category		HCB Emissions [kg]		Trend	Share in National Total	
		1990	**2007**	**1990–2007**	**1990**	**2007**
1	Energy	72,69	42,41	-42%	79%	91%
1 A	Fuel Combustion Activities	72,69	42,41	-42%	79%	91%
1 A 1	Energy Industries	0,21	0,38	85%	0%	1%
1 A 2	Manufacturing Industries and Construction	17,44	1,66	-90%	19%	4%
1 A 3	Transport	0,73	0,24	-67%	1%	1%
1 A 4	Other Sectors	54,32	40,12	-26%	59%	86%
1 A 5	Other	0,00	0,00	-4%	<1%	<1%
1 B	Fugitive Emissions from Fuels	NA	NA			
2	Industrial Processes	9,71	3,98	-59%	11%	9%
2 B	Chemical Industry	1,26	NA		1%	
2 C	Metal Production	8,09	3,95	-51%	9%	9%
2 D	Other Production	0,36	0,03	-93%	<1%	<1%
3	Solvent and Other Product Use	9,05	NO	-100%	10%	
4	Agriculture	0,04	0,03	-18%	<1%	<1%
4 F	Field Burning of Agricultural Residues	0,04	0,03	-18%	<1%	<1%
6	Waste	0,39	0,03	-91%	<1%	<1%
	Total Emissions	91,88	46,45	-49%		

HCB Emission Trends in NFR Category 1 A Fuel Combustion Activities

The Sector *Energy* is also an important source for HCB emissions in Austria. As shown in Table 28 in the period from 1990 to 2007 dioxin/furan emissions decreased by about 42% to 42 kg, which is a share of 91% in national total HCB emissions in 2007.

Within this source NFR *1 A 4 Other Sectors* has the highest contribution (86%) to HCB emissions due to biomass heatings.

HCB Emission Trends in NFR Category 2 Industrial Processes

The HCB emissions are rated as key sources in NFR Category *2 Industrial Processes*. As shown in Table 28 in the period 1990 to 2007 the HCB emissions decreased by 59% to 4 kg, which is a share of 9% to the total HCB emissions. The main source for HCB emissions of NFR Category 2 *Industrial Processes* was the sub sectors NFR *2 C Metal Production.* HCB emissions decreased significantly due to extensive abatement measures.

HCB Emission Trend in NFR Category 4 Agriculture

As shown in Table 28 in the period from 1990 to 2007 HCB emissions decreased by 18% to 0.03 kg, which is a share of less than 1% in total HCB emission, mainly due to reduced burning of agricultural wastes (straw, residual wood) on fields. Within this source *Field burning of agricultural residues* (NFR 4 F) is the only source.

HCB Emission Trend in NFR Category 6 Waste

As shown in Table 27 in the period from 1990 to 2007 HCB emissions decreased by about 91% to 0.03 kg, which is a share of about 1% in total HCB emissions.

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 2006 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.

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.

REPORTING

The new NFR templates from the new EMEP guidelines have been used. The new NFR is more detailed and does not define the subtotals of the old NFR (e.g. category *1.A.2 Manufacturing Industries and Construction*). NFR activity data is now better linked with sector emissions and more detailed (especially for energy).

According to the NEC-D the accounting of civil aviation has been corrected: Emissions from total LTOs are now included under National Total. In previous submissions the emissions from domestic LTOs and cruise activities were included under National Total.

ENERGY (1.A)

Update of activity data:

Updates of activity data and NCVs follow the updates of the IEA-compliant energy balance compiled by the federal statistics authority Statistik Austria.

Energy balance update and corrections:

The new estimates are mainly due to a revised evaluation of census data 2004/2006. Major revisions affect the years from 1999 onwards (except for 'other biomass' which has been revised for the whole time series). Revisions of traded fuels affect the categories *1.A.2 Industry* and *1.A.4 Other Sectors* because gross inland consumption has in general not been revised (only some minor shifts between consecutive years).

Natural gas: From 1999 up to 4.7 PJ have been shifted between final consumption of *1.A.2 Industry* (food, pulp and paper) and *1.A.4 Other Sectors.* The main sector affected by this revision is *1.A.4.b Residential* (1999: +8.5 PJ; 2006: +3.9 PJ). For 2006 9.6 PJ are shifted from *1.A.1.b Petroleum Refineries* to *1.A.1.c Other Energy Industries*, *1.A.2 Industry* and *1.A.4 Other Sectors*.

Residual fuel oil: From 2000 to 2003 shifts from *1.A.4.a Commercial* to *1.A.4.b Residential* (5.2 PJ in 2003) and from 2004 to 2006 shifts from *1.A.4 Other Sectors* to *1.A.2 Industry* (all subcategories except 1.A.2.a). Between 2004 and 2006 shifts of gross inland consumption (2006: -0.7 PJ).

Gasoil: 0.9 PJ of gross inland consumption has been shifted from the year 2001 to 2000. Between 2004 and 2006 shifts of gross inland consumption (2006: -1.3 PJ). This change affects the categories *1.A.2 Industry* and *1.A.4 Other Sectors*.

Other Biomass: Increase of gross inland consumption from 1990 to 2006. This affects mainly the categories *1.A.4.b Residential* (2006: +3.9 PJ), wood products industry (2006: +2.6 PJ; included in *1.A.2.f*) and *1.A.4.c Agriculture* (2006: +2.1 PJ).

Fuel wood: Increase of gross inland consumption from 2001 to 2006. This affects the categories *1.A.4.b Residential* (2006: +6.6 PJ) and *1.A.4.c Agriculture* (2006: +0.4 PJ).

Liquified Petroleum Gas (LPG): From 2000 to 2006 shifts between the sub-categories of *1.A.4 Other Sectors*. From 2005 to 2006 shifts from *1.A.4 Other Sectors* to *1.A.2 Industry* (2006: +0.5 PJ).

Minor revisions have been carried out for coal and waste from the year 2000 onwards:

Hard coal: From 2000 to 2006 shifts between subcategories of *1.A.4 Other Sectors.* From 2005 to 2006 increase of gross inland consumption (2006: +0.4 PJ).

Brown coal: From 1999 to 2006 shifts between *1.A.2 Industry* (2006: +0.2 PJ) and *1.A.4 Other Sectors.* From 2001 to 2006 increase of gross inland consumption (2006: +0.1 PJ).

Brown coal briquettes: From 2000 to 2006 shifts between the sub-categories of *1.A.4 Other Sectors.* Decrease of gross inland consumption 2006 by -0.1 PJ.

Coke oven coke: Increase of gross inland consumption from 2003 to 2006. From 1999 to 2006 shifts between *1.A.2 Industry* and *1.A.4 Other Sectors*.

Industrial waste: Increase of gross inland consumption from 2004 to 2006 (+3.8 PJ), mainly due to wood product and non metallic mineral products industry (included in *1.A.2.f*).

1.A.2.f Manufacturing Industries and Construction – Other – mobile sources:

Activity data for mobile machineries for the whole time series was updated with data from a new study commissioned by the Umweltbundesamt (see description for *1.A.4 Other Sectors – mobile*). Now the activity of mobile machineries in industry is considerably lower.

1.A.3.a Aviation:

From 2000 onwards recalculations have been carried out according to the IPCC Tier 3a methodology. For previous submissions the emissions after the year 2000 were estimated by means of total national fuel sales and national fuel use provided by energy statistics.

1.A.3.b Road Transportation:

Update of statistical energy data, particularly the biodiesel consumption. As the new study for off-road traffic (see description for *1.A.4 Other sectors – mobile*) concludes that less fuel is used by off-road vehicles, especially in industry and forestry, and that the overall fuel consumption is known, this decrease in fuel consumption had to be counterbalanced by an increase of fuel tourism.

1.A.4 Other Sectors – mobile:

Activity data for mobile machineries for the whole time series was updated with data from a new study commissioned by the Umweltbundesamt. The data is based on the most recent 'Nutz-Energie-Analyse' by Statistik Austria (which is a survey analysing energy use). Now the activity of mobile machineries in forestry is considerably lower.

Improvements of methodologies and emission factors:

1.A.2.f Cement Production – stationary

Update of NO_X, SO_2 and NMVOC emissions from 2005 to 2006 according to a recent study of the Austrian cement manufacturing industry. Update of NH_3 emissions according to the same study. Previously NH_3 estimates were based on country-specific emission factors.

1.A.2.f Manufacturing Industries and Construction, Other – mobile:

Update of emission factors based on a new study commissioned by the Umweltbundesamt.

1.A.3.a Aviation

Previously the split between national/international aviation was extrapolated for the years after 2000 using the split from 2000. This inventory data from 2000 onwards was updated following the CORINAIR Tier 3a bottom-up method. Tier 3a takes into account cruise emissions for different flight distances, depending on aircraft types. This affects primarily the calculation of NO_x emissions.

1.A.3.b Road Transport:

Update of vehicle-kilometres, ton-kilometres and passenger-kilometres.

1.A.4.b Residential – stationary

Update of heating type split from 2001 onwards by means of revised 2004 household census data. This affects the calculation of NMVOC and NO_x emissions from residential heatings.

Fuel consumption of new biomass, gas and oil heatings has been revised from the year 2005 onwards by means of boiler sales statistics. This affects the calculation of NMVOC and NO_x emissions from residential heatings.

1.A.4 Other Sectors – mobile:

Update of emission factors based on a new study commissioned by the Umweltbundesamt.

INDUSTRIAL PROCESSES (2)

Update of activity data:

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

Activity data for 2006 has been updated.

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

Activity data for 2006 has been updated.

SOLVENT USE (3)

To improve and update the solvent model a study (not published) was contracted out, that led to the following recalculations.

Update of activity data:

3.A, 3.B, 3.C and 3.D.5.:

The short term statistics for trade and services and the Austrian foreign trade statistics was revised by Statistik Austria from 2000 onwards.

The solvent share has been updated using the structural business statistics from 2000 onwards. The activity data from 2000 onwards concerning non-solvent use and solvent content of products has been updated by surveys at companies and associations.

Improvements of methodologies and emission factors:

3.A, 3.B, 3.C and 3.D.5.:

A modification of the solvent model led to a shift in emissions: In the sub-sector *Chemical Products (3.C)* now only the share of the solvent content that is emitted during production is considered as input. The remaining amount of solvent in the products, emitted during application and use, is reported as input and emissions of sub-sectors *3.A* and *3.D*.

Furthermore, emission factors have been updated with information from surveys at companies and associations, which were extrapolated using structural business statistics provided by Statistik Austria.

Agriculture (4)

No revisions.

WASTE (6)

Update of activity data

6.A.1 Managed waste disposal on land: activity data for the year 2006 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 in 2006 changed slightly (+6%) compared to the previous submission.

Furthermore, new data on collected landfill gas became available for 2002–2006 from questionnaires sent to landfill operators. The amount of collected landfill gas has decreased over time as methane generation has declined too.

6.D Other:

Activity data for mechanical-biological treatment has been updated for the years 2003-2006, as new data on incoming quantities became available.

Activity data for separately collected bio-waste (mainly) of the previous year was updated, because some of the nine Federal Provinces (Bundesländer) published new and more accurate data in their waste management concepts and plans. This led to a slightly different overall amount compared to previous years' submissions.

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[92]. Detailed explanations are provided in chapters 3.1 and 3.3.

Table 29: Recalculation difference of NEC and CO emissions in general with respect to submission 2006.

NFR Category	Absolute difference [Mg]						Relative difference	
	1990	1995	2000	2004	2005	2006	1990 Δ%	2006 Δ%
SO_2 emissions								
1 Energy	-1.07	-0.27	-0.18	0.64	0.53	0.48	*-1%*	*2%*
2 Industrial Processes	0.00	0.00	0.00	0.00	0.00	0.00	=	=
3 Solvent & Other Product Use								
4 Agriculture	0.00	0.00	0.00	0.00	0.00	0.00	*4%*	=
6 Waste	0.00	0.00	0.00	0.00	0.00	0.00	=	=
Total Emissions	-1.07	-0.27	-0.18	0.64	0.53	0.48	*-1%*	*2%*
NO_x emissions								
1 Energy	-20.78	-18.92	-14.92	-11.09	-9.70	-7.38	*-11%*	*-4%*
2 Industrial Processes	0.00	0.00	0.00	0.00	0.00	0.19	=	*11%*
3 Solvent & Other Product Use								
4 Agriculture	0.00	0.00	0.00	0.00	0.00	0.00	*0%*	=
6 Waste	0.00	0.00	0.00	0.00	0.00	0.00	=	=
Total Emissions	**-20.78**	**-18.92**	**-14.92**	**-11.09**	**-9.70**	**-7.20**	***-10%***	***-4%***
NMVOC emissions								
1 Energy	-8.38	-7.86	-6.33	4.12	4.09	5.46	*-5%*	*8%*
2 Industrial Processes	0.00	0.00	0.00	0.00	0.00	0.14	=	*3%*
3 Solvent & Other Product Use	-2.52	-0.48	4.58	-10.38	10.31	8.89	*-2%*	*9%*
4 Agriculture	0.00	0.00	0.00	0.01	0.00	0.00	*0%*	=
6 Waste	0.00	0.00	0.00	0.00	0.00	0.00	=	*6%*
Total Emissions	**-10.90**	**-8.33**	**-1.75**	**-6.25**	**14.40**	**14.50**	***-4%***	***9%***

[92] An equals sign "=" 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;

NFR Category		Absolute difference [Mg]						Relative difference	
		1990	1995	2000	2004	2005	2006	1990 ∆%	2006 ∆%
NH_3 emissions									
1	Energy	0.10	0.09	0.10	0.16	0.14	0.15	*2%*	*5%*
2	Industrial Processes	0.00	0.00	0.00	0.00	0.00	0.00	=	=
3	Solvent & Other Product Use								
4	Agriculture	0.00	0.00	0.00	0.00	0.00	0.00	*0%*	=
6	Waste	0.00	0.00	0.00	0.00	0.00	0.03	*0%*	*3%*
Total Emissions		**0.10**	**0.09**	**0.10**	**0.16**	**0.14**	**0.18**	***0%***	***0%***
CO emissions									
1	Energy	-11.61	-10.44	-3.87	54.63	46.13	52.96	*-1%*	*7%*
2	Industrial Processes	0.00	0.00	0.00	0.00	0.00	0.13	=	*1%*
3	Solvent & Other Product Use								
4	Agriculture	0.05	0.05	0.05	0.08	0.00	0.00	*4%*	=
6	Waste	0.00	0.00	0.00	0.12	0.20	0.35	=	*6%*
Total Emissions		**-11,56**	**-10.39**	**-3.82**	**54.83**	**46.34**	**53.44**	***-1%***	***7%***

4 ENERGY (NFR SECTOR 1)

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 NFR 1 A Stationary Fuel Combustion Activities

No changes regarding methodology and emission factor were made since submission 2008.

4.1.1 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 2009 (UMWELTBUNDESAMT 2009a) which is part of the submission under the UNFCCC.

- Additionally to information provided in this document, Annex 2 of (UMWELTBUNDESAMT 2009a) 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 2009a).

Completeness

Table 30 provides information on the status of emission estimates of all sub categories. A "✓" indicates that emissions from this sub category have been estimated.

Table 30: 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]	✓
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 31 shows the correspondence of NFR and SNAP categories.

Table 31: 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)
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

4.1.2 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 32: 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.

4.1.3 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).

General Methodology

The following Table 33 gives an overview of methodologies and data sources of sub category *1 A 1 Energy Industries*.

Table 33: 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 34 shows measured and calculated emission data of category 1 A 1 a for the year 2004.

Table 34: 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 35 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 35: 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 MWt_h		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
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 36 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 36: 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 37. The split follows closely (STANZEL et al. 1995).

Table 37: 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 38 summarizes the selected emission factors for main pollutants and activity data for the year 2006. It is assumed that emissions are uncontrolled.

Table 38: 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 39). It is assumed that imported oil products have a similar metal content.

Table 39: 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 40: 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 41: 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 42: 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 43: 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 44: 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 45: 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 46: 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 47: 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 48.

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

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

Table 48: 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. [93]

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 49: 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

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

4.1.4 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)[94]
  - other-stationary in industry (NFR 1 A 2 f 2).

General Methodology

Table 50 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 50: 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

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

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 51: 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 52 summarizes the selected emission factors for the main pollutants and activity data for the year 2006. It is assumed that emissions are uncontrolled.

Table 52: 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 53 shows fuel consumption and main pollutant emission factors of category *1 A 2 b* for the year 2006.

Table 53: 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 54 sumarizes activity data and emission factors for 2006. Underlined values indicate non default emission factors.

Table 54: 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 55 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 55: 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 56 sumarizes activity data and emission factors for 2006.

Table 56: 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 57 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 57: 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 58 shows total fuel consumption and emissions of main pollutants for sub categories of *1 A 2 f* for the year 2006.

Table 58: 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 62. 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 59 shows detailled fuel consumption data for 2006.

Table 59: 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 60. Heavy metals emission factors are presented in the following subchapter. Fuel consumption and main pollutant emission factors are shown in Table 62.

Table 60: 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 62. Table 61 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 61: 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 62 presents fuel consumption and main pollutant emission factors.

1 A 2 f ii Fuel consumption and main pollutant emission factors

Table 62 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 62: 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	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]
Fuel wood	(BMWA 1996)[7]	1 516	110.0	370.0	5.00	11.0	5.00
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 63: 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 64: 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 65: 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 66: 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 67: 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 68: 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 69: 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[95]	–	389 000–24 000[95]
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[95]	50–30[95]	12 000–200[95]
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.

[95] upper value for 1985, lower value for 2000; years in between were linearly interpolated

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.

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 71.

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 70: 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[96].

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.

[96] 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.

Table 71: 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
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/Nm^3 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 hexachloroethan 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 72: 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[97]	200 000–1 300[97]	–
030310 Secondary aluminium	130/40–7[97]	65 000–3500[97]	–
030313 Asphalt concrete plants	0.01	2.8	0.15
030324 Nickel production	13	2 600–2.25[97]	–

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).

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 73: 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

[97] Higher value for 1995/1990, lower value for 2000

	TSP Emission Factors [g/GJ]				PM10	PM2.5
	1990	1995	2000	2005	[%]	[%]
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

4.1.5 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 74 shows activity data and main pollutant emission factors. The NO_x emission factor of 150 kg/TJ is an expert guess by Umweltbundesamt.

Table 74: 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.*

4.1.6 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 75 presents new PM emission sources which have been estimated since the inventory 2007.

Table 75: 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 7 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) [94] (see page 115)	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 [94] (see page 115)	Fuels combusted in traction vehicles and other mobile machinery on farm land and in forests.
1 A 4	c	iii	National Fishing[94] (see page 115)	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 7: NFR 1 A 4 category definitions.

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 76: 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 77: 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 78: 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 79. The split follows closely (STANZEL et al. 1995).

Table 79: 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 80: 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 81: 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 82: 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		
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 83: 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 84: 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 85: 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
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 86: 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)			
Coal 102A, 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)			
Coal 102A, 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 87: 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 88: 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 57 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 89: 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%

4.1.7 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 35 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.

4.1.8 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.

4.2 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 90: 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 cm^3 0705 Motorcycles > 50 cm^3
• 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 0807 Other 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)

Completeness

Table 91 provides information on the status of emission estimates of all sub categories. A "✓" indicates that emissions from this sub category have been estimated. Table 90 proviedes an overview about NFR categories and the corresponding SNAP codes.

Table 91: 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.

4.2.1 NFR 1 A 3 a Civil Aviation

The category *1 A 3 a Civil Aviation* contains flights according to Visual Flight Rules (VFR) and Instrument Flight Rules (IFR) for national LTO (landing/take off) and national cruise. International LTO and international cruise is considered in *I B Av International Bunkers Aviation*. Military Aviation is allocated in *1 A 5* Other. As can be seen in Table 92 emissions from NFR 1 A 3 a Civil Aviation increased over the period from 1990–2007 due to an increase of activity by about 131%.

Table 92: Emissions from 1 A 3 a Civil Aviation 1990–2007.

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	22.82	18.25
1995	47.14	133.2	5.37	11.62	0.10	0.08	19.10	6.50
2000	68.93	190.5	6.97	13.18	0.11	0.09	49.99	16.36
2005	64.99	199.5	6.38	13.19	0.12	0.09	42.59	16.37
2006	75.98	208.1	7.41	13.70	0.13	0.09	50.75	17.00
2007	76.51	211.9	7.53	14.19	0.13	0.10	51.83	17.61
Trend 1990–2007	112%	423%	79%	215%	33%	213%	127%	-3%

Methodological Issues

IFR

For the years 1990–1999 a country-specific methodology was applied. The calculations are based on a study commissioned by the Umweltbundesamt finished in 2002 (KALIVODA et al. 2002). This methodology is consistent with the very detailed CORINAIR Tier 3b methodology (advanced version based on (MEET 1999)): air traffic movement data[98] (flight distance and destination per aircraft type) and aircraft/ engine performances data were used for the calculation.

For the years 2000–2007 the CORINAIR Tier 3a was applied. Tier 3a takes into account average fuel consumption and emission data for LTO phases and various flight lengths, for an array of representative aircraft categories.

VFR

Fuel consumption for the years 2000–2007 was extrapolated from 1990–1999.

The emissions have been calculated with IEF´s from the year 2000 by the study mentioned above (KALIVODA et al. 2002).

[98] This data is also used for the split national/ international aviation.

Activity Data

Fuel consumptions for 1 A 3 a Civil Aviation presented in Table 93.

Table 93: Fuel consumptions 1 A 3 a Civil Aviation 1990–2007.

Year	LTO		cruise
	Kerosene	Gasoline	Kerosene
	[Mg]	[Mg]	[Mg]
1990	3 164	2 487	4 508
1995	4 430	2 241	11 616
2000	6 109	2 039	13 178
2005	5 205	2 787	13 192
2006	6 202	2 868	13 697
2007	6 334	2 856	14 189
Trend 1990–2007	100%	15%	215%

IVR flights

For the years 1990–1999 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 with the total amount of kerosene sold in Austria of the national energy balance. As fuel sold is a robust value, 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 have the highest uncertainty.

For the years 2000–2007 fuel consumption for the different transport modes IFR national LTO, IFR international LTO, IFR national cruise and IFR international cruise was calculated according to the CORINAIR Tier 3a method, with average consumption data per aircraft typs and flight distances. The fuel consumption of IFR international cruise was adjusted as explained above. The numbers of flight movements per aircraft types were obtained from STATISTIK AUSTRIA. The total amount of jet kerosene was also obtained from Statistik Austria.

VFR flights

Fuel consumption for the years 2000–2007 was extrapolated from 1990–1999.

Fuel consumption of VFR flights have been calculated with IEF´s from the year 2000 by the study mentioned above (KALIVODA et al. 2002).

Emissionsfactors

NO_x, CO

IFR flights

For the years 1990–1999 emission estimates for fuel consumption, NO_x and CO were taken from an aviation study commissioned by the Umweltbundesamt (KALIVODA et al. 2002) the emission factors are aircraft/ engine specific.

For the years 2000–2007 the CORINAIR Tier 3a was applied. Tier 3a takes into account average fuel consumption and emission data for LTO phases and various flight lengths, for an array of representative aircraft categories.

VFR flights

For the years 1990–1999 emission estimates for fuel consumption, NO_x and CO were taken from an aviation study commissioned by the Umweltbundesamt (KALIVODA et al. 2002)

For the years 1999–2007 emissions of VFR flights have been calculated with IEF´s from the year 2000 by the study mentioned above (KALIVODA et al. 2002).

NMVOC

IFR flights

For the years 1990–1999 NMVOC emissions for IFR flights have been calculated like NO_x (VOC emissions calculated with a country specific method, KALIVODA et al. 2002). According to the CORINAIR guidebook 90.4% of VOC of the LTO-IFR are assumed to be NMVOC. According to CORINAIR Guidebook no CH4 emissions during the cruise phase is emitted. That means total VOC emissions equals NMVOC emissions. Emissions of VFR

For the years 2000–2007 NMVOC emissions for IFR flights have been calculated in this way:

Total VOC emissions have been calculated with the implied emission factor for the year 1999 as obtained in the study (KALIVODA et al. 2002). According to the CORINAIR guidebook 90.4% of VOC of the LTO-IFR are assumed to be NMVOC.

VFR flights

For the years 1990–1999 emission estimates were taken from an aviation study commissioned by the Umweltbundesamt (KALIVODA et al. 2002)

For the years 1999–2007 NMVOC emissions of VFR flights have been calculated with an IEF from the year 2000 by the study mentioned above (KALIVODA et al. 2002).

NH_3

IFR flights

For the years 1990–1999 NH_3 emissions for IFR flights have been calculated like NO_x (KALIVODA et al. 2002).

For the years 1999–2007 NH_3 emissions for IFR flights have been calculated with an IEF from the year 2000 by the study mentioned above (KALIVODA et al. 2002).

VFR flights

For the years 1990–1999 emission estimates were taken from an aviation study commissioned by the Umweltbundesamt (KALIVODA et al. 2002)

For the years 1999–2007 NH_3 emissions of VFR flights have been calculated with an IEF from the year 2000 by the study mentioned above (KALIVODA et al. 2002).

Table 94: Emission factors and activities for Civil Aviation (LTO + cruise) 1990–2007.

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	0.92	281.43	21.85	0.214	71.97
2005	0.92	289.01	21.38	0.23	64.44
2006	0.99	288.26	21.41	0.23	68.74
2007	1.01	284.93	21.47	0.23	68.62

Recalculation

Update of national/international fuel consumption data, resulting in a recalculation of emissions from 2000 to 2007 according to the bottom up CORINAIR Tier 3a method.

Planned improvements

No further aviation study is foreseen at the moment.

Addiational investigations concerning the allocation of aircraft types to equivalent aircraft types according to the CORINAIR guidebook. Update of activity data from military flights, see chapter Military Aviation.

4.2.2 International Bunkers – Aviation

Emissions from aviation assigned to international bunkers include the transport modes international LTO and international cruise for IFR-flights.

Table 95: Emissions for Civil Aviation (LTO+cruise) 1990–2007.

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	0.151	0.163
1995	0.632	3.601	0.049	0.372	0.000	0.003	0.205	0.279
2000	0.794	6.254	0.067	0.471	0.000	0.003	0.324	0.400
2005	1.028	6.788	0.086	0.536	0.001	0.004	0.417	0.455
2006	0.995	7.330	0.085	0.565	0.001	0.004	0.413	0.479
2007	1.092	7.781	0.092	0.598	0.001	0.004	0.447	0.508
Trend 1990–2007	*194%*	*224%*	*221%*	*137%*	*218%*	*135%*	*196%*	*212%*

Table 96: Activities for Civil Aviation (LTO + cruise) 1990–2007.

Year	Activity	
	LTO [PJ]	**Cruise [PJ]**
1990	1.25	11.01
1995	2.12	16.13
2000	2.89	20.40
2005	3.71	23.20
2006	3.68	24.46
2007	3.98	25.90
Trend 1990–2007	*218%*	*135%*

Emissions have been calculated using the methodology and emission factors as described in Chapter 1 A 3 a Civil aviation.

4.2.3 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. Technical improvements and a stricter legislation led to a reduction of SO_2. NMVOC and NH_3 emissions per vehicles or per mileage. respectively. In 2007 emissions were below 1990 levels. On the other hand a steady increase of transport activity is observed

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.

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).

<u>Road transport model GLOBEMI</u>

The program calculates vehicle mileages, passenger-km, ton-km, fuel consumption, exhaust gas emissions, evaporative emissions and suspended PM 10 of the road traffic. The balances use the vehicle stock and functions of the km driven per vehicle and year to assess the total traffic volume of each vehicle category.

Model input is:

1) the vehicle stock of each category split into layers according to the propulsion system (SI.CI...). cylinder capacity classes or vehicle mass
2) the emission factors of the vehicles according to the year of first registration and the layers from 1)
3) The passengers per vehicle and tons payload per vehicle

4) Optional either

   a) the total gasoline and diesel consumption of the area under consideration

   b) the average km per vehicle and year

Following data is calculated:

a. km driven per vehicle layer and year or total fuel consumption

b. total vehicle mileages

c. total passenger-km and ton-km

d. specific emission values for the vehicle fleets [g/km]. [g/t-km]. [g/pass-km]

e. total emissions and energy consumption of the traffic (fc. CO. HC. NO_x. particulate matter. CO_2. SO_2 and several unregulated pollutants among them CH_4 and N_2O)

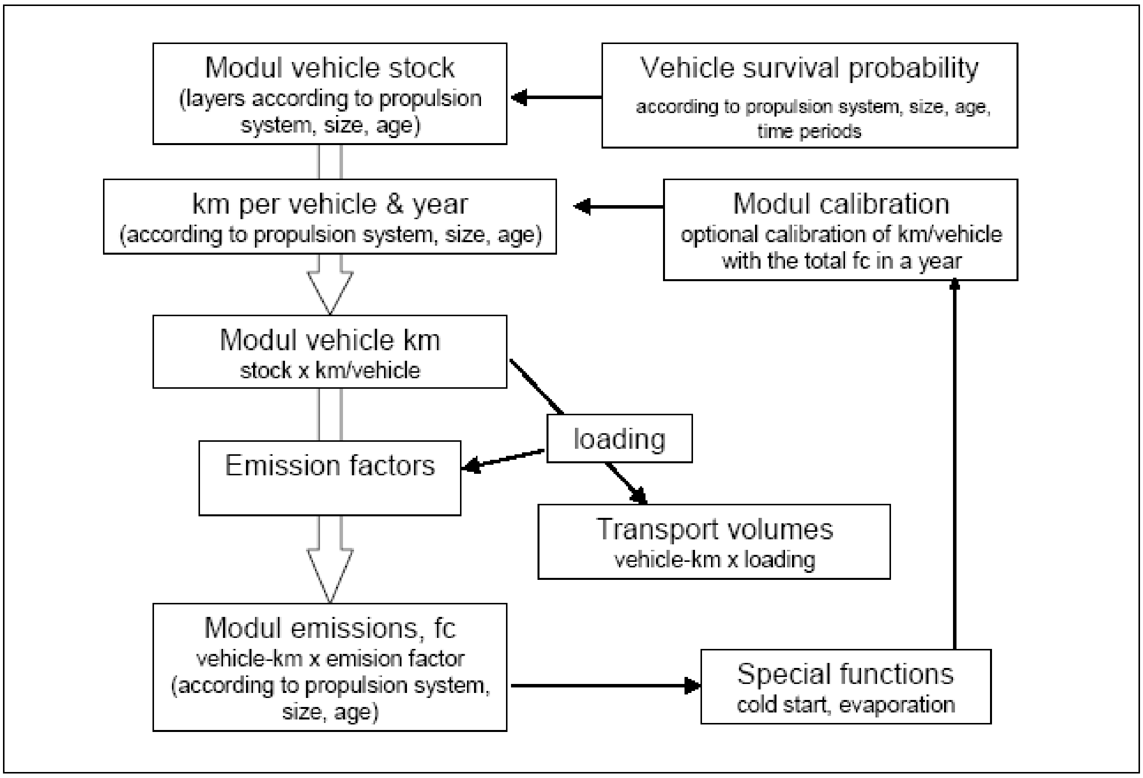

Figure 8: Schematic picture of the model GLOBEMI.

The calculation is done according to the following method for each year:

(1) Assessment of the vehicle stock split into layers according to the propulsion system (SI. CI...). cylinder capacity classes (or vehicle mass for HDV) and year of first registration using the vehicle survival probabilities and the vehicle stock of the year before.

$$stock_{Jg_i,\mathrm{year\,i}} = stock_{Jg_i,\mathrm{year\,i-1}} \times \mathrm{survival\ probability}_{Jg_i}$$

(2) Assessment of the km per vehicle for each vehicle layer using age and size dependent functions of the average mileage driven. If option switched on. iterative adaptation of the km per vehicle to meet the total fuel consumption targets.

(3) Calculation of the total mileage of each emission category (e.g. passenger car diesel. <1500ccm. EURO 3)

$$\text{total mileage}_{E_i} = \sum_{Jg=start.}^{end} (\text{stock}_{Jg,\text{year i}} \times \text{km/vehicle}_{Jg_i,\text{year i}})$$

(4) Calculation of the total fuel consumption and emissions of each emission category

$$\text{Emission}_{Ei} = \text{total mileage}_{Ei} \times \text{emission factor}_{Kj,\,Ei}$$

(5) Calculation of the total fuel consumption and emissions of each vehicle category

$$\text{Emission}_{\text{veh.category}} = \sum_{E_i=1}^{end} \text{Emission}_{E_i}$$

(6) Calculation of the total passenger-km and ton-km

$$\text{transport volumes}_{\text{veh.category}} = \sum_{E_i=1}^{end} (\text{vehicle mileage}_{E_i} \times \text{loading}_{E_i})$$

(7) Summation over all vehicle categories

with

Jgi....... Index for a vehicle layer (defined size class. propulsion type. year of first registration)

Ei........ Index for vehicles within a emission category (defined size class. propulsion type and exhaust certification level)

Emission factors used for GLOBEMI are based on a representative number of vehicles and engines measured in real world driving situations (HBEFA Vers. 2.1; ARTEMIS)

Activity data

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, multimodal 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 export (fuel sold in Austria but consumed abroad).

Since the end of the nineties an increasing discrepancy between the total Austrian fuel sales and the computed domestic fuel consumption became apparent. From 2003 onward this gap accounts for roughly 30 percent of the total fuel sales. A possible explanation of this discrepancy is the "fuel export in the vehicle tank" – due to the relatively low fuel prices in Austria (in comparison to the neighboring countries). Meaning that to a greater extent fuel is filled up in Austria and consumed abroad. This assumption is underpinned by a national study (MOLITOR; et al. 2009).

Table 97: Implied emission factors for NEC gases and CO and activities for 1A3b Road Transport 1990–2007.

Year	Activity	IEF NO_x	IEF SO_2	IEF NH_3	IEF NMVOC	IEF CO
	[PJ]	[t/PJ]				
1990	176.73	564.48	27.32	18.28	284.83	3.67
1995	204.62	484.45	27.88	30.99	212.42	2.74
2000	242.84	507.29	9.42	17.61	105.02	1.48
2005	330.70	464.68	0.49	8.59	48.77	0.82
2006	324.84	432.15	0.43	7.31	43.26	0.73
2007	331.14	413.86	0.40	6.19	37.63	0.65

Table 98: Implied emission factors for PM and activities for 1A3b Road Transport 1990–2007.

Year	Activity	IEF PM	IEF TSP Non Exhaust	IEF PM10 Non Exhaust	IEF PM2.5P Non Exhaust
	[PJ]	[t/PJ]			
1990	176.73	16.91	38.73	12.91	3.87
1995	204.62	20.08	39.59	13.20	3.96
2000	242.84	18.76	37.10	12.37	3.71
2005	330.70	15.10	30.13	10.04	3.01
2006	324.84	13.81	31.29	10.43	3.13
2007	331.14	12.57	31.87	10.62	3.19

Table 99: Implied emission factors for heavy metals and POPs and activities for 1A3b Road Transport 1990–2007.

Year	Activity	IEF Cd	IEF Hg	IEF Pb	IEF PAH	IEF Dioxin	IEF HCB
	[PJ]	[t/PJ]					
1990	176.73	0.00002	0.00001	0.87025	0.00494	0.00000	0.00000
1995	204.62	0.00002	0.00001	0.00006	0.00440	0.00000	0.00000
2000	242.84	0.00002	0.00001	0.00005	0.00481	0.00000	0.00000
2005	330.70	0.00002	0.00001	0.00004	0.00510	0.00000	0.00000
2006	324.84	0.00002	0.00001	0.00004	0.00510	0.00000	0.00000
2007	331.14	0.00002	0.00001	0.00004	0.00514	0.00000	0.00000

Emission factors

Emission factors are based on the "Handbook of Emission Factors" Version 2.1 (HAUSBERGER & KELLER 1998) and on ARTEMIS measurements (basically for passenger cars, light duty vehicles and motorcycles).

Recalculations

- Update of statistical energy
- Activity data for the years 1990-2007 based on VMOe (vehicle km. passenger km and ton km)

Planned Improvements

- Introduction of a new "Handbook of Emission Factors" Version (updated emission factors for all vehicle categories)

4.2.4 Other mobile sources – Off Road

Methodology

Energy consumption and emissions of off-road traffic in Austria are calculated with the model GEORG (Grazer Emissionsmodell für Off Road Geräte). This model has been developed within a study about off road emissions in Austria (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 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.

Input data to the model are:

- Machinery stock data (obtained from data on licences. through inquiries and statistical extrapolation)
- Assumptions on drop out rates of machinery (broken down machinery will be replaced)
- Operating time (obtained through inquiries). related to age of machinery

From machinery stock data and drop out rates an age structure of the off road machinery was obtained by GEORG. Emission factors for were defined for four categories of engine type depending on the year of construction. They are listed in Table 100 to Table 103. Depending on the fuel consumption of the engine the ratio power of the engine was calculated.

- Emissions were calculated by multiplying an engine specific emission factor (expressed in g/kWh) by the average engine power. the operating time and the number of vehicles

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.

The used methodology conforms to the requirements of the IPCC Tier 3 methodology.

Table 100: Emission Factors for diesel engines > 80 kW.

Year	Fuel	NO_x	NH_3	NMVOC	PM
			[t/TJ]		
1993	77	2.83	0.00	0.44	0.45
2001	73	3.44	0.00	0.33	0.25
2003	72	2.18	0.00	0.09	0.08
2006	75	1.44	0.00	0.14	0.05

Table 101: Emission Factors for diesel engines < 80 kW.

Year	Fuel	NO_x	NH_3	NMVOC	PM
			[t/TJ]		
1993	79	3.33	0.00	0.53	0.61
2001	75	3.03	0.00	0.40	0.47
2003	76	2.25	0.00	0.33	0.15
2006	76	1.75	0.00	0.18	0.08

Table 102: Emission Factors for 4-stroke-petrol engines.

Year	Fuel	NO_x	NH_3	NMVOC	PM
			[t/TJ]		
1993	156	0.85	0.00	4.42	0.01
2001	150	1.14	0.00	3.54	0.01
2003	130	1.25	0.00	3.38	0.01
2006	130	1.25	0.00	3.26	0.01

Table 103: Emission Factors for 2-stroke-petrol engines.

Year	Fuel	NO_x	NH_3	NMVOC	PM
			[t/TJ]		
1993	205	0.29	0.00	68.83	0.12
2001	187	0.32	0.00	48.41	0.08
2003	181	0.47	0.00	45.73	0.08
2006	139	0.39	0.00	14.03	0.08

Activity

Activity data, vehicle stock and specific fuel consumption for vehicles and machinery were taken from:

- Statistik Austria (fuel statistic)
- questionnaire to vehicle and machinery user
- information from vehicle and machinery manufacturer
- interviews with experts
- expert judgement.

Recalculations

- Updated energy data for all off road sectors according to the energy statistic for the years 1990-2007.
- Updated emission factors for all off road machienes (based on a new off road study. HAUSBERGER 2008. not published)

Planned Improvements

No additional investigations are planned.

4.2.4.1 NFR 1 A 2 f Manufacturing Industries and Construction – Other – mobile sources

Emissions from this category are presented in the following table.

Table 104: Emissions from off-road – Industry 1990–2007

Year	NO_x	SO_2	NH_3	NMVOC	PM
			[Gg]		
1990	3.05	0.21	0.001	0.52	0.53
1995	4.56	0.09	0.001	0.67	0.64
2000	7.92	0.12	0.002	0.94	0.80
2005	7.25	0.02	0.002	0.78	0.61
2006	6.79	0.02	0.002	0.76	0.51
2007	6.45	0.00	0.002	0.74	0.47
Trend 1990–2007	*111%*	*-98%*	*83%*	*42%*	*-11%*

Activity data

Activities as well as the implied emission factors for mobile sources of 1 A 2 f Manufacturing Industries and Construction are presented in the following table:

Table 105: Implied emission factors and activities for off-road transport in industry (NFR 1 A 2 f Manufacturing Industries and Construction – mobile) 1990–2007.

Year	Activity	IEF NO_x	IEF SO_2	IEF NH_3	IEF NMVOC	IEF PM
	[PJ]			[t/PJ]		
1990	3.47	878.94	59.33	0.32	149.37	151.92
1995	4.85	941.34	18.54	0.30	138.24	132.43
2000	7.69	1 029.77	16.19	0.27	121.94	103.84
2005	8.52	850.91	2.33	0.24	91.66	71.66
2006	9.94	682.53	2.32	0.21	76.26	51.50
2007	10.33	624.13	0.47	0.19	71.40	45.60

4.2.4.2 NFR 1 A 3 c Railways

Only diesel oil 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 106: Emissions from railways 1990–2007.

Year	NO_x	SO_2	NH_3	NMVOC	PM	PM non-exhaust
				[Gg]		
1990	1.95	0.26	0.00	0.30	0.20	0.52
1995	1.75	0.22	0.00	0.25	0.15	0.52
2000	1.77	0.10	0.00	0.24	0.11	0.52
2005	1.37	0.06	0.00	0.17	0.06	0.52
2006	1.35	0.06	0.00	0.17	0.06	0.52
2007	1.34	0.06	0.00	0.17	0.06	0.52
Trend 1990–2007	*-31%*	*-78%*	*-44%*	*-44%*	*-72%*	*0%*

Activities used for estimating the emissions and implied emission factors are presented in the following tables:

Table 107: Activities railways 1990–2007.

Year	Activity [PJ]
1990	2.33
1995	2.22
2000	2.43
2005	2.23
2006	2.35
2007	2.36

Table 108: Emission factors for railways 1990–2007.

Year	IEF NO_x	IEF SO_2	IEF NH_3	IEF NMVOC	IEF PM Total
			[t/PJ]		
1990	834.93	111.73	0.93	127.89	307.44
1995	788.19	98.53	0.83	114.75	299.42
2000	731.08	42.23	0.72	99.06	258.69
2005	614.90	25.83	0.57	78.41	261.29
2006	576.74	24.52	0.53	72.87	246.22
2007	567.53	24.41	0.52	71.05	243.90

4.2.4.3 NFR 1 A 3 d Navigation

Table 109: Emissions from navigation 1990–2007

Year	NO_x	SO_2	NH_3	NMVOC	PM
			[Gg]		
1990	0.46	0.04	0.00	0.60	0.10
1995	0.57	0.04	0.00	0.59	0.12
2000	0.70	0.02	0.00	0.56	0.13
2005	0.79	0.02	0.00	0.50	0.13
2006	0.69	0.02	0.00	0.46	0.11
2007	0.73	0.02	0.00	0.45	0.12
Trend 1990–2007	*57%*	*-45%*	*36%*	*-25%*	*11%*

Activities used for estimating the emissions and the implied emission factors are presented in the following table:

Table 110: Activities for navigation 1990–2007.

Year	Activity [PJ]
1990	0.71
1995	0.83
2000	0.96
2005	1.05
2006	0.94
2007	1.00

Table 111: Emission factors for navigation 1990–2007.

Year	IEF NO_x	IEF SO_2	IEF NH_3	IEF NMVOC	IEF PM
			[t/PJ]		
1990	651.33	50.52	0.21	842.22	146.56
1995	685.62	42.80	0.21	713.08	144.38
2000	733.90	20.79	0.21	585.02	138.54
2005	750.31	20.45	0.21	473.10	123.97
2006	730.99	20.01	0.20	489.12	118.38
2007	726.31	19.94	0.20	447.00	116.14

4.2.4.4 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 decreased over the period from 1990 to 2007. especially SO_2 emissions decreased to a greater extend due to decreasing emission factors.

Table 112: Emissions from off-road – household and gardening 1990–2007.

Year	NO_x	SO_2	NH_3	NMVOC	PM
			[Gg]		
1990	0.81	0.06	0.00	4.78	0.13
1995	0.93	0.02	0.00	4.60	0.11
2000	0.96	0.02	0.00	3.81	0.09
2005	0.78	0.00	0.00	3.19	0.05
2006	0.77	0.00	0.00	2.89	0.05
2007	0.70	0.00	0.00	2.59	0.04
Trend 1990–2007	*-13%*	*-98%*	*-29%*	*-46%*	*-67%*

Activities used for estimating emissions and the implied emission factors are presented in the following table.

Table 113: Emission factors and activities for off-road – household and gardening 1990–2007.

Year	Activity [PJ]
1990	1.93
1995	1.96
2000	1.92
2005	1.89
2006	1.89
2007	1.88

Table 114: Emission factors and activities for off-road – household and gardening 1990–2007.

Year	IEF NO_x	IEF SO_2	IEF NH_3	IEF NMVOC	IEF PM
			[t/PJ]		
1990	419.20	29.29	0.15	2 478.31	68.20
1995	472.98	10.89	0.14	2 343.69	53.53
2000	502.39	9.77	0.14	1 989.64	46.30
2005	413.92	2.34	0.12	1 684.98	27.40
2006	404.09	2.32	0.12	1 526.59	25.13
2007	372.06	0.46	0.11	1 377.05	23.24

4.2.4.5 NFR 1 A 4 c Agriculture and forestry – mobile sources

Emissions from this category decreased over the period from 1990 to 2007. especially SO_2 emissions decreased by about 99% due to decreasing emission factors.

Table 115: Emissions from off-road – agriculture 1990–2007.

Year	NO_x	SO_2	NH_3	NMVOC	PM
			[Gg]		
1990	8.47	0.54	0.00	1.93	1.85
1995	8.39	0.17	0.00	1.82	1.70
2000	8.89	0.15	0.00	1.72	1.59
2005	8.96	0.02	0.00	1.62	1.38
2006	8.77	0.02	0.00	1.56	1.30
2007	8.31	0.00	0.00	1.48	1.20
Trend 1990–2007	*-2%*	*-99%*	*-14%*	*-24%*	*-35%*

Activities used for estimating the emissions and the implied emission factors are presented in the following tables.

Table 116: Activities for off-road – agriculture 1990–2007.

Year	Activity [PJ]
1990	9.06
1995	9.05
2000	9.52
2005	10.27
2006	10.56
2007	10.31

Table 117: Emission factors for off-road – agriculture 1990–2007.

Year	IEF NO_x	IEF SO_2	IEF NH_3	IEF NMVOC	IEF PM
			[t/PJ]		
1990	934.40	60.10	0.46	213.24	203.85
1995	926.89	18.46	0.45	201.35	187.63
2000	934.06	16.18	0.42	181.24	167.04
2005	871.92	2.35	0.38	157.31	134.12
2006	830.75	2.30	0.36	147.97	123.56
2007	805.38	0.46	0.35	143.15	115.92

Table 118: Emissions from off-road – forestry 1990–2007.

Year	NO_x	SO_2	NH_3	NMVOC	PM
			[Gg]		
1990	0.87	0.06	0.00	2.33	0.24
1995	0.87	0.02	0.00	2.03	0.22
2000	0.91	0.02	0.00	1.80	0.21
2005	0.92	0.00	0.00	1.94	0.20
2006	0.91	0.00	0.00	2.19	0.20
2007	0.86	0.00	0.00	1.92	0.18
Trend 1990–2007	*-2%*	*-99%*	*-14%*	*-18%*	*-24%*

Table 119: Activities for off-road – forestry 1990–2007.

Year	Activity [PJ]
1990	1.11
1995	1.08
2000	1.11
2005	1.23
2006	1.30
2007	1.24

Table 120: Emission factors for off-road – forestry 1990–2007.

Year	IEF NO_x	IEF SO_2	IEF NH_3	IEF NMVOC	IEF PM
			[t/PJ]		
1990	785.14	50.37	0.39	2 095.64	219.17
1995	799.48	16.32	0.39	1 872.24	203.40
2000	815.62	14.56	0.37	1 619.36	187.14
2005	748.69	2.35	0.33	1 585.00	163.69
2006	701.42	2.31	0.31	1 691.43	157.36
2007	689.85	0.46	0.31	1 552.15	148.93

4.2.5 NFR 1 A 5 Other Military

In this category military off-road transport and military aviation are considered.

4.2.5.1 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 121: Emissions from military off road transport 1990–2007 [Gg].

Year	NO_x	SO_2	NH_3	NMVOC	PM
			[Gg]		
1990	0.02389	0.00172	0.00001	0.00397	0.00428
1995	0.02506	0.00053	0.00001	0.00371	0.00376
2000	0.02819	0.00045	0.00001	0.00312	0.00267
2005	0.02404	0.00006	0.00001	0.00225	0.00182
2006	0.02191	0.00006	0.00001	0.00202	0.00156
2007	0.01986	0.00001	-	0.00182	0.00133
Trend 1990–2007	-21%	-98%	-100%	-51%	-65%

Activities used and implied emission factors are presented in the following tables.

Table 122: Activities for military off road transport 1990–2007.

Year	Activity [PJ]
1990	0.03
1995	0.03
2000	0.03
2005	0.03
2006	0.03
2007	0.03

Table 123: Emission factors for military off road transport 1990–2007.

Year	IEF NO_x	IEF SO_2	IEF NH_3	IEF NMVOC	IEF PM
			[t/PJ]		
1990	832.87	59.96	0.35	138.41	149.21
1995	884.64	18.71	0.35	130.97	132.73
2000	1 025.55	16.37	0.36	113.51	97.13
2005	882.34	2.20	0.37	82.58	66.80
2006	799.21	2.19	0.36	73.68	56.90
2007	722.60	0.36	-	66.22	48.39

4.2.5.2 Military aviation

For the years 1990–1999 emission estimates were taken from an aviation study commissioned by the Umweltbundesamt (KALIVODA et al. 2002)

For the years 1999–2007 emissions for military flights have been calculated with IEF from the year 2000 by the study mentioned above (KALIVODA et al. 2002).

Calculation of emissions from military aviation did not distinguish between LTO and cruise.

Table 124: Emissions and activities military aviation 1990–2007.

Year	NO_x	SO_2	NMVOC	NH_3	Activity
	[Mg]				[PJ]
1990	50.66	10.49	11.24	0.07	0.46
1995	46.93	9.72	10.41	0.07	0.42
2000	59.73	12.37	13.25	0.08	0.53
2005	64.06	13.26	14.21	0.09	0.57
2006	64.92	13.44	14.41	0.09	0.58
2007	65.79	13.62	14.60	0.09	0.59

Recalculations

Fuel consumption for the years 2000–2007 was extrapolated from 1990–1999.

Emissions for Military flights have been calculated with IEF´s from the year 2000 by the study mentioned above (KALIVODA et al. 2002).

Planned Improvements

Further investigations concerning fuel consumption, operation hours and military aircraft types.

4.2.6 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 39. 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 125: 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 126: 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.[99]

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.

[99] 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).

Table 127: 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.

4.3 NFR 1 B Fugitive Emissions

No changes regarding methodology and emission factor were made since submission 2008.

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.

4.3.1 Completeness

Table 128 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 128: 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 transformation(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*

4.3.2 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 129 together with the national emission factors (WINIWARTER et al. 2001).

Table 129: 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	2 042.24	1 629.94	2 319.99
2002	1 942.23	1 560.94	2 589.07
2003	2 410.56	1 653.98	2 519.40
2004	2 426.01	1 212.01	2 511.29
2005	2 154.61	1 286.27	2 750.68
2006	2 355.75	764.84	2 788.21

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 130.

Table 130: 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 131: 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

Year	Gas extraction/first treatment			Gas distribution	
	IEF [g/1000m^3] NMVOC	IEF [g/1000 m^3] SO_2	Natural gas extracted [1000 m^3]	EF [g/km]	Distribution mains [km]
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

4.3.3 Recalculations

Activity data for 1 B 1 for the years 2001-2006 were updated due to updated energy statistics.

5 INDUSTRIAL PROCESSES (NFR SECTOR 2)

No changes regarding methodology and emission factor were made since submission 2008.

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.

5.2 General description

5.2.1 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.

5.2.2 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 132. 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 132: 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.

5.2.3 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 2006 has been updated.

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

Activity data for 2006 has been updated.

5.2.4 Completeness

Table 133 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 133: 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
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*

5.3 NFR 2 A Mineral Products

Key source: TSP, PM10, PM2.5, CO

5.3.1 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, from lime that are reported in NFR category 2 A 2, and from agricultural bulk material that are reported in NFR category 4 D 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). The latter 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)[100]. Emission factors are presented in Table 134. Activity data are mainly taken from national statistics and presented in Table 135.

Table 134: 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)

[100] http://www.air.sk/tno/cepmeip/em_factors_results.php?

Table 135: 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
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

5.3.2 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 136: 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

5.3.3 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".

5.3.4 Recalculations

No recalculations have been required for this version of the inventory.

5.4 NFR 2 B Chemical Products

Key source: SO_2, CO

5.4.1 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 137 and Table 138). 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 137: 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 138: 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.

5.4.2 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 139: 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

Year	NH_3 emission [Mg]	NH_3 IEF [g/Mg]	TSP emission [Mg]	PM10 emission [Mg]	PM2.5 emission [Mg]
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 140: 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
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[101] (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*.

[101] 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.

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 141: 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
2000	71	73
2001	75	56
2002	74	22
2003	77	26
2004	47	20
2005	89	25
2006	70	32

Table 142: 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 143.

Table 143: 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 144: 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

5.4.3 Recalculations

No recalculations have been required for this version of the inventory.

5.5 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.

5.5.1 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[102]), (HÜBNER 2001b[103]) 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[104]). 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.

[102] according to EUROPEAN COMMISSION IPPC BUREAU (2000); MA LINZ (1995)

[103] according to HÜBNER, C. et al. (2000); EUROPEAN COMMISSION IPPC BUREAU (2000); UBA BERLIN (1998)

[104] according to VOEST (2000)

Pig iron production figures were taken from national statistics. Activity data, POP, HM and PM emissions are presented in Table 145.

Table 145: 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

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[105]), 1995–2000 (HÜBNER 2001a[102]), 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[103]).

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 146; particular matter emissions are reported together with emissions from blast furnace charging.

Table 146: 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	13	1	470	0.01	0.23	46	IE	IE	IE
2000	5 183 461									
2004	5 900 810									
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 147 together with electric steel production figures.

105 according to CORINAIR (1995), VAN DER MOST et.al. (1992), WINIWARTER & SCHNEIDER (1995)

Table 147: 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)
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[105])*

(5) *(HÜBNER 2001a[102])*

(6) *(HÜBNER 2001b[103])*

(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 148: 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 149: 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

5.5.2 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[106]) 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.

Table 150: 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 151: 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

5.5.3 Recalculations

No recalculations have been required for this version of the inventory.

106 according to WURST, F. & C.HÜBNER (1997); UBA data base; EUROPEAN COMMISSION IPPC BUREAU (2000) ; NEUBACHER, F. et al. (1993)

5.6 NFR 2 D Other Production

Key source: NMVOC, TSP

5.6.1 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 152: 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 153: 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 154: 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 2006 was updated using statistical data, for the last submission this value was not available.

5.6.2 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[107]) 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 155.

Table 155: 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				

[107] according to MEISTERHOFER (1986)

Recalculations

Activity data (bread, wine, beer, spirits) for the year 2006 were updated using statistical data, for the last submission these values were not available.

5.6.3 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.

Table 156: 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

No recalculations have been required for this version of the inventory.

6 SOLVENT AND OTHER PRODUCT USE (CRF SOURCE CATEGORY 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 (see UMWELTBUNDESAMT 2009). Solvents are chemical compounds, which are used to dissolve substances as paint, glues, ink, rubber, plastic, pesticides or for cleaning purposes (degreasing). 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.
- PM from NFR 3 D 3 Other (Fireworks and Tobacco Smoking)

The following activities are covered by NFR sector 3:

NFR category	Description
3	SOLVENT AND OTHER PRODUCT USE
3 A	PAINT APPLICATION
3 A 1	Decorative coating application
3 A 2	Industrial coating application
3 A 3	Other coating application (Please specify)
3 B	DEGREASING AND DRY CLEANING
3 B 1	Degreasing
3 B 2	Dry cleaning
3 C	3 Chemical products
3 D	OTHER including products containing HMs and POPs
3 D 1	Printing
3 D 2	Domestic solvent use including fungicides
3 D 3	Other product use

6.1.1 Emission Trends

In the year 2007, 58% of total NMVOC emissions in Austria (104 Gg) originated from *Solvent and Other Product Use*. Figure 9 and Table 157 present the trend in NMVOC emissions by sub-categories.

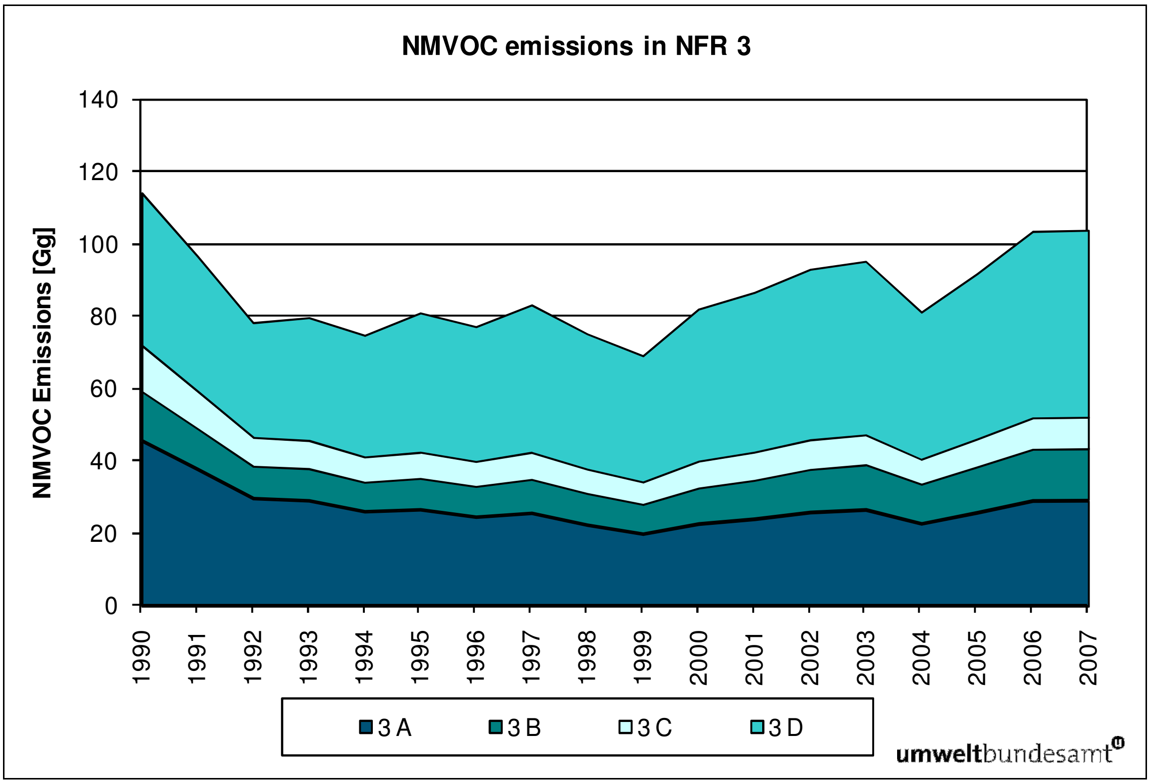

Figure 9: Total NMVOC emissions and trend from 1990–2007 by subcategories of Category 3 Solvent and Other Product Use.

Table 157: Total NMVOC emissions and trend from 1990–2007 by subcategories of Category 3 Solvent and Other Product Use.

	3	3 A	3 A 1	3 A 2	3 B	3 B 1	3 B 2	3 C	3 D	3 D 1	3 D 2	3 D 3
						NMVOC [Gg]						
1990	114.4	45.8	15.2	30.6	13.7	13.3	0.4	12.8	42.2	12.7	11.6	17.9
1991	96.9	37.9	12.8	25.0	11.3	10.9	0.4	10.4	37.4	10.8	11.2	15.4
1992	78.5	29.8	10.4	19.4	8.9	8.5	0.3	8.1	31.7	8.8	10.2	12.7
1993	79.9	29.2	10.5	18.7	8.8	8.4	0.3	8.0	34.0	9.0	11.8	13.2
1994	75.0	26.2	9.8	16.3	8.1	7.7	0.3	7.2	33.6	8.5	12.5	12.7
1995	81.3	26.7	10.6	16.1	8.6	8.2	0.4	7.4	38.6	9.3	15.3	14.0
1996	77.5	24.7	9.9	14.8	8.4	8.0	0.4	7.1	37.3	8.5	15.3	13.4
1997	83.5	25.7	10.4	15.3	9.3	8.9	0.4	7.7	40.8	8.9	17.4	14.5
1998	75.5	22.4	9.1	13.3	8.6	8.2	0.4	7.0	37.4	7.8	16.5	13.2
1999	69.4	19.9	8.2	11.7	8.1	7.8	0.3	6.4	35.0	6.9	15.9	12.2
2000	82.3	22.7	9.4	13.3	9.8	9.4	0.4	7.7	42.1	7.8	19.8	14.5
2001	86.9	24.1	10.0	14.1	10.7	10.2	0.4	7.9	44.2	8.0	20.7	15.4
2002	93.3	25.9	10.8	15.2	11.8	11.3	0.5	8.4	47.2	8.4	22.1	16.6
2003	95.5	26.6	11.1	15.6	12.4	11.9	0.5	8.4	48.0	8.3	22.5	17.1
2004	81.4	22.8	9.5	13.3	10.9	10.5	0.4	7.0	40.7	6.9	19.1	14.7
2005	92.1	25.9	10.8	15.1	12.7	12.2	0.5	7.8	45.8	7.6	21.5	16.7
2006	103.8	29.1	12.2	17.0	14.3	13.7	0.5	8.8	51.6	8.5	24.2	18.9
2007	104.1	29.2	12.2	17.0	14.3	13.8	0.5	8.8	51.7	8.5	24.3	18.9

	3	3 A	3 A 1	3 A 2	3 B	3 B 1	3 B 2	3 C	3 D	3 D 1	3 D 2	3 D 3
						NMVOC [Gg]						
Trend												
1990–2007	-9.0%	-36.2%	-19.7%	-44.4%	4.4%	3.7%	25.9%	-30.9%	22.7%	-32.5%	109.2%	5.7%
2006–2007	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%
Share in Sector												
1990		40.0%	13.3%	26.7%	12.0%	11.6%	0.4%	11.2%	36.8%	11.1%	10.1%	15.6%
2007		28.1%	11.7%	16.4%	13.7%	13.2%	0.5%	8.5%	49.7%	8.2%	23.3%	18.2%
Share in National Total												
1990	41.8%	16.7%	5.6%	11.2%	5.0%	4.8%	0.2%	4.7%	15.4%	4.6%	4.2%	6.5%
2007	57.9%	16.3%	6.8%	9.5%	8.0%	7.6%	0.3%	4.9%	28.8%	4.8%	13.5%	10.5%

NMVOC in this sector decreased by 9% between 1990 and 2007, due to decreasing solvent as well as due to the positive impact of the enforced laws and regulations in Austria:

- Solvent Ordinance: 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[108], amendment of Federal Law Gazette 872/1995[109]; amendment of Federal Law Gazette 492/1991[110] (implementation of Council Directive 2004/42/CE)*
- Ordinance for paint finishing system (surface technology systems): 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[111], amendment of Federal Law Gazette 27/1990[112]*
- 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[113]*

[108] 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

[109] Verordnung des Bundesministers für Umwelt über Verbote und Beschränkungen von organischen Lösungsmitteln (Lösungsmittelverordnung 1995 – LMVO 1995), BGBl 872/1995

[110] Verordnung des Bundesministers für Umwelt, Jugend und Familie über Verbote und Beschränkungen von organischen Lösungsmitteln (Lösungsmittelverordnung), BGBl. Nr. 492/1991

[111] 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

[112] 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

[113] 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)

- 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*[114]
- Convention on Long-range Transboundary Air Pollution (LRTAP)[115], extended by eight protocols from which the following have relevance
  - The 1988 Protocol concerning the Control of Nitrogen Oxides or their Transboundary Fluxes[116]
  - The 1991 Protocol concerning the Control of Emissions of Volatile Organic Compounds or their Transboundary Fluxes[117]
  - The 1998 Protocol on Persistent Organic Pollutants (POPs)[118]
  - The 1999 Protocol to Abate Acidification, Eutrophication and Ground-level Ozone; 21 Parties.[119]
- 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*[120]*, amended by Federal Law Gazette*[121]
- Council Directive 1999/13/EC[122] 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[123] 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

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[114] 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

[115] Entered into force 14 February 1991; ratified by Austria 16 December 1982; See for more information UMWELTBUNDESAMT (2009): Informative Inventory Report. Vienna.

[116] Entered into force 14 February 1991; ratified by Austria 15 January 1990; BGBl. Nr. 273/1991

[117] 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

[118] Entered into force on 23 October 2003; ratified by Austria 27 August 2002

[119] Entered into force on 17 May 2005; signed by Austria 1 December 2000

[120] 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

[121] Änderung der VOC-Anlagen-Verordnung – VAV, BGBl. II Nr. 42/2005

[122] 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

[123] 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

- *Federal Law Gazette II No. 411/2005*[124]

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

6.1.2 Completeness

Table 158 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 158: 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	✓

[124] 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

6.2 NMVOC Emissions from Solvent and Other Product Use (NFR Category 3 A, 3 B, 3 C and 3 D)

6.2.1 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 10 to Figure 12 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.

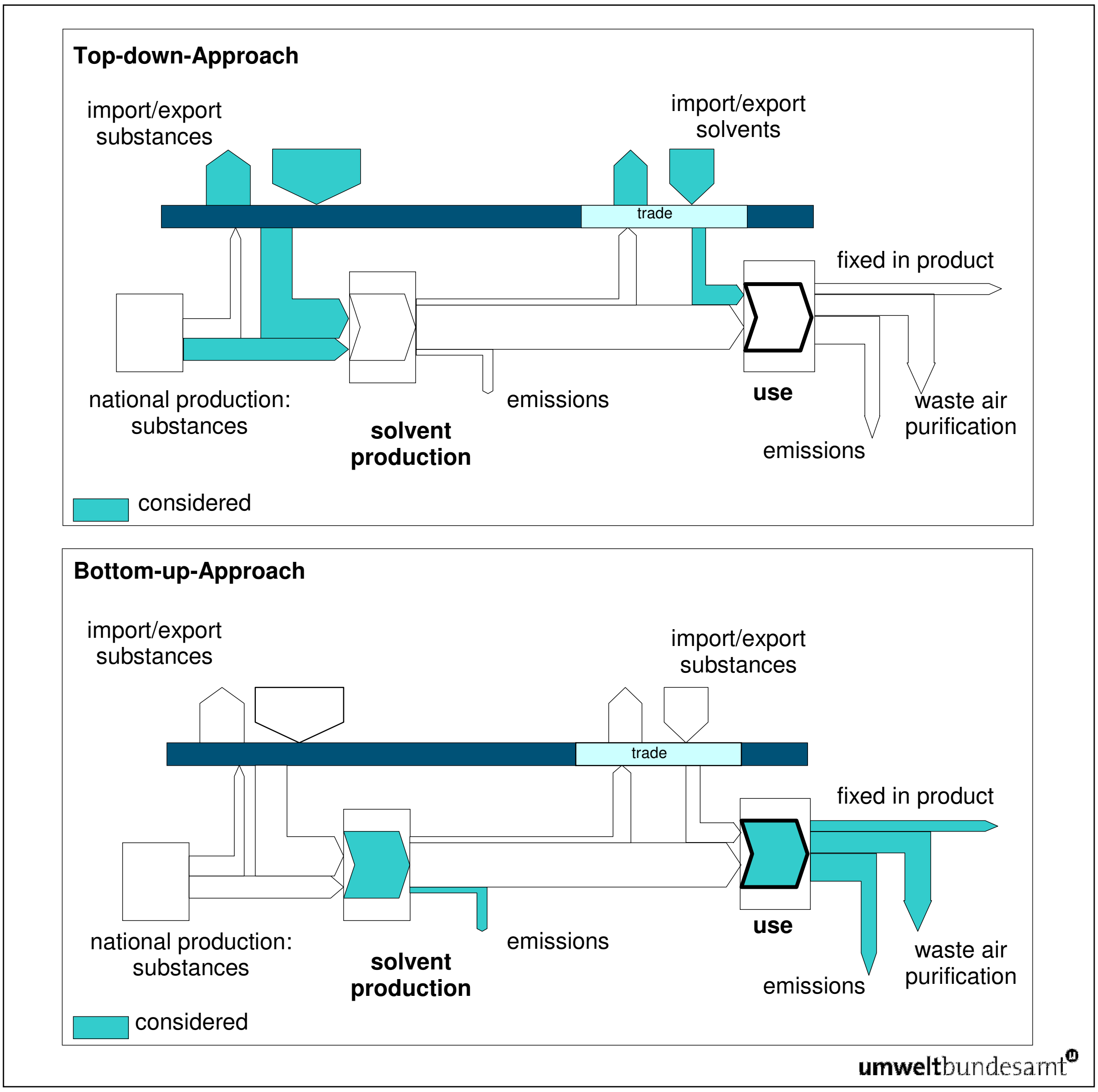

Figure 10: Top-down-Approach compared to Bottom-up-Approach.

Top-down (CRF Sector 3)

Imp/Exp Solvent products	17
Inland Solvent production	21
Imp/Exp Organic Substances	372
Non-solvent applications	-250
Substances used as solvents	122
Solvents in applications	143
Solvent Activity	160

Bottom-up									Combination Top-down to Bottom-up					
CRF Sector 3A-3D	SNAP Level 3		Solvent Share			Solvent Emission Factor			Solvent Activity			Solvent Emissions		
			CRF 3	CRF 3A-D	SNAP Lev 3	CRF 3	CRF 3A-D	SNAP Lev 3	CRF 3	CRF 3A-D	SNAP Lev 3	CRF 3	CRF 3A-D	SNAP Lev 3
3 A, Paint application	060101	Manufacture of automobiles	100%	37%	1,7%	58%	43%	59%	159,6	59,5	2,6	92,1	25,9	1,6
	060102	Car repairing			0,7%			88%			1,1			1,0
	060103	Construction and buildings			3,2%			89%			5,1			4,5
	060104	Domestic use			1,4%			89%			2,2			2,0
	060105	Coil coating			3,4%			52%			5,5			2,8
	060107	Wood coating			3,1%			67%			4,9			3,3
	060108	Other industrial paint application			23,8%			28%			38,0			10,7
3 B, Degreasing and Dry Cleaning	060201	Metal degreasing		14%	6,0%		55%	43%		22,9	9,6		12,7	4,1
	060202	Dry cleaning			0,4%			84%			0,6			0,5
	060203	Electronic components manufact.			1,0%			38%			1,6			0,6
	060204	Other industrial cleaning			6,9%			68%			11,0			7,5
3 C, Chemical Products, Manufacture and Processing	060305	Rubber processing		10%	0,3%		51%	93%		15,4	0,5		7,8	0,5
	060306	Pharmaceutical products manufact.			5,7%			26%			9,1			2,4
	060307	Paints manufacturing			0,8%			100%			1,3			1,3
	060308	Inks manufacturing			0,2%			100%			0,3			0,3
	060309	Glues manufacturing			0,4%			100%			0,7			0,7
	060310	Asphalt blowing			0,5%			1%			0,8			0,0
	060311	Adhesive, films & photographs			0,0%			94%			0,0			0,0
	060312	Textile finishing			0,0%			88%			0,0			0,0
	060314	Other manufacturing			1,7%			100%			2,6			2,6
3 D, Other	060403	Printing industry		39%	7,3%		74%	65%		61,9	11,6		45,8	7,6
	060404	Fat and oil extraction			0,1%			20%			0,2			0,0
	060405	Application of glues and adhesives			0,2%			63%			0,4			0,2
	060406	Preservation of wood			0,5%			99%			0,8			0,8
	060407	Treatment & conservation of			0,1%			85%			0,2			0,2
	060408	Domestic solvent use (other)			16,0%			84%			25,5			21,5
	060411	Domestic use of pharma. products			4,4%			94%			7,1			6,7
	060412	Other (preservation of seeds,…)			10,1%			55%			16,1			8,8

Figure 11: Combination of Top-down-Approach compared to Bottom-up-Approach for 2007.

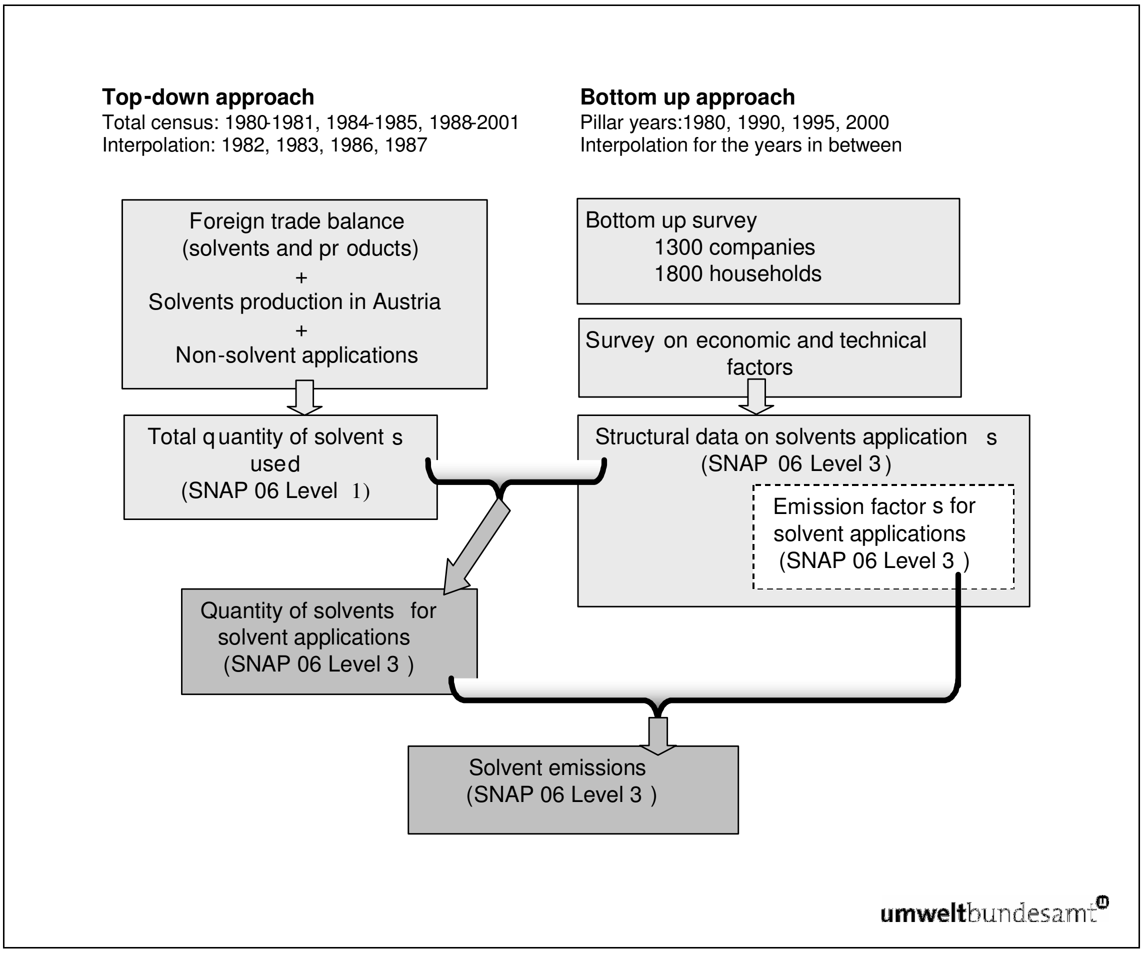

Figure 12: Overview of the methodology for solvent emissions.

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[125], ETBE[126], 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 and ETBE 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.

[125] Methyl-tertiär-butylether

[126] Ethyl-*tert*-butylether

6.2.2 Top down Approach

The top-down approach is based on

import-export statistics (foreign trade balance)

production statistics on solvents in Austria

- a survey on non-solvent-applications in companies (WINDSPERGER et al. 2004a, WINDSPERGER et al. 2008)
- survey on the solvent content in products and preparations at producers and retailers (WINDSPERGER et al. 2002a, WINDSPERGER et al. 2008)

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 2007 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". In 2008 these companies were requested to report the quantities of used solvents for the time period 2002-2007 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.

6.2.3 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.

Furthermore information were gathered about

- type of application of the solvents
  - final application
  - cleaner
  - product preparation
- type of waste gas treatment
  - open application
  - waste gas collection
  - 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 159).

Table 159: 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

The above mentioned survey was carried out at all industrial branches with solvent applications, results for solvent use per substance category were collected at NACE-level-4. The total amounts of solvents used per industrial branch were extrapolated using the number of employees (the values of "solvent use per employee" of the sample was multiplied by total employment of the industrial branch taken from (KSV1870 INFORMATION, 2000) in comparison with national employment statistics (STATISTIK AUSTRIA 2000 & 1998).)

For three pillar years (1980, 1990, 1995) the values for solvent use were extrapolated using the factor "solvent use per employee" of the year 2000 and the number of employees of the respective year taken from national statistics (Statistik Austria 2001)(WINDSPERGER et al. 2004a). For the pillar year 2005 the structural business statistics (number of employees (NACE Rev.1.1)) were taken from (EUROSTAT 2008).

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, that 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. The 2000 data was also used for the subsequent years as no new survey has been conducted.

Table 160: General aspects and their development.

General aspects	1980	1990	1995	2000	2005
efficiency factor solvent cleaning	250%	150%	130%	100%	100%
efficiency factor application	150%	110%	105%	100%	100%
solvent content of water-based paints	15%	12%	10%	8%	8%
solvent content of solvent-based paints	60%	58%	55%	55%	55%
efficiency of waste gas purification	70%	75%	78%	80%	80%

Table 161: 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	2005 2000	73%	27%	10%	0%
		1995	80%	20%	8%	0%
		1990	90%	10%	5%	0%
		1980	100%	0%	0%	0%
060102	car repairing	2005 2000	51%	49%	62%	1%
		1995	55%	45%	60%	0%
		1990	75%	25%	10%	0%
		1980	85%	15%	5%	0%
060107	wood coating	2005 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	2005 2000	97%	3%	90%	46%
		1995	99%	1%	87%	45%
		1990	100%	0%	26%	20%
		1980	100%	0%	0%	0%
060201	Metal degreasing	2005 2000	92%	8%	75%	0%
		1995	95%	5%	65%	0%
		1990	100%	0%	10%	0%
		1980	100%	0%	0%	0%

SNAP category	description	Year	Distribution of used paints		Part of waste gas treatment	
			Solvent based paints	Water based paints	application	purification
060403	Printing industry	2005			44%	17%
		2000				
		1995			29%	10%
		1990			10%	5%
		1980			0%	0%
060405	Application of glues and adhesives	2005			58%	0%
		2000				
		1995			53%	0%
		1990			15%	0%
		1980			0%	0%
060103	Paint application : construction and buildings	2005	91%	9%	19%	4%
		2000				
		1995	93%	7%	15%	2%
		1990	100%	0%	5%	0%
		1980	100%	0%	0%	0%
060105	Paint application : coil coating	2005	100%	0%	63%	0%
		2000				
		1995	100%	0%	60%	0%
		1990	100%	0%	25%	0%
		1980	100%	0%	0%	0%
060406	Preservation of wood	2005	83%	17%	0%	0%
		2000				
		1995	85%	15%	0%	0%
		1990	95%	5%	0%	0%
		1980	100%	0%	0%	0%
060412	Other (preservation of seeds,…)	2005	100%	0%	90%	0%
		2000				
		1995	100%	0%	80%	0%
		1990	100%	0%	10%	0%
		1980	100%	0%	0%	0%

Table 162: 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**	**2005**
0601	**Paint application**					
060101	manufacture of automobiles	88%	82%	72%	100%	131%
060102	car repairing	94%	98%	96%	100%	107%
060103	construction and buildings	96%	90%	102%	100%	106%
060104	domestic use	separate analysed				
060105	coil coating	99%	113%	107%	100%	96%
060107	wood coating	107%	109%	112%	100%	90%
060108	industrial paint application	122%	112%	106%	100%	101%
0602	**Degreasing, dry cleaning and electronics**					
060201	Metal degreasing	151%	113%	83%	100%	104%
060202	Dry cleaning	63%	75%	88%	100%	103%
060203	Electronic components manufacturing	143%	122%	104%	100%	84%
060204	Other industrial cleaning	33%	77%	56%	100%	130%
0603	**Chemical products manufacturing and processing**					
060305	Rubber processing	110%	101%	102%	100%	75%
060306	Pharmaceutical products manufacturing	118%	112%	97%	100%	90%
060307	Paints manufacturing	118%	112%	97%	100%	101%
060308	Inks manufacturing	118%	112%	97%	100%	100%
060309	Glues manufacturing	118%	112%	98%	100%	62%
060310	Asphalt blowing	124%	120%	120%	100%	94%
060311	Adhesive, magnetic tapes, films and photographs	33%	57%	76%	100%	97%
060312	Textile finishing	241%	171%	132%	100%	71%
060314	Other	117%	112%	98%	100%	88%
0604	**Other use of solvents and related activities**					
060403	Printing industry	129%	125%	111%	100%	85%
060404	Fat, edible and non edible oil extraction	129%	116%	112%	100%	52%
060405	Application of glues and adhesives	239%	156%	104%	100%	56%
060406	Preservation of wood	108%	105%	100%	100%	110%
060407	Under seal treatment and conservation of vehicles	97%	102%	103%	100%	101%
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%	107%

A comprehensive summary on the methodology for the year 2000 can also be found in the Austrian Informative Inventory Report (UMWELTBUNDESAMT 2009).

6.2.4 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 in the pillar years (1980, 1990, 1995, 2000) by 15 defined categories of solvent groups. For the updated pillar year 2005 only the total difference is shown because no complete bottom up survey is carried out (see below Table 163). The differences between the quantities of solvents from the top down approach and bottom up approach between 1980 and 2000 respectively are lower than 15%. Since 2000 no new bottom up survey has been conducted, therefore the difference increased up to 25%. Table 163 shows the range of the differences in the considered pillar years broken down to the 15 substance categories.

Table 163: 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]
2005																	-44
2000																	-
1995																	-7
1990																	8
1980																	-26

	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 inventory has been updated with data from (WINDSPERGER et al. 2008) since the study (WINDSPERGER et al. 2002) has been published.

The following tables (Table 164, Table 165 and Table 166) present activity data, emission and implied emission factors.

Table 164: Activity data of Category 3 Solvent and other product use [Mg].

IPCC	3.A	3.A	3.A	3.A	3.A	3.A	3.A	3.A
SNAP	**Total**	**060101**	**060102**	**060103**	**060104**	**060105**	**060107**	**060108**
Unit	**Mg Solvent**							
1990	54 665	1 785	995	3 827	4 535	5 626	7 002	30 896
1991	48 827	1 515	889	3 542	3 558	5 061	6 139	28 124
1992	41 825	1 230	763	3 140	2 627	4 366	5 160	24 540
1993	45 119	1 254	823	3 502	2 382	4 742	5 460	26 956
1994	45 044	1 179	823	3 609	1 929	4 767	5 345	27 392
1995	52 085	1 280	953	4 304	1 714	5 550	6 059	32 226
1996	49 249	1 303	904	4 073	1 666	5 177	5 537	30 589
1997	52 612	1 495	968	4 355	1 830	5 452	5 702	32 809
1998	47 117	1 435	870	3 904	1 686	4 809	4 907	29 505
1999	42 917	1 399	796	3 559	1 581	4 311	4 281	26 991
2000	50 375	1 754	937	4 182	1 911	4 975	4 792	31 824
2001	53 751	1 977	1 007	4 485	2 035	5 231	4 979	34 036
2002	58 348	2 258	1 101	4 894	2 206	5 596	5 260	37 033
2003	60 385	2 451	1 148	5 090	2 279	5 707	5 297	38 414
2004	52 050	2 210	996	4 409	1 961	4 848	4 440	33 185
2005	59 503	2 637	1 146	5 065	2 239	5 461	4 935	38 021
2006	67 062	2 972	1 292	5 708	2 523	6 155	5 562	42 851
2007	67 244	2 980	1 295	5 724	2 530	6 171	5 577	42 968

IPCC	3.B	3.B	3.B	3.B	3.B
SNAP	**Total**	**060201**	**060202**	**060203**	**060204**
Unit	**Mg Solvent**				
1990	15 926	9 258	459	2 191	4 017
1991	14 001	7 866	408	1 902	3 826
1992	11 803	6 394	348	1 582	3 479
1993	12 527	6 528	373	1 655	3 971
1994	12 302	6 149	370	1 602	4 181
1995	13 990	6 687	426	1 794	5 083
1996	13 989	6 626	417	1 694	5 252
1997	15 792	7 415	461	1 808	6 107
1998	14 933	6 955	428	1 617	5 933
1999	14 353	6 634	404	1 471	5 844
2000	17 768	8 153	491	1 725	7 399
2001	19 305	8 694	523	1 768	8 320
2002	21 328	9 433	567	1 841	9 487
2003	22 452	9 757	586	1 826	10 283
2004	19 675	8 406	504	1 506	9 259
2005	22 857	9 604	576	1 645	11 032
2006	25 761	10 824	649	1 854	12 433
2007	25 831	10 854	651	1 859	12 467

IPCC	3.C	3.C	3.C	3.C	3.C	3.C	3.C	3.C	3.C	3.C
SNAP	Total	060305	060306	060307	060308	060309	060310	060311	060312	060314
Unit	Mg Solvent									
1990	18 585	977	8 272	3 170	359	829	1 329	3	157	3 488
1991	15 609	853	6 886	2 582	313	743	1 158	3	131	2 940
1992	12 525	714	5 470	1 998	262	639	967	3	105	2 369
1993	12 603	752	5 440	1 926	275	691	1 017	3	104	2 394
1994	11 679	733	4 973	1 695	268	692	989	3	96	2 230
1995	12 465	826	5 223	1 697	302	803	1 114	4	101	2 395
1996	12 305	749	5 614	1 525	282	791	987	4	89	2 265
1997	13 722	764	6 749	1 541	297	879	980	4	87	2 420
1998	12 828	650	6 746	1 298	263	819	809	4	71	2 167
1999	12 196	561	6 812	1 104	236	777	671	4	57	1 974
2000	14 943	619	8 813	1 200	273	949	708	5	59	2 318
2001	15 520	623	9 162	1 256	290	928	742	5	58	2 456
2002	16 393	636	9 687	1 337	312	917	791	6	59	2 648
2003	16 502	618	9 762	1 356	321	857	804	6	56	2 722
2004	13 829	498	8 190	1 146	275	661	680	5	44	2 331
2005	15 364	530	9 109	1 284	312	667	764	6	46	2 647
2006	17 316	597	10 266	1 448	352	752	861	6	51	2 983
2007	17 363	599	10 294	1 452	353	754	863	6	52	2 991

IPCC	3 D	3 D 1	3 D 4	3 D 4	3 D 2	3 D 4	3 D 3	3 D 3	3 D 4
SNAP	Total	060403	060404	060405	060406	060407	060408	060411	060412
Unit	Mg Solvent								
1990	48.748	14 729	510	836	677	217	13 842	4 984	12 952
1991	44.506	13 050	442	717	601	197	13 305	4 578	11 617
1992	38.946	11 089	366	588	512	171	12 200	4 029	9 992
1993	42.897	11 865	382	607	549	186	14 023	4 462	10 823
1994	43.705	11 749	369	579	545	188	14 857	4 569	10 849
1995	51.548	13 474	412	637	627	220	18 167	5 416	12 595
1996	49.960	12 541	369	601	594	203	18 238	5 265	12 149
1997	54.728	13 177	370	640	637	211	20 664	5 784	13 245
1998	50.278	11 594	309	571	572	183	19 608	5 329	12 110
1999	46.998	10 364	261	519	522	162	18 907	4 996	11 267
2000	56.640	11 925	280	607	615	184	23 476	6 038	13 515
2001	59.511	12 266	269	587	666	195	24 643	6 432	14 454
2002	63.611	12 824	259	572	732	210	26 317	6 971	15 725
2003	64.822	12 771	234	526	768	216	26 792	7 203	16 311
2004	55.014	10 582	173	397	671	186	22 717	6 199	14 090
2005	61.922	11 616	166	391	776	211	25 544	7 075	16 143
2006	69.788	13 092	187	440	875	238	28 789	7 974	18 193
2007	69.978	13 127	187	441	877	239	28 868	7 996	18 243

Table 165: NMVOC emission of Category 3 Solvent and Other Product Use 1990–2007.

IPCC	3.A	3 A 2	3 A 1	3 A 1	3 A 1	3 A 2	3 A 1	3 A 2
SNAP	**Total**	**060101**	**060102**	**060103**	**060104**	**060105**	**060107**	**060108**
Unit				**Mg**				
1990	45 789.5	1 678.6	971.0	3 658.7	4 011.7	4 732.9	6 563.3	24 173.3
1991	37 874.9	1 334.8	865.5	3 340.6	3 149.5	3 996.0	5 479.8	19 708.5
1992	29 790.0	1 010.8	739.9	2 920.7	2 327.2	3 221.6	4 375.6	15 194.3
1993	29 206.0	956.2	796.5	3 211.0	2 111.8	3 254.4	4 386.4	14 489.7
1994	26 166.1	829.5	793.5	3 262.6	1 711.4	3 025.1	4 055.8	12 488.2
1995	26 719.8	824.6	915.5	3 834.4	1 521.2	3 235.0	4 327.1	12 061.9
1996	24 663.0	821.0	856.5	3 618.9	1 478.7	2 962.4	3 907.4	11 018.1
1997	25 701.8	921.0	905.2	3 858.9	1 624.6	3 061.5	3 975.2	11 355.4
1998	22 436.9	863.9	801.9	3 449.6	1 496.9	2 649.2	3 379.4	9 796.0
1999	19 905.2	822.1	722.5	3 136.5	1 403.3	2 328.6	2 911.4	8 580.8
2000	22 737.6	1 006.1	838.7	3 675.2	1 695.9	2 634.0	3 218.8	9 668.9
2001	24 079.1	1 140.7	898.6	3 948.8	1 806.6	2 758.8	3 343.2	10 182.5
2002	25 941.7	1 311.1	979.2	4 315.9	1 957.9	2 939.5	3 531.4	10 906.6
2003	26 644.7	1 432.2	1 017.2	4 496.9	2 023.1	2 986.0	3 555.0	11 134.3
2004	22 792.3	1 299.3	879.9	3 902.0	1 741.0	2 526.1	2 979.5	9 464.4
2005	25 857.8	1 559.5	1 009.4	4 490.2	1 987.3	2 834.3	3 310.5	10 666.6
2006	29 142.5	1 757.6	1 137.7	5 060.6	2 239.7	3 194.4	3 731.0	12 021.6
2007	29 221.6	1 762.3	1 140.7	5 074.3	2 245.8	3 203.1	3 741.1	12 054.2

IPCC	3.B	3 B 1	3 B 2	3 B 1	3 B 1
SNAP	**Total**	**060201**	**060202**	**060203**	**060204**
Unit			**Mg**		
1990	13 698.6	8 655.1	436.3	1 703.9	2 903.3
1991	11 262.2	6 764.0	381.9	1 370.9	2 745.4
1992	8 869.2	5 018.8	320.5	1 050.4	2 479.5
1993	8 788.2	4 634.4	338.7	1 005.4	2 809.6
1994	8 055.0	3 904.8	331.2	882.1	2 936.9
1995	8 551.3	3 745.0	374.9	886.2	3 545.2
1996	8 387.4	3 560.4	364.5	818.2	3 644.3
1997	9 285.4	3 816.4	400.5	853.1	4 215.4
1998	8 609.5	3 421.9	369.0	745.1	4 073.5
1999	8 112.2	3 113.4	345.8	661.6	3 991.4
2000	9 842.5	3 641.5	417.7	756.4	5 026.9
2001	10 692.1	3 846.8	444.3	754.2	5 646.8
2002	11 810.4	4 133.9	480.9	763.6	6 432.1
2003	12 431.4	4 234.9	496.2	735.6	6 964.7
2004	10 893.0	3 613.1	426.4	588.9	6 264.7
2005	12 653.7	4 087.9	486.0	623.8	7 456.0
2006	14 261.1	4 607.2	547.8	703.0	8 403.1
2007	14 299.8	4 619.7	549.3	705.0	8 425.9

IPCC	3.C	3.C	3.C	3.C	3.C	3.C	3.C	3.C	3.C	3.C
SNAP	Total	060305	060306	060307	060308	060309	060310	060311	060312	060314
Unit						Mg				
1990	12 789.8	963.4	3 825.7	3 170.4	358.9	828.6	13.3	2.8	138.6	3 488.1
1991	10 440.5	837.2	2 896.0	2 581.6	312.9	742.8	11.6	2.6	115.7	2 940.1
1992	8 139.5	697.4	2 071.0	1 998.0	261.6	638.5	9.7	2.3	92.3	2 368.7
1993	7 954.6	731.3	1 831.6	1 926.0	275.2	691.2	10.2	2.7	92.1	2 394.3
1994	7 158.0	709.3	1 465.9	1 694.8	267.8	692.5	9.9	2.8	84.7	2 230.4
1995	7 417.9	796.4	1 320.6	1 697.1	301.6	803.5	11.2	3.4	89.4	2 394.8
1996	7 097.1	717.6	1 425.2	1 525.4	281.9	790.6	9.9	3.4	78.4	2 264.7
1997	7 676.1	727.7	1 720.3	1 541.4	297.5	878.9	9.8	3.9	76.8	2 419.7
1998	6 964.2	616.0	1 726.3	1 298.1	263.0	819.2	8.1	3.8	62.4	2 167.3
1999	6 430.2	527.6	1 750.0	1 104.1	236.3	776.7	6.7	3.7	50.7	1 974.4
2000	7 656.1	578.9	2 273.1	1 200.1	273.4	949.0	7.1	4.7	52.0	2 317.8
2001	7 941.3	582.1	2 365.1	1 255.8	289.7	928.3	7.4	4.9	51.6	2 456.3
2002	8 376.4	593.8	2 502.6	1 336.8	312.4	917.5	7.9	5.3	51.8	2 648.2
2003	8 419.7	575.8	2 523.9	1 356.5	321.1	857.4	8.1	5.4	49.3	2 722.3
2004	7 045.4	463.4	2 119.1	1 146.2	274.9	660.7	6.8	4.6	38.9	2 330.8
2005	7 815.1	492.6	2 358.9	1 284.5	312.2	666.8	7.7	5.2	40.3	2 646.8
2006	8 807.9	555.2	2 658.6	1 447.6	351.9	751.6	8.6	5.9	45.5	2 983.1
2007	8 831.8	556.7	2 665.8	1 451.5	352.8	753.6	8.7	5.9	45.6	2 991.2

IPCC	3 D	3 D 1	3 D 4	3 D 4	3 D 2	3 D 4	3 D 3	3 D 3	3 D 4
SNAP	Total	060403	060404	060405	060406	060407	060408	060411	060412
Unit					Mg				
1990	42 154.0	12 653.5	102.5	719.1	670.6	184.8	11 607.4	4 689.1	11 527.1
1991	37 352.7	10 763.5	88.7	592.1	595.6	167.2	11 161.7	4 307.0	9 676.9
1992	31 740.8	8 765.1	73.6	466.0	507.4	145.0	10 239.0	3 790.6	7 754.0
1993	33 965.6	8 971.5	76.8	460.3	544.3	158.3	11 774.3	4 197.9	7 782.1
1994	33 636.5	8 480.7	74.2	419.1	540.3	160.0	12 480.4	4 299.1	7 182.6
1995	38 579.3	9 263.9	82.8	440.1	621.3	187.2	15 267.5	5 095.6	7 620.9
1996	37 323.3	8 546.4	74.0	408.7	589.1	172.5	15 332.3	4 953.4	7 246.8
1997	40 818.9	8 899.2	74.3	428.7	631.1	179.3	17 376.8	5 442.1	7 787.3
1998	37 445.8	7 759.9	62.1	376.8	566.9	155.9	16 493.5	5 014.2	7 016.5
1999	34 958.8	6 873.7	52.4	336.7	518.0	137.6	15 908.5	4 700.6	6 431.4
2000	42 084.7	7 836.2	56.3	387.5	609.9	156.1	19 758.9	5 681.0	7 598.7
2001	44 175.0	8 045.4	53.9	373.6	660.0	165.6	20 739.6	6 051.8	8 085.1
2002	47 172.1	8 396.2	52.0	363.2	726.3	178.8	22 145.8	6 558.7	8 751.3
2003	48 022.4	8 345.9	47.0	332.8	761.7	184.0	22 543.8	6 776.8	9 030.3
2004	40 715.7	6 902.5	34.8	250.4	665.1	157.8	19 112.6	5 832.1	7 760.4
2005	45 782.4	7 563.2	33.3	245.4	769.9	179.4	21 489.5	6 656.8	8 844.7
2006	51 598.1	8 524.0	37.5	276.6	867.8	202.2	24 219.3	7 502.5	9 968.2
2007	51 738.1	8 547.1	37.6	277.4	870.1	202.7	24 285.1	7 522.8	9 995.2

Table 166: Implied NMVOC Emission factors for Category 3 Solvent and Other Product Use 1990–2007.

IPCC	**3.A**	**3 A 2**	**3 A 1**	**3 A 1**	**3 A 1**	**3 A 2**	**3 A 1**
SNAP	**060101**	**060102**	**060103**	**060104**	**060105**	**060107**	**060108**
Unit	**[gNMVOC/t]**						
1990	940.26	976.33	956.09	884.69	841.28	937.30	782.41
1991	881.09	973.30	943.07	885.29	789.60	892.67	700.78
1992	821.92	970.27	930.04	885.89	737.92	848.04	619.16
1993	762.75	967.24	917.02	886.49	686.24	803.41	537.54
1994	703.58	964.22	903.99	887.09	634.56	758.78	455.91
1995	644.41	961.19	890.97	887.69	582.88	714.14	374.29
1996	630.22	947.90	888.55	887.69	572.20	705.64	360.20
1997	616.04	934.62	886.13	887.69	561.53	697.14	346.10
1998	601.85	921.33	883.71	887.69	550.85	688.64	332.01
1999	587.67	908.05	881.29	887.69	540.17	680.14	317.92
2000	573.48	894.76	878.87	887.69	529.49	671.64	303.82
2001	577.07	891.96	880.41	887.69	527.39	671.48	299.17
2002	580.66	889.17	881.95	887.69	525.30	671.33	294.51
2003	584.24	886.38	883.50	887.69	523.21	671.17	289.85
2004	587.83	883.58	885.04	887.69	521.11	671.01	285.20
2005	591.42	880.79	886.58	887.69	519.02	670.85	280.54
2006	591.42	880.79	886.58	887.69	519.02	670.85	280.54
2007	591.42	880.79	886.58	887.69	519.02	670.85	280.54

IPCC	**3 B 1**	**3 B 2**	**3 B 1**	**3 B 1**
SNAP	**060201**	**060202**	**060203**	**060204**
Unit	**[gNMVOC/t]**			
1990	934.87	950.00	777.58	722.71
1991	859.91	936.00	720.86	717.65
1992	784.94	922.00	664.14	712.59
1993	709.98	908.00	607.42	707.53
1994	635.02	894.00	550.70	702.47
1995	560.05	880.00	493.98	697.42
1996	537.37	874.00	482.89	693.82
1997	514.69	868.00	471.80	690.22
1998	492.01	862.00	460.70	686.63
1999	469.33	856.00	449.61	683.03
2000	446.65	850.00	438.52	679.44
2001	442.45	848.81	426.64	678.72
2002	438.25	847.62	414.76	678.01
2003	434.05	846.43	402.88	677.29
2004	429.84	845.23	391.00	676.58
2005	425.64	844.04	379.12	675.86
2006	425.64	844.04	379.12	675.86
2007	425.64	844.04	379.12	675.86

IPCC	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					**[tCO2/t]**				
1990	985.59	462.47	1 000.00	1 000.00	1 000.00	10.02	914.94	882.32	1 000.00
1991	981.27	420.54	1 000.00	1 000.00	1 000.00	10.02	915.71	882.32	1 000.00
1992	976.95	378.61	1 000.00	1 000.00	1 000.00	10.02	916.49	882.32	1 000.00
1993	972.63	336.69	1 000.00	1 000.00	1 000.00	10.02	917.26	882.32	1 000.00
1994	968.31	294.76	1 000.00	1 000.00	1 000.00	10.02	918.03	882.32	1 000.00
1995	963.98	252.84	1 000.00	1 000.00	1 000.00	10.02	918.81	882.32	1 000.00
1996	958.32	253.86	1 000.00	1 000.00	1 000.00	10.02	922.80	882.32	1 000.00
1997	952.65	254.88	1 000.00	1 000.00	1 000.00	10.02	926.80	882.32	1 000.00
1998	946.98	255.90	1 000.00	1 000.00	1 000.00	10.02	930.80	882.32	1 000.00
1999	941.32	256.92	1 000.00	1 000.00	1 000.00	10.02	934.80	882.32	1 000.00
2000	935.65	257.94	1 000.00	1 000.00	1 000.00	10.02	938.80	882.32	1 000.00
2001	934.53	258.14	1 000.00	1 000.00	1 000.00	10.02	939.60	882.74	1 000.00
2002	933.40	258.34	1 000.00	1 000.00	1 000.00	10.02	940.40	883.15	1 000.00
2003	932.27	258.55	1 000.00	1 000.00	1 000.00	10.03	941.20	883.56	1 000.00
2004	931.15	258.75	1 000.00	1 000.00	1 000.00	10.03	942.01	883.97	1 000.00
2005	930.02	258.96	1 000.00	1 000.00	1 000.00	10.03	942.81	884.38	1 000.00
2006	930.02	258.96	1 000.00	1 000.00	1 000.00	10.03	942.81	884.38	1 000.00
2007	930.02	258.96	1 000.00	1 000.00	1 000.00	10.03	942.81	884.38	1 000.00

IPCC	3 D 1	3 D 4	3 D 4	3 D 2	3 D 4	3 D 3	3 D 3	3 D 4
SNAP	**060403**	**060404**	**060405**	**060406**	**060407**	**060408**	**060411**	**060412**
Unit				**[gMNVOC/t]**				
1990	859.07	200.89	859.96	990.47	850.00	838.54	940.86	890.01
1991	824.76	200.89	826.07	990.54	850.00	838.92	940.86	833.02
1992	790.46	200.89	792.17	990.60	850.00	839.29	940.86	776.04
1993	756.16	200.89	758.28	990.66	850.00	839.67	940.86	719.05
1994	721.86	200.89	724.39	990.72	850.00	840.04	940.86	662.06
1995	687.55	200.89	690.49	990.78	850.00	840.41	940.86	605.08
1996	681.47	200.89	680.13	990.95	850.00	840.67	940.86	596.51
1997	675.38	200.89	669.78	991.12	850.00	840.92	940.86	587.94
1998	669.29	200.89	659.42	991.28	850.00	841.17	940.86	579.38
1999	663.21	200.89	649.06	991.45	850.00	841.43	940.86	570.81
2000	657.12	200.89	638.70	991.62	850.00	841.68	940.86	562.24
2001	655.91	200.89	636.66	991.65	850.00	841.60	940.86	559.37
2002	654.71	200.89	634.62	991.68	850.00	841.51	940.86	556.51
2003	653.50	200.89	632.59	991.72	850.00	841.43	940.86	553.64
2004	652.30	200.89	630.55	991.75	850.00	841.34	940.86	550.77
2005	651.09	200.89	628.51	991.79	850.00	841.26	940.86	547.90
2006	651.09	200.89	628.51	991.79	850.00	841.26	940.86	547.90
2007	651.09	200.89	628.51	991.79	850.00	841.26	940.86	547.90

6.3 Recalculation for Emissions from Solvent and Other Product Use

To improve and update the solvent model a study (WINDSPERGER, 2008 (not published) was contracted out, that led to the following recalculations.

Update of activity data:

3.A, 3.B, 3.C and 3.D.5.:

The short term statistics for trade and services and the Austrian foreign trade statistics was revised by Statistik Austria from 2000 onwards.

The solvent share has been updated using the structural business statistics from 2000 onwards. The activity data from 2000 onwards concerning non-solvent use and solvent content of products has been updated by surveys at companies and associations.

Improvements of methodologies and emission factors:

3.A, 3.B, 3.C and 3.D.5.:

A modification of the solvent model led to a shift in emissions: In the sub-sector *Chemical Products (3.C)* now only the share of the solvent content that is emitted during production is considered as input. The remaining amount of solvent in the products, emitted during application and use, is reported as input and emissions of sub-sectors *3.A* and *3.D*.

Furthermore, emission factors have been updated with information from surveys at companies and associations, which were extrapolated using structural business statistics provided by Statistik Austria.

7 AGRICULTURE (NFR SECTOR 4)

No changes regarding methodology and emission factor were made since submission 2008.

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.*

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.

To give an overview of Austria's agricultural sector some information is provided below (according to the 2005 Farm Structure Survey – full survey) (BMLFUW 2008):

Agriculture in Austria is small-structured: 189 600 farms are managed, 60% of these farms manage less than 20 ha, whereas only 4% of the Austrian farms manage more than 100 ha cultivated area. 138 100 holdings are classified as situated in less favoured areas. Related to the federal territory Austria has the highest share of mountainous areas in the EU (70%).

The agricultural area comprises 3.3 million hectares that is a share of ~ 41% of the total territory (forestry ~ 46%, other area ~ 13%). The shares of the different agricultural activities are as follows:

- 43% arable land
- 28% grassland (meadows mown several times and seeded grassland)
- 27% extensive grassland (meadows mown once, litter meadows, rough pastures, Alpine pastures and mountain meadows)
- 2% other types of agricultural land-use (vineyards, orchards, house gardens, vine and tree nurseries)

7.2 General description

7.2.1 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.

7.2.2 Recalculations

Update of activity data

4 F – Field burning of agricultural residues

For the years 1990 to 2004 the area of cereal residues burnt (referring to the main production regions) was extrapolated to Austria's total cereal production area. The revision resulted in about 4% higher emissions.

7.2.3 Completeness

Table 167 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 167: 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*

7.2.4 Uncertainty Assessment

Table 168 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 168: 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)*

7.3 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 169: 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

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**
2002	53.67	37.41	15.04	22.38	0.78	0.15	0.68	9.54	5.01	0.10
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%*

7.3.1 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[127].

In Table 170 and Table 171 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.

127 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 170: 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 171: 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 172: 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

Year	Population size [heads] *			
	Livestock Category			
	Poultry	Chicken	Other Poultry	Other
2000	11 786 670	11 077 343	709 327	38 475
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 173).

MMS are distinguished for *Dairy Cattle*, *Suckling Cows* and *Cattle 1–2 years* in "summer situation" and "winter situation" (Table 173). 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 173: 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.

7.3.1.1 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-N (solid storage) = Nex (solid storage) x EF(ss)

$\underline{NH_3\text{-N (liquid slurry)} = \text{Nex (liquid slurry) x EF(ls)}}$

The sum of both gives NH_3-N emitted from housing:

NH_3 (housing) = [NH_3-N (solid storage) + NH_3-N (liquid slurry)] 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 170, Table 171 and Table 172))*
$Nex_{(T)}$	=	*N excretion of animals of type T in the country [kg N animal⁻¹ yr⁻¹] (see Table 174, Table 175)*
$AWMS_{(T)}$	=	*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 173)*
(T)	=	*type of animal category*

N excretion

N excretion values as shown in Table 174 and Table 175 base on following literature: (GRUBER & POETSCH 2006), (PÖTSCH et al. 2005), (STEINWIDDER & GUGGENBERGER 2003), (UNTERARBEITSGRUPPE N-ADHOC 2004) and (ZAR 2004). Values consider the typical agricultural practice in Austria.

Table 174: 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 175: 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 170, Table 171 and Table 172, manure management system distribution for *cattle* and *swine* can be found in Table 173.

Emission Factors

Table 176 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 176: 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)
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 177: 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 178.

Table 178: 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 179 and Table 180 present the calculated amounts of nitrogen left for spreading from 1990 to 2006.

Table 179: 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 180: 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

7.3.1.2 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 181 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 181: 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 179 and Table 180.

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-NH_3-N_{spread}), which is also dependent on the quality of animal waste.

$$\mathbf{NH_3\text{-}N_{spread} = N_{exLFS} * Frac_{TAN} * EF\text{-}NH_3\text{-}N_{spread}}$$

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)*

7.3.2 Recalculations

No recalculations have been done.

7.3.3 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 2010.

7.4 NFR 4 D Agricultural Soils

Key Source: NH_3, NO_X, TSP, PM10, PM2.5

NFR sector *4 D Agricultural Soils* includes emissios of ammonia (NH_3), nitrogen oxide (NO_x), non-methane volatile organic compounds (NMVOC) and particulate matter (TSP, PM).

7.4.1 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 7.5).

Activity Data

Activity data are taken from the following sources:

Table 182: 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 183.

Table 183: 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 184: 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
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 185.

Table 185: 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 183), 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:

$$F_{BN} = LCA * B_{Fix}/1000$$

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 184. 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 185) 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.

$$E\text{-}NMVOC = CA * \varepsilon\text{-}NMVOC * D * \Gamma$$

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 184) and expansion factors for leaves. For simplification, wheat was considered to be representative for the vegetation cover of agricultural crop land (see Table 186).

Table 186: 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 187: 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 186)

The results are highly dependent on the assumptions about biomass density.

7.4.2 Recalculations

No recalculations have been done.

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 2010.

7.5 NFR 4 D Particle Emissions from Agricultural Soils

- Particle emissions reported under source category 4 D result from
  - certain steps of farm work such as soil cultivation and harvesting (field operations). The calculations are based on (WINIWARTER et al. 2007).
  - agricultural bulk material handling. These emissions are estimated under source category *2 A Mineral Products* (see chapter 5.3).

7.5.1 Methodological Issues

PM emissions from field operations

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 188: 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 189: 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%

PM emissions from bulk material handling

The CORINAIR simple methodology was applied. Emissions were estimated multiplying the amount of bulk material (see Table 135) by an emission factor (see Table 134). Activity data was taken from national statistics.

7.5.2 Recalculations

No recalculations have been done.

7.6 NFR 4 F Field Burning of Agricultural Waste

Burning agricultural residues on open fields in Austria is legally restricted 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 0.6%), except for PAH emissions where this source category is a key source with a contribution of 2.1% to national total emissions in 2007.

7.6.1 Methodological Issues

Activity Data

According to the *Presidential Conference of the Austrian Chambers of Agriculture* (personal communication to Dr. Reindl 2008), in Austria's most important cereal production areas about 1 360 ha were burnt in 2007. The extrapolation to Austria's total cereal production area results in 2 130 ha burnt in 2007. This value was applied for the national inventory and corresponds to about 0.3% of total area under cereals 2007. For 1990 an average value of 2 500 ha was indicated (Dr. Reindl 2004), the extrapolation to Austria's total cereal production area gives a value of 2 630 ha.

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 190: 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.

- *Particulate Matter (TSP, PM10, PM2.5)*

Emission factors related to the dry matter (dm) mass of residue burnt have been taken (JENKINS et al. 1996):

- TSP.........0.0058 kg/kg dm_{burnt}
- PM10….. 0.0058 kg/kg dm_{burnt}
- PM2.5…. 0.0055 kg/kg dm_{burnt}

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 191 presents the resulting emission factors.

Table 191: 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

Particulate Matter (TSP, PM10, PM2.5)

The same methodology like for the estimation of PM emissions from bonfires (WINIWARTER et al. 2007) was applied. An emission factor of 1 500 g/GJ (similar to open fire places, expert guess from literature) was taken. Under the assumption of a heating value of 10 GJ per ton residual wood the following emission factor has been derived:

- $EF_{TSP} = EF_{PM10} = EF_{PM2.5}$ = 15kg/t residual wood

7.7 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.

7.7.1 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 170, Table 171 and Table 172).

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 192 the applied emission factors are listed.

Table 192: TSP emission factors animal housing.

Livestock	Emission Factor [kg TSP/animal]	Livestock	Emission Factor [kg TSP/animal]
Dairy cows	0.235	Laying hens	0.016
Other cattle	0.235	Broilers	0.016
Fattening pigs	0.108	Other poultry (ducks,gooses,etc.)	0.016
Sows	0.108	Goats	0.153
Ovines	0.235	Other	0.016
Horses	0.153		

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%.

7.7.2 Recalculations

No recalculations have been done.

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 193 presents the results of the Key Category Analysis of the Austrian inventory with regard to the contribution to national total emissions (for details of the Key Category Analysis see Chapter 1.4).

Table 193: 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%		

The overall emission trend reflects changes in waste management policies as well as waste treatment facilities. According to the Landfill Ordinance[128] 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).

[128] 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.

8.1.1 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 for6) 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 in 2006 changed slightly (+ 6%) compared to the previous submission.

- New data on collected landfill gas became available for 2002–2006 (SCHACHERMAYER & LAMPERT 2008). This new information – decreasing methane collection values due to declining methane generation – was taken into account when calculating the actually emitted CH4.

6 C Incineration of Corps

Update of activity data according to expert judgements.

6 D Other

- Activity data for mechanical-biological treatment have been updated for the years 2003-2006, as new data on incoming quantities became available[129].
- Activity Data for separately collected bio-waste (mainly) of the previous year was updated, because some of the nine Federal Provinces (Bundesländer) published new or updated data in their Waste Management Concepts and Plans. This has led to a slightly differing overall amount compared to previous years' submission.

Completeness

Table 194 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 194: 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

8.2 NFR 6 A Waste Disposal on Land

8.2.1 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 constantly until 2002. For example, the share of collected in overall generated landfill gas was about 2% in 1990, and 16% in the year 2002 respectively. However, since 2002 the amount of collected landfill gas decreases again (SCHACHERMAYER & LAMPERT 2008), which is due to the declining methane generation.

[129] Behandlung von gemischten Siedlungs- und Gewerbeabfällen in Österreich – Betrachtungszeitraum 2003–2007", Christian Neubauer, Birgit Walter

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 195.

In 1990 the Austrian Waste Management Law[130] took into force. 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 pretreated or harmless waste was allowed to be deposited (see Landfill Ordinance[131]).

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 2007, residual waste decreased by 92%, non residual waste by 42%, and total waste by 80%.

Table 195: Activity data for "Residual waste" and "Non Residual Waste" 1990–2007.

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	260 068	374 663	596 519
2007	152 885	387 617	540.502

[130] Abfallwirtschaftsgesetz (AWG): BGBl. Nr. 325/1990, in der Fassung BGBl. I. Nr. 102/2002

[131] Deponieverordnung: BGBl. Nr. 164/1996, in der Fassung BGBl II Nr. 49/2004

Residual Waste

"Residual waste" corresponds to waste from households and similar establishments remaining after separation of paper, glass, plastic etc. at the source. 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.

In 2006 only 3.8% of residual waste was directly deposited. The remaining part was recycled, incinerated or treated mechanical-biologically. According to the federal waste management plans 2001 and 2006 as well as the recent update in 2008, recycling and treatment of waste from households and similar establishments was performed according to the following procedures.

Table 196: Recycling and treatment of waste from households and similar establishments.

Treatment	1989[1)]	1999[2)]	2004[2)]	2006[3)]
mechanical-biological treatment	16.7%	6.3%	11.2%	17.9%
thermal treatment (incineration)	5.9%	14.7%	28.3%	23.7%
treatment in plants for hazardous waste	0.4%	0.8%	1.2%	1.8%
recycling	12.9%	34.3%	35.6%	34.8%
recycling (biogenous waste)	1.0%	15.4%	16.0%	17.9%
direct deposition at landfills ("residual waste")	63.1%	28.5%	7.7%	3.8%

1) *(BUNDESABFALLWIRTSCHAFTSPLAN 2001)*

2) *(BUNDESABFALLWIRTSCHAFTSPLAN 2006)*

3) *latest update (Statusbericht 2008) to the BAWP 2006*

The quantities of "residual waste" were taken from the following sources:

- From 1998 to 2007 data were taken from the database for solid waste disposals "Deponiedatenbank" ("Austrian landfill database"): according to the Landfill Ordinance[132], which came into force in 1997, operators of landfill sites have to report type and amount of waste deposited at their landfill site annually. The Umweltbundesamt stores the data in the landfill database.
- From 1950 to 1997 the amounts of deposited residual waste were taken from national studies (HACKL & MAUSCHITZ 1999, HÄUSLER 2001) and the respective Federal Waste Management Plans (Bundesabfallwirtschaftplan 1995, 2001).

While In the national study (HACKL & MAUSCHITZ 1999) as well as in the federal waste management plans the amounts of residual waste from administrative facilities of businesses and industries were not considered and therefore originally not included in the data of the years 1950 to 1999). Waste from these sources is however deposited and hence reported by the operators of landfill sites from 1998 on (therefore included in the "Deponiedatenbank") and thus considered in the time series from 1998 on. To achieve a consistent time series the two overlapping years[133] (1998 and 1999) were examined and the difference – which represents the residual waste from administrative facilities of industries and businesses – was calculated. This difference, relative to the change of residual waste from households, was then applied to the years 1950 to 1997 accordingly.

[132] Deponieverordnung, Federal Gazette BGBl. Nr 164/1996

[133] Data available from the BAWPas well as from the Deponiedatenbank

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

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 197 presents a summary of all considered waste types and the corresponding numbers (list of waste). 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 197: Considered types of waste (list of waste[134]).

Waste Identification No	Type of Waste	Waste Identification No	Type of Waste
		170204	Glass, plastic and wood containing or contaminated with dangerous substances
0303	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

[134] Commission Decision of 3 May 2000 replacing Decision 94/3/EC establishing a list of wastes pursuant to Article 1(a) of Council Directive 75/442/EEC on waste and Council Decision 94/904/EC establishing a list of hazardous waste pursuant to Article 1(4) of Council Directive 91/689/EEC on hazardous waste.

Waste Identification No	Type of Waste	Waste Identification No	Type of Waste
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		

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 198 summarises the parameters used and the corresponding references.

Table 198: 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 198). IPCC default taking into account national waste expertises.								
DOC	see Table 200	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	57								
	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) was calculated until 2003. The DOC value for the year 2004 was updated based on the most recent composition of residual waste. This new value resulted in updated values for2001 to 2003.For the years 2005 to 2007 the same DOC values as for 2004 were used.

Table 199 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 200). For the years before 1990, quantities according to a national study (HACKL & MAUSCHITZ 1999) were used.

Table 199: 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
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 200: 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	2007	169

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 13). While for example the amount of the collected landfill gas was about 2% in 1990, this amount reached 13% in the year 2002.

In 2008 a further study was conducted (SCHACHERMAYER & LAMPERT 2008) again sending questionnaires to landfill operators to get new data on collected landfill gas as well as information on its use. Results show that the amount of collected landfill gas decreased significantly (- 30 %) since 2002, which is due to the decreasing methane generation. Reason for the decreasing methane is the changing composition of deposited waste respectively their reduced carbon content. These new data led to new updated values for the years 2002 to 2006.

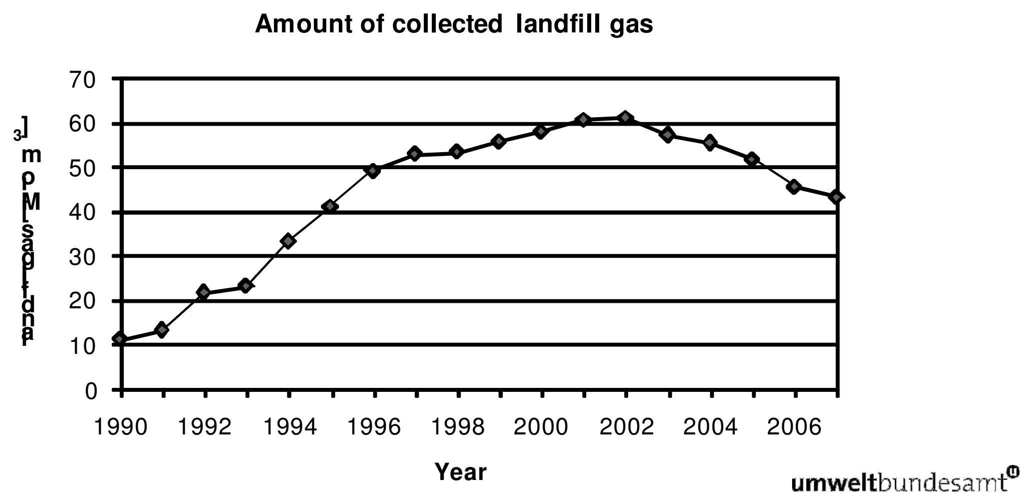

Figure 13: Amount of collected landfill gas 1990 to 2007 (ROLLAND & OLIVA 2004, SCHACHERMAYER & LAMPERT 2008).

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). [135]

Table 201: 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 to WINIWARTER et al. 2008 It is assumed that PM10 is 47% of TSP and PM2.5 is 15% of TSP.

[135] according to UMWELTBUNDESAMT (2001b)

Table 202: Emission factors for PM.

TSP	PM10	PM2.5
g/Mg WASTE	g/Mg WASTE	g/Mg WASTE
18.00	8.52	2.68

8.2.1.1 Recalculations

Improvements and recalculations made are described in Chapter 3.

8.3 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 203: 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	9 954
1991	22 000	7 525	1 500	71 000	62 000	10 011
1992	0	6 050	1 800	IE	IE	9 979
1993	0	4 575	2 100	IE	IE	9 902
1994	0	3 100	2 500	IE	IE	9 682
1995	0	3 100	2 600	IE	IE	9 741
1996	0	3 100	2 700	IE	IE	9 695
1997	0	3 100	2 800	IE	IE	9 532
1998	0	3 100	2 900	IE	IE	9 401
1999	0	3 100	3 000	IE	IE	9 384
2000	0	3 100	3 000	IE	IE	9 214
2001	0	3 100	3 000	IE	IE	8 972
2002	0	3 100	3 000	IE	IE	9 136
2003	0	3 100	3 000	IE	IE	13 818
2004	0	3 100	3 000	IE	IE	18 500
2005	0	3 100	3 000	IE	IE	19 800
2006	0	3 100	3 000	IE	IE	19 800
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 204 shows emission factors of the air pollutants.

Table 204: 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	8 300.0	1.6	160.0	970.0
1986	678.0	102.4	7 120.0	1.6	160.0	970.0
1987	636.0	104.8	5 940.0	1.6	160.0	970.0
1988	594.0	107.2	4 760.0	1.6	160.0	970.0
1989	552.0	109.6	3 580.0	1.6	160.0	970.0
1990	510.0	112.0	2 400.0	1.6	160.0	970.0
1991	414.0	99.4	1 922.0	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 205: 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*

8.4 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. 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:

- mechanical-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 206: Activity data for NFR Category 6 D Other Waste (Compost Production).

	Total waste	Mechanical-biological waste treatment		Bio waste collected separately[1)]	Loppings; gardening waste		Home composting	
	[Gg]	[Mg]	source	[Mg]	[Mg]	source	[Mg]	source
1990	762.8	345 000	(BAUMELER et al. 1998)	10 436	37 370	Sum of data reported by the Austrian federal provinces, (AMLINGER 2003)	370 000	(AMLINGER 2003)
1991	798.4	345 000		27 372	50 995		375 000	
1992	941.7	345 000		88 243	48 464		460 000	
1993	1 161.4	345 000		156 936	149 470		510 000	
1994	1 373.5	345 000		246 375	197 130		584 985	
1995	1 446.1	295 000	(ANGERER 1997)	301 809	249 264		600 000	
1996	1 513.5	280 000	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	1 666.9	253 156	interpolated	374 271	267 670	Interpol-ated	771 773	
2001	1 702.9	241 312		399 090	290 752		771 773	value of 2002
2002	1 737.2	229 468		422 126	313 835		771 773	
2003	1 760.2	217 625	(NEUBAUER & WALTER 2008)	433 911	336 917		771 773	
2004	2 129.2	487 623		481 581	360 000	(BAWP 2006)	800 000	(BAWP 2006)
2005	2 287.9	623 393		504 467	360 000	value of 2004	800 000	
2006	2 343.9	660 231		523 626	360 000		800 000	(BAWP 2006)[2)]
2007	2 370.1	684 322		535 777	350 000	(BAWP 2006)[2)]	800 000	

[1)] *source of data for 1990–2007: Sum of data reported by the Austrian federal provinces, partly interpolated*

[2)] *latest update (Statusbericht 2008) to the BAWP 2006*

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 207: 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 2007
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 2007

(a) Sectors already reported to UNFCCC for NO_x, CO, NMVOC, SO_2.

(b) Including NH_3 from Enteric Fermentation and emissions from Cultivation of Rice.

(c) Including PM sources.

(d) Excludes waste incineration for energy (this is included in 1 A 1) and in industry (if used as fuel).

(e) Includes accidental fires.

(f) National Total refers to the territory declared upon ratification of the relevant Protocol of the Convention.

(g) EMEP grid domain is defined in the Emission Reporting Guidelines (ECE/EB.AIR/80/Annex V)

(h) Member States of the European Union may use this template for reporting under the National Emissions Ceiling Directive (NECD); MS should consult the text of the NECD to determine what should be included within the NEC Total, as this may differ from the LRTAP National Total in terms of its geographic coverage, sectors (e.g. inclusion/exclusion of international aviation and inland shipping activities) etc.

(i) Member States of the European Union may use this line for reporting of transport emissions if based on fuel used

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.

Notes 2:

(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(a)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).

TABLE IV 1: National sector emissions: Main pollutants, particulate matter, heavy metals and persistent organic pollutants

Version 2008-1

COUNTRY:	AT	(as ISO2 code)
DATE:	18.02.2009	(as DD.MM.YYYY)
YEAR:	2007	(as YYYY, year of Emissions and Activity Data)
version:	v2.0	(as v1.0 for the initial submission)

Print Main Pollutants and Particulates

1 A 3 b i **fuel used**	33,29	7,95	0,05	1,52	1,57	1,57	1,57	136,84	0,01	0,00	0,00
1 A 3 b iii **fuel used**	39,57	2,44	0,03	0,03	0,91	0,91	0,91	8,00	0,00	0,00	0,00
1 A 3 b i **fuel sold**	41,10	9,34	0,06	1,93	1,92	1,92	1,92	168,80	0,01	0,00	0,00
1 A 3 b iii **fuel sold**	89,26	4,93	0,06	0,06	1,81	1,81	1,81	16,33	0,00	0,00	0,00

COLOUR CODING:

Memo items

NATIONAL TOTAL

Reporting YEARS are detailed in Note 1 below

Table IV 1 (Revised UNECE/EMEP Reporting Guidelines ECE/EB.AIR/2008/4)

AT: 18.02.2009: 2007	*NFR sectors to be reported to LRTAP*				NECD pollutants																	
					Main Pollutants (from 1980)				Particulate Matter (from 2000)			Main pollutants (from 1980)	Priority Heavy Metals (from 1990)			Other Heavy Metals (from 1990)					
					NOx	NMVOC	SOx	NH3	PM2.5	PM10	TSP	CO	Pb	Cd	Hg	As	Cr	Cu	Ni	Se	Zn
NFR Aggregation for Gridding and LPS (GNFR)	*NFR Code*	*annotation*	*Longname*	Notes:	Gg NO_2	Gg	Gg SO_2	Gg	Gg	Gg	Gg	Gg	Mg	Mg	Mg	Mg	Mg	Mg	Mg	Mg	Mg
A_PublicPower	1 A 1 a	(a)	1 A 1 a Public Electricity and Heat Production		9,85	0,67	2,74	0,28	0,86	1,03	1,13	3,88	1,59	0,11	0,19	NR	NR	NR	NR	NR	NR
B_IndustrialComb	1 A 1 b	(a)	1 A 1 b Petroleum refining		3,05	IE	3,23	0,09	0,08	0,09	0,10	0,39	0,26	0,18	0,01	NR	NR	NR	NR	NR	NR
B_IndustrialComb	1 A 1 c	(a)	1 A 1 c Manufacture of Solid Fuels and Other Energy Industries		1,70	0,01	NA	0,01	0,07	0,07	0,08	0,11	0,00	0,00	0,00	NR	NR	NR	NR	NR	NR
B_IndustrialComb	1 A 2 a	(a)	1 A 2 a Stationary Combustion in Manufacturing Industries and Construction: Iron and Steel		5,11	0,31	5,59	0,05	0,04	0,03	0,03	138,86	0,21	0,00	0,00	NR	NR	NR	NR	NR	NR
B_IndustrialComb	1 A 2 b	(a)	1 A 2 b Stationary Combustion in Manufacturing Industries and Construction: Non-ferrous Metals		0,22	0,00	0,10	0,00	0,01	0,01	0,01	0,04	1,05	0,02	0,01	NR	NR	NR	NR	NR	NR
B_IndustrialComb	1 A 2 c	(a)	1 A 2 c Stationary Combustion in Manufacturing Industries and Construction: Chemicals		1,48	0,37	0,79	0,03	0,49	0,59	0,65	2,15	0,69	0,03	0,01	NR	NR	NR	NR	NR	NR
B_IndustrialComb	1 A 2 d	(a)	1 A 2 d Stationary Combustion in Manufacturing Industries and Construction: Pulp, Paper and Print		4,96	0,23	1,17	0,07	0,21	0,26	0,29	1,82	0,76	0,08	0,07	NR	NR	NR	NR	NR	NR
B_IndustrialComb	1 A 2 e	(a)	1 A 2 e Stationary Combustion in Manufacturing Industries and Construction: Food Processing, Beverages and Tobacco		0,90	0,02	0,36	0,02	0,04	0,05	0,06	0,15	0,01	0,00	0,00	NR	NR	NR	NR	NR	NR
B_IndustrialComb	1 A 2 f i		1 A 2 f i Stationary Combustion in Manufacturing Industries and Construction: Other (Please specify in your IIR)		13,17	0,52	3,15	0,32	1,17	1,74	2,49	16,64	0,90	0,09	0,20	NR	NR	NR	NR	NR	NR
I_OffRoadMob	1 A 2 f ii		1 A 2 f ii Mobile Combustion in Manufacturing Industries and Construction: (Please specify in your IIR)		6,45	0,74	0,00	0,00	0,47	0,47	0,47	6,46	0,00	0,00	0,00	NR	NR	NR	NR	NR	NR
J_CivilLTO	1 A 3 a ii (i)		1 A 3 a ii (i) Civil Aviation (Domestic, LTO)		0,08	0,11	0,01	0,00	0,01	0,01	0,01	2,35	0,00	0,00	0,00	NR	NR	NR	NR	NR	NR
K_IternationalLTO	1 A 3 a i (i)		1 A 3 a i (i) International Aviation (LTO)		1,09	0,45	0,09	0,00	0,10	0,10	0,10	1,49	0,00	0,00	0,00	NR	NR	NR	NR	NR	NR
G_RoadRail	1 A 3 b i		1 A 3 b i Road Transport:, Passenger cars		41,10	9,34	0,06	1,93	1,92	1,92	1,92	168,80	0,01	0,00	0,00	NR	NR	NR	NR	NR	NR
G_RoadRail	1 A 3 b ii		1 A 3 b ii Road Transport:, Light duty vehicles		6,25	0,66	0,01	0,05	0,44	0,44	0,44	8,59	0,00	0,00	0,00	NR	NR	NR	NR	NR	NR
G_RoadRail	1 A 3 b iii		1 A 3 b iii Road Transport:, Heavy duty vehicles		89,26	4,93	0,06	0,06	1,81	1,81	1,81	16,33	0,00	0,00	0,00	NR	NR	NR	NR	NR	NR
G_RoadRail	1 A 3 b iv		1 A 3 b iv Road Transport:, Mopeds & Motorcycles		0,44	1,80	0,00	0,00	0,00	0,00	0,00	21,49	0,00	0,00	0,00	NR	NR	NR	NR	NR	NR
G_RoadRail	1 A 3 b v		1 A 3 b v Road Transport:, Gasoline evaporation		NA	3,16	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
G_RoadRail	1 A 3 b vi		1 A 3 b vi Road Transport:, Automobile tyre and brake wear		NA	NA	NA	NA	IE	IE	IE	NA	NA	0,00	NA	NR	NR	NR	NR	NR	NR
G_RoadRail	1 A 3 b vii		1 A 3 b vii Road Transport:, Automobile road abrasion		NA	NA	NA	NA	1,06	3,52	10,55	NA	NA	0,09	NA	NR	NR	NR	NR	NR	NR
G_RoadRail	1 A 3 c	(a)	1 A 3 c Railways		1,34	0,17	0,06	0,00	0,21	0,57	1,61	0,35	0,00	0,00	0,00	NR	NR	NR	NR	NR	NR
H_Shipping	1 A 3 d i (ii)		1 A 3 d i (ii) International inland waterways		IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	NR	NR	NR	NR	NR	NR
H_Shipping	1 A 3 d ii	(a)	1 A 3 d ii National Navigation (Shipping)		0,73	0,45	0,02	0,00	0,12	0,12	0,12	2,58	0,00	0,00	0,00	NR	NR	NR	NR	NR	NR
I_OffRoadMob	1 A 3 e		1 A 3 e Pipeline compressors		1,22	0,00	NA	0,01	0,00	0,00	0,00	0,08	NA	NA	NA	NR	NR	NR	NR	NR	NR
C_SmallComb	1 A 4 a i		1 A 4 a i Commercial / Institutional: Stationary		1,98	1,74	0,91	0,07	0,50	0,54	0,58	14,11	0,41	0,05	0,02	NR	NR	NR	NR	NR	NR
I_OffRoadMob	1 A 4 a ii		1 A 4 a ii Commercial / Institutional: Mobile		IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	NR	NR	NR	NR	NR	NR
C_SmallComb	1 A 4 b i		1 A 4 b i Residential: Stationary plants		11,67	31,70	5,51	0,53	7,03	7,82	8,60	274,24	2,19	0,25	0,17	NR	NR	NR	NR	NR	NR
I_OffRoadMob	1 A 4 b ii		1 A 4 b ii Residential: Household and gardening (mobile)		0,70	2,59	0,00	0,00	0,04	0,04	0,04	17,30	0,00	0,00	0,00	NR	NR	NR	NR	NR	NR
C_SmallComb	1 A 4 c i		1 A 4 c i Agriculture/Forestry/Fishing: Stationary		1,09	2,82	0,23	0,05	0,58	0,65	0,72	23,33	0,21	0,06	0,02	NR	NR	NR	NR	NR	NR
I_OffRoadMob	1 A 4 c ii		1 A 4 c ii Agriculture/Forestry/Fishing: Off-road Vehicles and Other Machinery		9,16	3,40	0,01	0,00	1,44	1,59	1,86	15,56	0,00	0,00	0,00	NR	NR	NR	NR	NR	NR
H_Shipping	1A 4 c iii		1A 4 c iii Agriculture/Forestry/Fishing: National Fishing		NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NR	NR	NR	NR	NR	NR
B_IndustrialComb	1 A 5 a	(a)	1 A 5 a Other, Stationary (including Military)		IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	NR	NR	NR	NR	NR	NR
I_OffRoadMob	1 A 5 b	(a)	1 A 5 b Other, Mobile (Including military, land based and recreational boats)		0,09	0,02	0,01	0,00	0,02	0,02	0,02	0,27	0,00	0,00	0,00	NR	NR	NR	NR	NR	NR
E_Fugitive	1 B 1 a	(a)	1 B 1 a Fugitive emission from Solid Fuels: Coal Mining and Handling		NA	NA	NA	NA	0,08	0,25	0,53	NA	NA	NA	NA	NR	NR	NR	NR	NR	NR
E_Fugitive	1 B 1 b	(a)	1 B 1 b Fugitive emission from Solid Fuels:Solid fuel transformation		IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	NR	NR	NR	NR	NR	NR
E_Fugitive	1 B 1 c	(a)	1 B 1 c Other fugitive emissions from solid fuels		NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NR	NR	NR	NR	NR	NR
E_Fugitive	1 B 2 a i		1 B 2 a i Exploration Production, Transport		NA	0,52	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
E_Fugitive	1 B 2 a iv		1 B 2 a iv Refining / Storage		NA	0,96	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
E_Fugitive	1 B 2 a v		1 B 2 a v Distribution of oil products		NA	0,99	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
E_Fugitive	1 B 2 a vi		1 B 2 a vi Geothermal energy extraction		NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NR	NR	NR	NR	NR	NR
E_Fugitive	1 B 2 b	(a)	1 B 2 b Natural gas		NA	0,26	0,18	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
E_Fugitive	1 B 2 c	(a)	1 B 2 c Venting and flaring		IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	NR	NR	NR	NR	NR	NR

TABLE IV 1: National sector emissions: Main pollutants, particulate matter, heavy metals and persistent orga

Version 2008-1

COUNTRY:	AT	(as ISO2 code)
DATE:	18.02.2009	(as DD.MM.YYYY)
YEAR:	2007	(as YYYY, year of Emissions and Activity Data)
version:	v2.0	(as v1.0 for the initial submission)

Print Activity Data

	DIOX	Total 1-4	HCB
1 A 3 b i **fuel used**	0,34	0,58	0,07
1 A 3 b iii **fuel used**	0,31	0,35	0,06
1 A 3 b i **fuel sold**	0,40	0,69	0,08
1 A 3 b iii **fuel sold**	0,69	0,79	0,14

Print Activity Data

COLOUR CODING:

Memo items

NATIONAL TOTAL

Reporting YEARS are detailed in Note 1 below

Table IV 1 (Revised UNECE/EMEP Reporting Guidelines ECE/EB.AIR/2008/4)

AT: 18.02.2009: 2007	*NFR sectors to be reported to LRTAP*			**Persistent Organic Pollutants (POPs) Annex I (1) (From 1990)**									**POPs Annex II (2) (From 1990)**			**POPs Annex III (3) (from 1990)**							**Other POPs (4) (From 1990)**	
																	PAH							
				Aldrin	Chlordane	Chlordecone	Dieldrin	Endrin	Heptachlor	Hexabromo-biphenyl	Mirex	Toxaphene	HCH	DDT	PCB	DIOX	benzo(a) pyrene	benzo(b) fluoranthene	benzo(k) fluoranthene	Indeno(1,2,3-cd)pyrene	Total 1-4	HCB	PCP	SCCP
NFR Aggregation for Gridding and LPS (GNFR)	*NFR Code*	*annotation*	*Longname*	kg	kg	kg	kg	kg	kg	kg	kg	kg	kg	kg	kg	g I-Teq	Mg	Mg	Mg	Mg	Mg	kg	kg	kg
A_PublicPower	1 A 1 a	(a)	1 A 1 a Public Electricity and Heat Production	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NR	0,88	NR	NR	NR	NR	0,01	0,38	NA	NA
B_IndustrialComb	1 A 1 b	(a)	1 A 1 b Petroleum refining	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NR	0,02	NR	NR	NR	NR	0,00	0,00	NA	NA
B_IndustrialComb	1 A 1 c	(a)	1 A 1 c Manufacture of Solid Fuels and Other Energy Industries	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NR	0,00	NR	NR	NR	NR	0,00	0,00	NA	NA
B_IndustrialComb	1 A 2 a	(a)	1 A 2 a Stationary Combustion in Manufacturing Industries and Construction: Iron and Steel	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NR	0,04	NR	NR	NR	NR	0,00	0,01	NA	NA
B_IndustrialComb	1 A 2 b	(a)	1 A 2 b Stationary Combustion in Manufacturing Industries and Construction: Non-ferrous Metals	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NR	2,22	NR	NR	NR	NR	0,00	1,00	NA	NA
B_IndustrialComb	1 A 2 c	(a)	1 A 2 c Stationary Combustion in Manufacturing Industries and Construction: Chemicals	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NR	0,94	NR	NR	NR	NR	0,04	0,15	NA	NA
B_IndustrialComb	1 A 2 d	(a)	1 A 2 d Stationary Combustion in Manufacturing Industries and Construction: Pulp, Paper and Print	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NR	0,63	NR	NR	NR	NR	0,00	0,13	NA	NA
B_IndustrialComb	1 A 2 e	(a)	1 A 2 e Stationary Combustion in Manufacturing Industries and Construction: Food Processing, Beverages and Tobacco	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NR	0,04	NR	NR	NR	NR	0,00	0,01	NA	NA
B_IndustrialComb	1 A 2 f i		1 A 2 f i Stationary Combustion in Manufacturing Industries and Construction: Other (Please specify in your IIR)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NR	2,28	NR	NR	NR	NR	0,08	0,36	NA	NA
I_OffRoadMob	1 A 2 f ii		1 A 2 f ii Mobile Combustion in Manufacturing Industries and Construction: (Please specify in your IIR)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0,06	NR	NR	NR	NR	0,07	0,01	NA	NA
J_CivilLTO	1 A 3 a ii (i)		1 A 3 a ii (i) Civil Aviation (Domestic, LTO)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NE	NR	NR	NR	NR	NE	NE	NA	NA
K_IternationalLTO	1 A 3 a i (i)		1 A 3 a i (i) International Aviation (LTO)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NE	NR	NR	NR	NR	NE	NE	NA	NA
G_RoadRail	1 A 3 b i		1 A 3 b i Road Transport:, Passenger cars	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0,40	NR	NR	NR	NR	0,69	0,08	NA	NA
G_RoadRail	1 A 3 b ii		1 A 3 b ii Road Transport:, Light duty vehicles	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0,11	NR	NR	NR	NR	0,17	0,02	NA	NA
G_RoadRail	1 A 3 b iii		1 A 3 b iii Road Transport:, Heavy duty vehicles	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0,69	NR	NR	NR	NR	0,79	0,14	NA	NA
G_RoadRail	1 A 3 b iv		1 A 3 b iv Road Transport:, Mopeds & Motorcycles	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0,01	NR	NR	NR	NR	0,05	0,00	NA	NA
G_RoadRail	1 A 3 b v		1 A 3 b v Road Transport:, Gasoline evaporation	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	IE	NR	NR	NR	NR	NA	NA	NA	NA
G_RoadRail	1 A 3 b vi		1 A 3 b vi Road Transport:, Automobile tyre and brake wear	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NR	NR	NR	NR	NA	NA	NA	NA
G_RoadRail	1 A 3 b vii		1 A 3 b vii Road Transport:, Automobile road abrasion	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NR	NR	NR	NR	NA	NA	NA	NA
G_RoadRail	1 A 3 c	(a)	1 A 3 c Railways	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0,02	NR	NR	NR	NR	0,02	0,00	NA	NA
H_Shipping	1 A 3 d i (ii)		1 A 3 d i (ii) International inland waterways	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	IE	NR	NR	NR	NR	IE	IE	NA	NA
H_Shipping	1 A 3 d ii	(a)	1 A 3 d ii National Navigation (Shipping)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0,01	NR	NR	NR	NR	0,01	0,00	NA	NA
I_OffRoadMob	1 A 3 e		1 A 3 e Pipeline compressors	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0,00	NR	NR	NR	NR	NA	0,00	NA	NA
C_SmallComb	1 A 4 a i		1 A 4 a i Commercial / Institutional: Stationary	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NR	2,48	NR	NR	NR	NR	0,18	1,62	NA	NA
I_OffRoadMob	1 A 4 a ii		1 A 4 a ii Commercial / Institutional: Mobile	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	IE	NR	NR	NR	NR	IE	IE	NA	NA
C_SmallComb	1 A 4 b i		1 A 4 b i Residential: Stationary plants	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NR	29,83	NR	NR	NR	NR	6,50	33,94	NA	NA
I_OffRoadMob	1 A 4 b ii		1 A 4 b ii Residential: Household and gardening (mobile)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0,05	NR	NR	NR	NR	0,03	0,01	NA	NA
C_SmallComb	1 A 4 c i		1 A 4 c i Agriculture/Forestry/Fishing: Stationary	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NR	2,80	NR	NR	NR	NR	0,62	4,54	NA	NA
I_OffRoadMob	1 A 4 c ii		1 A 4 c ii Agriculture/Forestry/Fishing: Off-road Vehicles and Other Machinery	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0,08	NR	NR	NR	NR	0,08	0,02	NA	NA
H_Shipping	1A 4 c iii		1A 4 c iii Agriculture/Forestry/Fishing: National Fishing	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NO	NR	NR	NR	NR	NO	NO	NA	NA
B_IndustrialComb	1 A 5 a	(a)	1 A 5 a Other, Stationary (including Military)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	IE	NR	NR	NR	NR	IE	IE	NA	NA
I_OffRoadMob	1 A 5 b	(a)	1 A 5 b Other, Mobile (Including military, land based and recreational boats)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0,00	NR	NR	NR	NR	0,00	0,00	NA	NA
E_Fugitive	1 B 1 a	(a)	1 B 1 a Fugitive emission from Solid Fuels: Coal Mining and Handling	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
E_Fugitive	1 B 1 b	(a)	1 B 1 b Fugitive emission from Solid Fuels:Solid fuel transformation	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	IE	NR	NR	NR	NR	IE	IE	NA	NA
E_Fugitive	1 B 1 c	(a)	1 B 1 c Other fugitive emissions from solid fuels	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NO	NA	NA	NA	NA	NO	NO	NA	NA
E_Fugitive	1 B 2 a i		1 B 2 a i Exploration Production, Transport	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
E_Fugitive	1 B 2 a iv		1 B 2 a iv Refining / Storage	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
E_Fugitive	1 B 2 a v		1 B 2 a v Distribution of oil products	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
E_Fugitive	1 B 2 a vi		1 B 2 a vi Geothermal energy extraction	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NE	NR	NR	NR	NR	NE	NE	NR	NR
E_Fugitive	1 B 2 b	(a)	1 B 2 b Natural gas	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
E_Fugitive	1 B 2 c	(a)	1 B 2 c Venting and flaring	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	IE	NR	NR	NR	NR	IE	IE	NA	NA

TABLE IV 1: National sector emissions: Main pollutants, particulate matter, heavy metals and persistent orga
Version 2008-1

Print Main Pollutants and Particulates

Print Activity Data

COUNTRY:	AT	(as ISO2 code)
DATE:	18.02.2009	(as DD.MM.YYYY)
YEAR:	2007	(as YYYY, year of Emissions and Activity Data)
version:	v2.0	(as v1.0 for the initial submission)

1 A 3 b i **fuel used**
1 A 3 b iii **fuel used**
1 A 3 b i **fuel sold**
1 A 3 b iii **fuel sold**

COLOUR CODING:
Memo items
NATIONAL TOTAL
Reporting YEARS are detailed in Note 1 below

Table IV 1 (Revised UNECE/EMEP Reporting Guidelines ECE/EB.AIR/2008/4)

AT: 18.02.2009: 2007	*NFR sectors to be reported to LRTAP*			Activity Data (From 1990)						
				Liquid Fuels	Solid Fuels	Gaseous Fuels	Biomass	Other Fuels	*Other activity (specified)*	*Other Activity Units*
NFR Aggregation for Gridding and LPS (GNFR)	*NFR Code*	*annotation*	*Longname*	TJ NCV	TJ NCV	TJ NCV	TJ NCV	TJ NCV		
A_PublicPower	1 A 1 a	(a)	1 A 1 a Public Electricity and Heat Production	9.712,75	54.463,28	71.236,46	36.354,37	11.795,35	*NA*	*TJ NCV*
B_IndustrialComb	1 A 1 b	(a)	1 A 1 b Petroleum refining	36.447,81	0,00	2.569,54	0,00	0,00	*NA*	*TJ NCV*
B_IndustrialComb	1 A 1 c	(a)	1 A 1 c Manufacture of Solid Fuels and Other Energy Industries	0,00	0,00	11.314,08	0,00	0,00	*NA*	*TJ NCV*
B_IndustrialComb	1 A 2 a	(a)	1 A 2 a Stationary Combustion in Manufacturing Industries and Construction: Iron and Steel	11.043,46	41.690,59	19.634,24	0,00	0,00	*NA*	*TJ NCV*
B_IndustrialComb	1 A 2 b	(a)	1 A 2 b Stationary Combustion in Manufacturing Industries and Construction: Non-ferrous Metals	414,26	138,13	3.790,44	0,00	0,00	*NA*	*TJ NCV*
B_IndustrialComb	1 A 2 c	(a)	1 A 2 c Stationary Combustion in Manufacturing Industries and Construction: Chemicals	710,15	836,88	16.012,15	2.208,87	9.011,84	*NA*	*TJ NCV*
B_IndustrialComb	1 A 2 d	(a)	1 A 2 d Stationary Combustion in Manufacturing Industries and Construction: Pulp, Paper and Print	1.282,44	4.006,15	30.976,71	34.009,67	203,60	*NA*	*TJ NCV*
B_IndustrialComb	1 A 2 e	(a)	1 A 2 e Stationary Combustion in Manufacturing Industries and Construction: Food Processing, Beverages and Tobacco	2.767,95	106,53	12.243,03	533,34	0,00	*NA*	*TJ NCV*
B_IndustrialComb	1 A 2 f i		1 A 2 f i Stationary Combustion in Manufacturing Industries and Construction: Other (Please specify in your IIR)	11.087,51	6.971,96	34.474,49	20.916,33	7.784,38	*NA*	*TJ NCV*
I_OffRoadMob	1 A 2 f ii		1 A 2 f ii Mobile Combustion in Manufacturing Industries and Construction: (Please specify in your IIR)	10.331,94	0,00	0,00	0,00	0,00	*NA*	*TJ NCV*
J_CivilLTO	1 A 3 a ii (i)		1 A 3 a ii (i) Civil Aviation (Domestic, LTO)	398,46	NA	NA	NA	NA	*NA*	*TJ NCV*
K_IternationalLTO	1 A 3 a i (i)		1 A 3 a i (i) International Aviation (LTO)	3.977,37	NA	NA	NA	NA	*NA*	*TJ NCV*
G_RoadRail	1 A 3 b i		1 A 3 b i Road Transport:, Passenger cars	179.671,02	NA	0,00	NO	NA	*NA*	*TJ NCV*
G_RoadRail	1 A 3 b ii		1 A 3 b ii Road Transport:, Light duty vehicles	26.678,86	NA	0,00	NA	NA	*NA*	*TJ NCV*
G_RoadRail	1 A 3 b iii		1 A 3 b iii Road Transport:, Heavy duty vehicles	123.038,14	NA	0,00	NA	NA	*NA*	*TJ NCV*
G_RoadRail	1 A 3 b iv		1 A 3 b iv Road Transport:, Mopeds & Motorcycles	1.756,61	NA	0,00	NA	NA	*NA*	*TJ NCV*
G_RoadRail	1 A 3 b v		1 A 3 b v Road Transport:, Gasoline evaporation	3,26	NA	NA	NA	NA	*NA*	*TJ NCV*
G_RoadRail	1 A 3 b vi		1 A 3 b vi Road Transport:, Automobile tyre and brake wear	NA	NA	NA	NA	NA	*61.036,10*	*10^6 km*
G_RoadRail	1 A 3 b vii		1 A 3 b vii Road Transport:, Automobile road abrasion	NA	NA	NA	NA	NA	*61.036,10*	*10^6 km*
G_RoadRail	1 A 3 c	(a)	1 A 3 c Railways	2.351,36	5,63	0,00	0,00	0,00	*NA*	*TJ NCV*
H_Shipping	1 A 3 d i (ii)		1 A 3 d i (ii) International inland waterways	NO	NO	NA	NA	NA	*NA*	*TJ NCV*
H_Shipping	1 A 3 d ii	(a)	1 A 3 d ii National Navigation (Shipping)	998,31	0,00	0,00	0,00	0,00	*NA*	*TJ NCV*
I_OffRoadMob	1 A 3 e		1 A 3 e Pipeline compressors	0,00	0,00	8.104,70	0,00	0,00	*NA*	*TJ NCV*
C_SmallComb	1 A 4 a i		1 A 4 a i Commercial / Institutional: Stationary	8.285,31	617,06	20.720,73	6.050,67	1.472,84	*NA*	*TJ NCV*
I_OffRoadMob	1 A 4 a ii		1 A 4 a ii Commercial / Institutional: Mobile	0,00	0,00	0,00	0,00	0,00	*NA*	*TJ NCV*
C_SmallComb	1 A 4 b i		1 A 4 b i Residential: Stationary plants	55.730,87	4.564,03	53.877,67	66.519,08	0,00	*NA*	*TJ NCV*
I_OffRoadMob	1 A 4 b ii		1 A 4 b ii Residential: Household and gardening (mobile)	1.880,63	0,00	0,00	0,00	0,00	*NA*	*TJ NCV*
C_SmallComb	1 A 4 c i		1 A 4 c i Agriculture/Forestry/Fishing: Stationary	1.157,50	85,54	547,01	8.872,12	0,00	*NA*	*TJ NCV*
I_OffRoadMob	1 A 4 c ii		1 A 4 c ii Agriculture/Forestry/Fishing: Off-road Vehicles and Other Machinery	11.458,96	NA	NA	NO	NA	*NA*	*TJ NCV*
H_Shipping	1A 4 c iii		1A 4 c iii Agriculture/Forestry/Fishing: National Fishing	0,00	NA	0,00	NO	NA	*NA*	*TJ NCV*
B_IndustrialComb	1 A 5 a	(a)	1 A 5 a Other, Stationary (including Military)	0,00	0,00	0,00	0,00	0,00	*NA*	*TJ NCV*
I_OffRoadMob	1 A 5 b	(a)	1 A 5 b Other, Mobile (Including military, land based and recreational boats)	614,58	0,00	0,00	0,00	0,00	*NA*	*TJ NCV*
E_Fugitive	1 B 1 a	(a)	1 B 1 a Fugitive emission from Solid Fuels: Coal Mining and Handling	NA	NA	NA	NA	NA	*NO*	*coal produced [Mt]*
E_Fugitive	1 B 1 b	(a)	1 B 1 b Fugitive emission from Solid Fuels:Solid fuel transformation	NA	NA	NA	NA	NA	*1.899,99*	*coal used for transformation [Mt]*
E_Fugitive	1 B 1 c	(a)	1 B 1 c Other fugitive emissions from solid fuels	NA	NA	NA	NA	NA	*NO*	
E_Fugitive	1 B 2 a i		1 B 2 a i Exploration Production, Transport	NA	NA	NA	NA	NA	*0,85*	*Crude Oil produced [Mt]*
E_Fugitive	1 B 2 a iv		1 B 2 a iv Refining / Storage	NA	NA	NA	NA	NA	*8.545,90*	*Crude Oil Refined [Mt]*
E_Fugitive	1 B 2 a v		1 B 2 a v Distribution of oil products	NA	NA	NA	NA	NA	*1,97*	*Oil Consumed [Mt]*
E_Fugitive	1 B 2 a vi		1 B 2 a vi Geothermal energy extraction	NA	NA	NA	NA	NA	*NO*	*Geothermal energy extracted [Tj]*
E_Fugitive	1 B 2 b	(a)	1 B 2 b Natural gas	NA	NA	NA	NA	NA	*1.848,00*	*Gas throughput [Mn3]*
E_Fugitive	1 B 2 c	(a)	1 B 2 c Venting and flaring	NA	NA	NA	NA	NA	*IE*	*Gas vented Flared [TJ]*

Table IV 1 (Revised UNECE/EMEP Reporting Guidelines ECE/EB.AIR/2008/4)

AT: 18.02.2009: 2007	NFR sectors to be reported to LRTAP				NECD pollutants																
					Main Pollutants (from 1980)				Particulate Matter (from 2000)			Main pollutants (from 1980)	Priority Heavy Metals (from 1990)			Other Heavy Metals (from 1990)					
					NOx	NMVOC	SOx	NH3	PM2.5	PM10	TSP	CO	Pb	Cd	Hg	As	Cr	Cu	Ni	Se	Zn
NFR Aggregation for Gridding and LPS (GNFR)	NFR Code	annotation	Longname	Notes:	Gg NO_2	Gg	Gg SO_2	Gg	Gg	Gg	Gg	Gg	Mg	Mg	Mg	Mg	Mg	Mg	Mg	Mg	Mg
D_IndProcess	2 A 1	(a)	2 A 1 Cement Production		NA	NA	NA	NA	0,08	0,09	0,10	NA	NA	NA	NA	NR	NR	NR	NR	NR	NR
D_IndProcess	2 A 2	(a)	2 A 2 Lime Production		NA	NA	NA	NA	0,06	0,09	0,10	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
D_IndProcess	2 A 3	(a)	2 A 3 Limestone and Dolomite Use		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
D_IndProcess	2 A 4	(a)	2 A 4 Soda Ash Production and use		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
D_IndProcess	2 A 5	(a)	2 A 5 Asphalt Roofing		NA	IE	NA	NA	NA	NA	NA	9,78	NA	NA	NA	NA	NA	NA	NA	NA	NA
D_IndProcess	2 A 6	(a)	2 A 6 Road Paving with Asphalt		NA	IE	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
D_IndProcess	2 A 7 a		2 A 7 a Quarrying and mining of minerals other than coal		NA	NA	NA	NA	1,16	10,48	22,28	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
D_IndProcess	2 A 7 b		2 A 7 b Construction and demolition		NA	NA	NA	NA	0,14	1,35	2,71	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
D_IndProcess	2 A 7 c		2A 7 c Storage, handling and transport of mineral products		IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	NA	NA	NA	NA	NA	NA
D_IndProcess	2 A 7 d		2 A 7 d Other Mineral products (Please specify the sources included/excluded in the notes column to the right)		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NR	NR	NR	NR	NR	NR
D_IndProcess	2 B 1	(a)	2 B 1 Ammonia Production		0,18	IE	NA	0,02	NA	NA	NA	0,08	NA	NA	NA	NA	NA	NA	NA	NA	NA
D_IndProcess	2 B 2	(a)	2 B 2 Nitric Acid Production		0,14	NA	NA	0,00	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
D_IndProcess	2 B 3	(a)	2 B 3 Adipic Acid Production		NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NA	NA	NA	NA	NA	NA
D_IndProcess	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
D_IndProcess	2 B 5 a		2 B 5 a Other chemical industry (Please specify the sources included/excluded in the notes column to the right)		0,03	1,32	0,77	0,05	0,12	0,23	0,39	11,07	0,00	0,00	0,00	NR	NR	NR	NR	NR	NR
D_IndProcess	2 B 5 b		2 B 5 b Storage, handling and transport of chemical products (Please specify the sources included/excluded in the notes column to the right)		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NR	NR	NR	NR	NR	NR
D_IndProcess	2 C 1	(a)	2 C 1 Iron and Steel Production		0,09	0,31	0,06	IE	0,25	0,56	0,79	2,53	7,00	0,23	0,33	NR	NR	NR	NR	NR	NR
D_IndProcess	2 C 2	(a)	2 C 2 Ferroalloys Production		NA	NA	NA	NA	NE	NE	NE	NA	NE	NE	NE	NR	NR	NR	NR	NR	NR
D_IndProcess	2 C 3	(a)	2 C 3 Aluminum Production		NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NR	NR	NR	NR	NR	NR
D_IndProcess	2 C 5 a		2 C 5 a Copper Production		NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NR	NR	NR	NR	NR	NR
D_IndProcess	2 C 5 b		2 C 5 b Lead Production		NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NR	NR	NR	NR	NR	NR
D_IndProcess	2 C 5 c		2 C 5 c Nickel Production		NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NR	NR	NR	NR	NR	NR
D_IndProcess	2 C 5 d		2 C 5 d Zinc Production		NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NR	NR	NR	NR	NR	NR
D_IndProcess	2 C 5 e		2 C 5 e Other metal production (Please specify the sources included/excluded in the notes column to the right)		0,02	0,18	0,40	NA	NE	NE	NE	0,32	IE	IE	IE	NR	NR	NR	NR	NR	NR
D_IndProcess	2 C 5 f		2 C 5 f Storage, handling and transport of metal products (Please specify the sources included/excluded in the notes column to the right)		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NR	NR	NR	NR	NR	NR
D_IndProcess	2 D 1	(a)	2 D 1 Pulp and Paper		1,26	0,92	NA	NA	NA	NA	NA	0,91	NA	NA	NA	NA	NA	NA	NA	NA	NA
D_IndProcess	2 D 2	(a)	2 D 2 Food and Drink		NA	2,16	NA	NA	0,00	0,00	0,00	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
D_IndProcess	2 D 3		2 D 3 Wood processing		NA	NA	NA	NA	0,17	0,41	1,03	NA	NA	NA	NA	NR	NA	NR	NA	NA	NA
D_IndProcess	2 E		2 E Production of POPs		NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NA	NA	NA	NA	NA	NA
D_IndProcess	2 F		2 F Consumption of POPs and Heavy Metals (e.g. electricial and scientific equipment)		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NR	NR	NR	NR	NR	NR
D_IndProcess	2 G		2 G Other production, consumption, storage, transportation or handling of bulk products (Please specify the sources included/excluded in the notes		NA	NA	NA	0,00	NA	NA	NA	NA	NA	NA	NA	NR	NR	NR	NR	NR	NR
F_Solvents	3 A 1		3 A 1 Decorative coating application	Default AD-Unit has been changed from "Paint Used[kt]" to "Solvents Used[kt]"	NA	12,20	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
F_Solvents	3 A 2		3 A 2 Industrial coating application	Default AD-Unit has been changed from "Paint Used[kt]" to "Solvents Used[kt]"	NA	17,02	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
F_Solvents	3 A 3		3 A 3 Other coating application (Please specify the sources included/excluded in the notes column to the right)		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
F_Solvents	3 B 1		3 B 1 Degreasing		NA	13,75	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
F_Solvents	3 B 2		3 B 2 Dry cleaning		NA	0,55	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
F_Solvents	3 C	(a)	3 C Chemical products	Default AD-Unit has been changed from "NA" to "Solvents Used[kt]"	NA	8,83	NA	NA	NA	NA	NA	NA	0,02	0,00	NA	NR	NR	NR	NR	NR	NR
F_Solvents	3 D 1		3 D 1 Printing	Default AD-Unit has been changed from "NA" to "Solvents Used[kt]"	NA	8,55	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
F_Solvents	3 D 2		3 D 2 Domestic solvent use including fungicides		NA	24,29	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
F_Solvents	3 D 3		3 D 3 Other product use	Default AD-Unit has been changed from "NA" to "Solvents Used[kt]"	NA	18,91	NA	NA	0,44	0,44	0,44	NA	NA	NA	NA	NR	NR	NR	NR	NR	NR

Table IV 1 (Revised UNECE/EMEP Reporting Guidelines ECE/EB.AIR/2008/4)

AT: 18.02.2009: 2007	*NFR sectors to be reported to LRTAP*			Persistent Organic Pollutants (POPs) Annex I (1) (From 1990)									POPs Annex II (2) (From 1990)			POPs Annex III (3) (from 1990)							Other POPs (4) (From 1990)	
																	PAH							
				Aldrin	Chlordane	Chlordecone	Dieldrin	Endrin	Heptachlor	Hexabromo-biphenyl	Mirex	Toxaphene	HCH	DDT	PCB	DIOX	benzo(a) pyrene	benzo(b) fluoranthene	benzo(k) fluoranthene	Indeno(1,2,3-cd)pyrene	Total 1-4	HCB	PCP	SCCP
NFR Aggregation for Gridding and LPS (GNFR)	*NFR Code*	*annotation*	*Longname*	kg	kg	kg	kg	kg	kg	kg	kg	kg	kg	kg	kg	g I-Teq	Mg	Mg	Mg	Mg	Mg	kg	kg	kg
D_IndProcess	2 A 1	(a)	2 A 1 Cement Production	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NR	NR	NR	NR	NA	NA	NA	NA
D_IndProcess	2 A 2	(a)	2 A 2 Lime Production	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
D_IndProcess	2 A 3	(a)	2 A 3 Limestone and Dolomite Use	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
D_IndProcess	2 A 4	(a)	2 A 4 Soda Ash Production and use	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
D_IndProcess	2 A 5	(a)	2 A 5 Asphalt Roofing	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NR	NR	NR	NR	NA	NA	NA	NA
D_IndProcess	2 A 6	(a)	2 A 6 Road Paving with Asphalt	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NR	NR	NR	NR	NA	NA	NA	NA
D_IndProcess	2 A 7 a		2 A 7 a Quarrying and mining of minerals other than coal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
D_IndProcess	2 A 7 b		2 A 7 b Construction and demolition	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
D_IndProcess	2 A 7 c		2A 7 c Storage, handling and transport of mineral products	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	IE	NA	NA	NA	NA	IE	IE	NA	NA
D_IndProcess	2 A 7 d		2 A 7 d Other Mineral products (Please specify the sources included/excluded in the notes column to the right)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NR	NR	NR	NR	NA	NA	NA	NA
D_IndProcess	2 B 1	(a)	2 B 1 Ammonia Production	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
D_IndProcess	2 B 2	(a)	2 B 2 Nitric Acid Production	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
D_IndProcess	2 B 3	(a)	2 B 3 Adipic Acid Production	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NO	NA	NA	NA	NA	NO	NO	NA	NA
D_IndProcess	2 B 4	(a)	2 B 4 Carbide Production	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NR	NR	NR	NR	NA	NA	NA	NA
D_IndProcess	2 B 5 a		2 B 5 a Other chemical industry (Please specify the sources included/excluded in the notes column to the right)	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NA	NR	NR	NR	NR	NA	NA	NR	NR
D_IndProcess	2 B 5 b		2 B 5 b Storage, handling and transport of chemical products (Please specify the sources included/excluded in the notes column to the right)	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NA	NR	NR	NR	NR	NA	NA	NR	NR
D_IndProcess	2 C 1	(a)	2 C 1 Iron and Steel Production	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	3,95	NR	NR	NR	NR	0,19	3,95	NA	NA
D_IndProcess	2 C 2	(a)	2 C 2 Ferroalloys Production	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NE	NR	NR	NR	NR	NE	NE	NA	NA
D_IndProcess	2 C 3	(a)	2 C 3 Aluminum Production	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NO	NR	NR	NR	NR	NO	NO	NA	NA
D_IndProcess	2 C 5 a		2 C 5 a Copper Production	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NO	NR	NR	NR	NR	NO	NO	NA	NA
D_IndProcess	2 C 5 b		2 C 5 b Lead Production	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NO	NR	NR	NR	NR	NO	NO	NA	NA
D_IndProcess	2 C 5 c		2 C 5 c Nickel Production	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NO	NR	NR	NR	NR	NO	NO	NA	NA
D_IndProcess	2 C 5 d		2 C 5 d Zinc Production	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NO	NR	NR	NR	NR	NO	NO	NA	NA
D_IndProcess	2 C 5 e		2 C 5 e Other metal production (Please specify the sources included/excluded in the notes column to the right)	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	IE	NR	NR	NR	NR	IE	IE	NR	NR
D_IndProcess	2 C 5 f		2 C 5 f Storage, handling and transport of metal products (Please specify the sources included/excluded in the notes column to the right)	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NA	NR	NR	NR	NR	NA	NA	NR	NR
D_IndProcess	2 D 1	(a)	2 D 1 Pulp and Paper	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NR	NR	NR	NA	NA	NA	NA
D_IndProcess	2 D 2	(a)	2 D 2 Food and Drink	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0,13	NA	NA	NA	NA	0,04	0,03	NA	NA
D_IndProcess	2 D 3		2 D 3 Wood processing	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
D_IndProcess	2 E		2 E Production of POPs	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NO	NA	NA	NA	NA	NO	NO	NR	NR
D_IndProcess	2 F		2 F Consumption of POPs and Heavy Metals (e.g. electricial and scientific equipment)	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NA	NA	NA	NA	NA	NA	NA	NR	NR
D_IndProcess	2 G		2 G Other production, consumption, storage, transportation or handling of bulk products (Please specify the sources included/excluded in the notes	NA	NA	NA	NA	NA	NA	NR	NA	NA	NA	NR	NR	NA	NR	NR	NR	NR	NA	NA	NA	NR
F_Solvents	3 A 1		3 A 1 Decorative coating application	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NR
F_Solvents	3 A 2		3 A 2 Industrial coating application	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NR
F_Solvents	3 A 3		3 A 3 Other coating application (Please specify the sources included/excluded in the notes column to the right)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NR
F_Solvents	3 B 1		3 B 1 Degreasing	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
F_Solvents	3 B 2		3 B 2 Dry cleaning	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
F_Solvents	3 C	(a)	3 C Chemical products	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NA	NR	NR	NR	NR	NA	NA	NR	NR
F_Solvents	3 D 1		3 D 1 Printing	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
F_Solvents	3 D 2		3 D 2 Domestic solvent use including fungicides	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
F_Solvents	3 D 3		3 D 3 Other product use	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NE	NR	NR	NR	NR	NE	NE	NR	NR

Table IV 1 (Revised UNECE/EMEP Reporting Guidelines ECE/EB.AIR/2008/4)

AT: 18.02.2009: 2007	*NFR sectors to be reported to LRTAP*			Activity Data (From 1990)						
				Liquid Fuels	Solid Fuels	Gaseous Fuels	Biomass	Other Fuels	*Other activity (specified)*	*Other Activity Units*
NFR Aggregation for Gridding and LPS (GNFR)	*NFR Code*	*annotation*	*Longname*	TJ NCV	TJ NCV	TJ NCV	TJ NCV	TJ NCV		
D_IndProcess	2 A 1	(a)	2 A 1 Cement Production	NA	NA	NA	NA	NA	*3.992,38*	*Clinker Production [kt]*
D_IndProcess	2 A 2	(a)	2 A 2 Lime Production	NA	NA	NA	NA	NA	*782,00*	*Lime Produced [kt]*
D_IndProcess	2 A 3	(a)	2 A 3 Limestone and Dolomite Use	NA	NA	NA	NA	NA	*696,91*	*Limestone and Dolomite used [kt]*
D_IndProcess	2 A 4	(a)	2 A 4 Soda Ash Production and use	NA	NA	NA	NA	NA	*NA*	*Soda Ash Production kt*
D_IndProcess	2 A 5	(a)	2 A 5 Asphalt Roofing	NA	NA	NA	NA	NA	*27,95*	*Roofing Material Production [Mio m2]*
D_IndProcess	2 A 6	(a)	2 A 6 Road Paving with Asphalt	NA	NA	NA	NA	NA	*1.469,31*	*Asphalt Production [kt]*
D_IndProcess	2 A 7 a		2 A 7 a Quarrying and mining of minerals other than coal	NA	NA	NA	NA	NA	*NO*	*Material quarried [Mt]*
D_IndProcess	2 A 7 b		2 A 7 b Construction and demolition	NA	NA	NA	NA	NA	*NO*	*floor space constructed/demolished [M3]*
D_IndProcess	2 A 7 c		2A 7 c Storage, handling and transport of mineral products	NA	NA	NA	NA	NA	*NO*	*Amount [Mt]*
D_IndProcess	2 A 7 d		2 A 7 d Other Mineral products (Please specify the sources included/excluded in the notes column to the right)	NA	NA	NA	NA	NA	*NO*	*Please specify*
D_IndProcess	2 B 1	(a)	2 B 1 Ammonia Production	NA	NA	NA	NA	NA	*441,30*	*Ammonia Production [kt]*
D_IndProcess	2 B 2	(a)	2 B 2 Nitric Acid Production	NA	NA	NA	NA	NA	*499,40*	*Nitric Acid Production [kt]*
D_IndProcess	2 B 3	(a)	2 B 3 Adipic Acid Production	NA	NA	NA	NA	NA	*NO*	*Adipic Acid Production [kt]*
D_IndProcess	2 B 4	(a)	2 B 4 Carbide Production	NA	NA	NA	NA	NA	*28,00*	*Carbide Production [kt]*
D_IndProcess	2 B 5 a		2 B 5 a Other chemical industry (Please specify the sources included/excluded in the notes column to the right)	NA	NA	NA	NA	NA	*NO*	*Please specify*
D_IndProcess	2 B 5 b		2 B 5 b Storage, handling and transport of chemical products (Please specify the sources included/excluded in the notes column to the right)	NA	NA	NA	NA	NA	*NO*	
D_IndProcess	2 C 1	(a)	2 C 1 Iron and Steel Production	NA	NA	NA	NA	NA	*7.578,00*	*Steel Produced [kt]*
D_IndProcess	2 C 2	(a)	2 C 2 Ferroalloys Production	NA	NA	NA	NA	NA	*12,51*	*Ferroalloys Production [kt]*
D_IndProcess	2 C 3	(a)	2 C 3 Aluminum Production	NA	NA	NA	NA	NA	*NO*	*Aluminium production [kt]*
D_IndProcess	2 C 5 a		2 C 5 a Copper Production	NA	NA	NA	NA	NA	*NO*	*Copper production [kt]*
D_IndProcess	2 C 5 b		2 C 5 b Lead Production	NA	NA	NA	NA	NA	*NO*	*Lead production [kt]*
D_IndProcess	2 C 5 c		2 C 5 c Nickel Production	NA	NA	NA	NA	NA	*NO*	*Nickel production [kt]*
D_IndProcess	2 C 5 d		2 C 5 d Zinc Production	NA	NA	NA	NA	NA	*NO*	*Zinc production [kt]*
D_IndProcess	2 C 5 e		2 C 5 e Other metal production (Please specify the sources included/excluded in the notes column to the right)	NA	NA	NA	NA	NA	*NO*	*Please specify*
D_IndProcess	2 C 5 f		2 C 5 f Storage, handling and transport of metal products (Please specify the sources included/excluded in the notes column to the right)	NA	NA	NA	NA	NA	*NO*	*Amount (kt)*
D_IndProcess	2 D 1	(a)	2 D 1 Pulp and Paper	NA	NA	NA	NA	NA	*1.596,72*	*Pulp production [kt]*
D_IndProcess	2 D 2	(a)	2 D 2 Food and Drink	NA	NA	NA	NA	NA	*1.454,22*	*Bread, Wine, Beer, Spirits Production [kt]*
D_IndProcess	2 D 3		2 D 3 Wood processing	NA	NA	NA	NA	NA	*NA*	
D_IndProcess	2 E		2 E Production of POPs	NA	NA	NA	NA	NA	*NA*	*NA*
D_IndProcess	2 F		2 F Consumption of POPs and Heavy Metals (e.g. electricial and scientific equipment)	NA	NA	NA	NA	NA	*NA*	*NA*
D_IndProcess	2 G		2 G Other production, consumption, storage, transportation or handling of bulk products (Please specify the sources included/excluded in the notes	NA	NA	NA	NA	NA	*NA*	*NA*
F_Solvents	3 A 1		3 A 1 Decorative coating application	NA	NA	NA	NA	NA	*15,13*	*Solvents used [kt]*
F_Solvents	3 A 2		3 A 2 Industrial coating application	NA	NA	NA	NA	NA	*52,12*	*Solvents used [kt]*
F_Solvents	3 A 3		3 A 3 Other coating application (Please specify the sources included/excluded in the notes column to the right)	NA	NA	NA	NA	NA	*NO*	Solvents used [kt]
F_Solvents	3 B 1		3 B 1 Degreasing	NA	NA	NA	NA	NA	*25,18*	Solvents used [kt]
F_Solvents	3 B 2		3 B 2 Dry cleaning	NA	NA	NA	NA	NA	*0,65*	Solvents used [kt]
F_Solvents	3 C	(a)	3 C Chemical products	NA	NA	NA	NA	NA	*17,36*	*Solvents used [kt]*
F_Solvents	3 D 1		3 D 1 Printing	NA	NA	NA	NA	NA	*13,13*	*Solvents used [kt]*
F_Solvents	3 D 2		3 D 2 Domestic solvent use including fungicides	NA	NA	NA	NA	NA	*28,87*	Solvents used [kt]
F_Solvents	3 D 3		3 D 3 Other product use	NA	NA	NA	NA	NA	*27,98*	*Solvents used [kt]*

Table IV 1 (Revised UNECE/EMEP Reporting Guidelines ECE/EB.AIR/2008/4)

AT: 18.02.2009: 2007	NFR sectors to be reported to LRTAP				NECD pollutants Main Pollutants (from 1980)				Particulate Matter (from 2000)			Main pollutants (from 1980)	Priority Heavy Metals (from 1990)			Other Heavy Metals (from 1990)					
					NOx	NMVOC	SOx	NH3	PM2.5	PM10	TSP	CO	Pb	Cd	Hg	As	Cr	Cu	Ni	Se	Zn
NFR Aggregation for Gridding and LPS (GNFR)	NFR Code	annotation	Longname	Notes:	Gg NO_2	Gg	Gg SO_2	Gg	Gg	Gg	Gg	Gg	Mg	Mg	Mg	Mg	Mg	Mg	Mg	Mg	Mg
O_AgriLivestock	4 B 1 a	(a)	4 B 1 a Cattle Dairy		NA	NA	NA	14,32	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
O_AgriLivestock	4 B 1 b	(a)	4 B 1 b Cattle Non-Dairy		NA	NA	NA	22,46	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
O_AgriLivestock	4 B 2	(a)	4 B 2 Buffalo		NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NA	NA	NA	NA	NA	NA
O_AgriLivestock	4 B 3	(a)	4 B 3 Sheep		NA	NA	NA	0,90	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
O_AgriLivestock	4 B 4	(a)	4 B 4 Goats		NA	NA	NA	0,15	NA	NA	NA	NA	NA	NA	NA	NR	NR	NR	NR	NR	NR
O_AgriLivestock	4 B 6	(a)	4 B 6 Horses		NA	NA	NA	0,73	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
O_AgriLivestock	4 B 7	(a)	4 B 7 Mules and Asses		IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	NA	NA	NA	NA	NA	NA
O_AgriLivestock	4 B 8	(a)	4 B 8 Swine		NA	NA	NA	9,63	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
O_AgriLivestock	4 B 9 a		4 B 9 a Laying Hens		NA	NA	NA	4,57	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
O_AgriLivestock	4 B 9 b		4 B 9 b Broilers		IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	NA	NA	NA	NA	NA	NA
O_AgriLivestock	4 B 9 c		4 B 9 c Turkeys		IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	NA	NA	NA	NA	NA	NA
O_AgriLivestock	4 B 9 d		4 B 9 d Other Poultry		NA	NA	NA	0,62	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
O_AgriLivestock	4 B 13	(a)	4 B 13 Other		NA	NA	NA	0,11	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
P_AgriOther	4 D 1 a	(b)	4 D 1 a Synthetic N-fertilizers		1,02	1,01	NA	4,31	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
P_AgriOther	4 D 2 a		4 D 2 a Farm-level agricultural operations including storage, handling and transport of agricultural products		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
P_AgriOther	4 D 2 b		4 D 2 b Off-farm storage, handling and transport of bulk agricultural products		NA	NA	NA	NA	0,01	0,03	0,06	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
P_AgriOther	4 D 2 c		4 D 2 c N-excretion on pasture range and paddock Unspesified (Please specify the sources included/excluded in the notes column to the right)		4,21	0,69	NA	3,83	1,10	4,95	11,00	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Q_AgriWastes	4 F	(a)	4 F FIELD BURNING OF AGRICULTURAL WASTES		0,03	0,11	0,00	0,04	0,13	0,14	0,14	1,07	0,01	0,00	0,00	NR	NR	NR	NR	NR	NR
P_AgriOther	4 G	(a)	4 G Agriculture OTHER (c)		NA	NA	NA	NA	0,10	0,43	0,96	NA	NA	NA	NA	NR	NR	NR	NR	NR	NR
L_OtherWasteDisp	6 A	(a)	6 A SOLID WASTE DISPOSAL ON LAND		NA	0,08	NA	0,00	0,03	0,10	0,21	5,85	0,00	0,00	0,00	NA	NA	NA	NA	NA	NA
M_WasteWater	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
N_WasteIncin	6 C a		6 C a Clinical Waste Incineration (d)		0,02	0,00	0,00	0,00	NE	NE	NE	0,00	0,01	0,00	0,00	NR	NR	NR	NR	NR	NR
N_WasteIncin	6 C b		6 C b Industrial Waste Incineration (d)		0,02	0,00	0,05	0,00	NE	NE	NE	0,00	0,00	0,00	0,00	NR	NR	NR	NR	NR	NR
N_WasteIncin	6 C c		6 C c Municipal Waste Incineration (d)		NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NR	NR	NR	NR	NR	NR
N_WasteIncin	6 C d		6 C d Cremation		0,01	0,00	NE	NE	NE	NE	NE	0,01	0,00	NE	0,02	NR	NR	NR	NR	NR	NR
N_WasteIncin	6 C e		6 C e Small Scale Waste Burning		NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NR	NR	NR	NR	NR	NR
L_OtherWasteDisp	6 D	(a)	6 D OTHER WASTE (e)		NA	NA	NA	1,08	NA	NA	NA	NA	NA	NA	NA	NR	NR	NR	NR	NR	NR
R_Other	7 A	(a)	7 A OTHER (included in National Total for Entire Territory)		NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NR	NR	NR	NR	NR	NR
	NATIONAL TOTAL	**(f)**	**National Total for the entire territory**		**220,10**	**179,81**	**25,60**	**66,41**	**22,58**	**43,04**	**74,41**	**768,99**	**15,33**	**1,22**	**1,05**	**NR**	**NR**	**NR**	**NR**	**NR**	**NR**
	Memo Items. NOT TO BE INCLUDED IN NATIONAL TOTALS UNLESS OTHERWISE STATED																				
	NECD TOTAL	(h)	National Total for the NEC Directive		162,59	175,91	25,55	65,96	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
	GRID TOTAL	(g)	National Total for the EMEP grid domain		220,10	179,81	25,60	66,41	22,58	43,04	74,41	768,99	15,33	1,22	1,05	NR	NR	NR	NR	NR	NR
	SNAP NATIONAL	(f)	National Total for the entire territory (1997 Guidelines)		NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
	UNFCCC national total		National Total as reported under UNFCCC		219,22	179,38	25,52	NR	NR	NR	NR	767,56	NR	NR	NR	NR	NR	NR	NR	NR	NR
z_Memo	1 A 3 a ii (ii)		1 A 3 a ii (ii) Civil Aviation (Domestic, Cruise)		0,21	0,02	0,01	0,00	0,02	0,02	0,02	0,05	0,00	0,00	0,00	NR	NR	NR	NR	NR	NR
z_Memo	1 A 3 a i (ii)		1 A 3 a i (ii) International Aviation (Cruise)		7,78	0,51	0,60	0,00	0,65	0,65	0,65	0,90	0,00	0,00	0,00	NR	NR	NR	NR	NR	NR
z_Memo	1 A 3 d i (i)	(a)	1 A 3 d i (i) International maritime Navigation		NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NR	NR	NR	NR	NR	NR
S_Natural	7 B		7 B Other not included in National Total of the entire Territory (Please specify in your IIR)		0,97	124,62	NA	NA	NA	NA	NA	NA	NA	NA	NA	NR	NR	NR	NR	NR	NR
S_Natural	11A		X (11 08 Volcanoes)		0,00	0,01	0,00	0,00	NE	NE	NE	0,07	0,00	0,00	0,00	NR	NR	NR	NR	NR	NR
S_Natural	11 B		FF Forest fires		NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NR	NR	NR	NR	NR	NR
z_Memo	1 A 3	(i)	Transport (fuel used)		NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NR	NR	NR	NR	NR	NR

Table IV 1 (Revised UNECE/EMEP Reporting Guidelines ECE/EB.AIR/2008/4)

AT: 18.02.2009: 2007	*NFR sectors to be reported to LRTAP*			Persistent Organic Pollutants (POPs) Annex I (1) (From 1990)									POPs Annex II (2) (From 1990)			POPs Annex III (3) (from 1990)							Other POPs (4) (From 1990)	
																	PAH							
				Aldrin	Chlordane	Chlordecone	Dieldrin	Endrin	Heptachlor	Hexabromo-biphenyl	Mirex	Toxaphene	HCH	DDT	PCB	DIOX	benzo(a) pyrene	benzo(b) fluoranthene	benzo(k) fluoranthene	Indeno(1,2,3-cd)pyrene	Total 1-4	HCB	PCP	SCCP
NFR Aggregation for Gridding and LPS (GNFR)	*NFR Code*	*annotation*	*Longname*	kg	kg	kg	kg	kg	kg	kg	kg	kg	kg	kg	kg	g I-Teq	Mg	Mg	Mg	Mg	Mg	kg	kg	kg
O_AgriLivestock	4 B 1 a	(a)	4 B 1 a Cattle Dairy	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
O_AgriLivestock	4 B 1 b	(a)	4 B 1 b Cattle Non-Dairy	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
O_AgriLivestock	4 B 2	(a)	4 B 2 Buffalo	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NO	NA	NA	NA	NA	NO	NO	NA	NA
O_AgriLivestock	4 B 3	(a)	4 B 3 Sheep	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
O_AgriLivestock	4 B 4	(a)	4 B 4 Goats	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NA	NR	NR	NR	NR	NA	NA	NR	NR
O_AgriLivestock	4 B 6	(a)	4 B 6 Horses	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
O_AgriLivestock	4 B 7	(a)	4 B 7 Mules and Asses	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	IE	NA	NA	NA	NA	IE	IE	NA	NA
O_AgriLivestock	4 B 8	(a)	4 B 8 Swine	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
O_AgriLivestock	4 B 9 a		4 B 9 a Laying Hens	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
O_AgriLivestock	4 B 9 b		4 B 9 b Broilers	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	IE	NA	NA	NA	NA	IE	IE	NA	NA
O_AgriLivestock	4 B 9 c		4 B 9 c Turkeys	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	IE	NA	NA	NA	NA	IE	IE	NA	NA
O_AgriLivestock	4 B 9 d		4 B 9 d Other Poultry	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
O_AgriLivestock	4 B 13	(a)	4 B 13 Other	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
P_AgriOther	4 D 1 a	(b)	4 D 1 a Synthetic N-fertilizers	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NA	NA	NA	NA	NA	NA	NA	NA	NR	NA
P_AgriOther	4 D 2 a		4 D 2 a Farm-level agricultural operations including storage, handling and transport of agricultural products	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
P_AgriOther	4 D 2 b		4 D 2 b Off-farm storage, handling and transport of bulk agricultural products	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
P_AgriOther	4 D 2 c		4 D 2 c N-excretion on pasture range and paddock Unspesified (Please specify the sources included/excluded in the notes column to the right)	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NA	NA	NA	NA	NA	NA	NA	NA	NR	NA
Q_AgriWastes	4 F	(a)	4 F FIELD BURNING OF AGRICULTURAL WASTES	NA	NA	NA	NA	NA	NA	NR	NA	NA	NA	NA	NA	0,15	NR	NR	NR	NR	0,21	0,03	NA	NA
P_AgriOther	4 G	(a)	4 G Agriculture OTHER (c)	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NA	NR	NR	NR	NR	NA	NA	NR	NA
L_OtherWasteDisp	6 A	(a)	6 A SOLID WASTE DISPOSAL ON LAND	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
M_WasteWater	6 B	(a)	6 B WASTE-WATER HANDLING	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
N_WasteIncin	6 C a		6 C a Clinical Waste Incineration (d)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NR	0,00	NR	NR	NR	NR	0,00	0,00	NA	NA
N_WasteIncin	6 C b		6 C b Industrial Waste Incineration (d)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NR	0,00	NR	NR	NR	NR	0,00	0,00	NA	NA
N_WasteIncin	6 C c		6 C c Municipal Waste Incineration (d)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NR	NO	NR	NR	NR	NR	NO	NO	NA	NA
N_WasteIncin	6 C d		6 C d Cremation	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NR	0,16	NR	NR	NR	NR	0,00	0,03	NA	NA
N_WasteIncin	6 C e		6 C e Small Scale Waste Burning	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NR	NE	NR	NR	NR	NR	NE	NE	NA	NA
L_OtherWasteDisp	6 D	(a)	6 D OTHER WASTE (e)	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NA	NR	NR	NR	NR	NA	NA	NR	NR
R_Other	7 A	(a)	7 A OTHER (included in National Total for Entire Territory)	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NO	NR	NR	NR	NR	NO	NO	NR	NR
	NATIONAL TOTAL	(f)	**National Total for the entire territory**	**NR**	**NR**	**NR**	**NR**	**NR**	**NR**	**NR**	**NR**	**NR**	**NR**	**NR**	**NR**	**47,98**	**NR**	**NR**	**NR**	**NR**	**9,78**	**46,45**	**NR**	**NR**
	Memo Items. NOT TO BE INCLUDED IN NATIONAL TOTALS UNLESS OTHERWISE STA																							
	NECD TOTAL	(h)	National Total for the NEC Directive	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
	GRID TOTAL	(g)	National Total for the EMEP grid domain	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	47,98	NR	NR	NR	NR	9,78	46,45	NR	NR
	SNAP NATIONAL	(f)	National Total for the entire territory (1997 Guidelines)	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
	UNFCCC national total		National Total as reported under UNFCCC	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
z_Memo	1 A 3 a ii (ii)		1 A 3 a ii (ii) Civil Aviation (Domestic, Cruise)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NE	NR	NR	NR	NR	NE	NE	NA	NA
z_Memo	1 A 3 a i (ii)		1 A 3 a i (ii) International Aviation (Cruise)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NE	NR	NR	NR	NR	NE	NE	NA	NA
z_Memo	1 A 3 d i (i)	(a)	1 A 3 d i (i) International maritime Navigation	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NO	NR	NR	NR	NR	NO	NO	NA	NA
S_Natural	7 B		7 B Other not included in National Total of the entire Territory (Please specify in your IIR)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NR	NR	NR	NR	NA	NA	NA	NA
S_Natural	11A		X (11 08 Volcanoes)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0,01	NR	NR	NR	NR	0,12	0,00	NR	NR
S_Natural	11 B		FF Forest fires	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NO	NR	NR	NR	NR	NO	NO	NR	NR
z_Memo	1 A 3	(i)	Transport (fuel used)	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NO	NR	NR	NR	NR	NO	NO	NR	NR

Table IV 1 (Revised UNECE/EMEP Reporting Guidelines ECE/EB.AIR/2008/4)

AT: 18.02.2009: 2007	*NFR sectors to be reported to LRTAP*			Activity Data (From 1990)						
				Liquid Fuels	Solid Fuels	Gaseous Fuels	Biomass	Other Fuels	*Other activity (specified)*	*Other Activity Units*
NFR Aggregation for Gridding and LPS (GNFR)	*NFR Code*	*annotation*	*Longname*	TJ NCV	TJ NCV	TJ NCV	TJ NCV	TJ NCV		
O_AgriLivestock	4 B 1 a	(a)	4 B 1 a Cattle Dairy	NA	NA	NA	NA	NA	*524,50*	*Population Size (1000 head)*
O_AgriLivestock	4 B 1 b	(a)	4 B 1 b Cattle Non-Dairy	NA	NA	NA	NA	NA	*1.475,70*	*Population Size (1000 head)*
O_AgriLivestock	4 B 2	(a)	4 B 2 Buffalo	NA	NA	NA	NA	NA	*NO*	*Population Size (1000 head)*
O_AgriLivestock	4 B 3	(a)	4 B 3 Sheep	NA	NA	NA	NA	NA	*351,33*	*Population Size (1000 head)*
O_AgriLivestock	4 B 4	(a)	4 B 4 Goats	NA	NA	NA	NA	NA	*60,49*	*Population Size (1000 head)*
O_AgriLivestock	4 B 6	(a)	4 B 6 Horses	NA	NA	NA	NA	NA	*87,07*	*Population Size (1000 head)*
O_AgriLivestock	4 B 7	(a)	4 B 7 Mules and Asses	NA	NA	NA	NA	NA	*IE*	*Population Size (1000 head)*
O_AgriLivestock	4 B 8	(a)	4 B 8 Swine	NA	NA	NA	NA	NA	*3.286,29*	*Population Size (1000 head)*
O_AgriLivestock	4 B 9 a		4 B 9 a Laying Hens	NA	NA	NA	NA	NA	*12.354,36*	*Population Size (1000 head)*
O_AgriLivestock	4 B 9 b		4 B 9 b Broilers	NA	NA	NA	NA	NA	*IE*	*Population Size (1000 head)*
O_AgriLivestock	4 B 9 c		4 B 9 c Turkeys	NA	NA	NA	NA	NA	*IE*	*Population Size (1000 head)*
O_AgriLivestock	4 B 9 d		4 B 9 d Other Poultry	NA	NA	NA	NA	NA	*672,79*	*Population Size (1000 head)*
O_AgriLivestock	4 B 13	(a)	4 B 13 Other	NA	NA	NA	NA	NA	*41,19*	*Population Size (1000 head)*
P_AgriOther	4 D 1 a	(b)	4 D 1 a Synthetic N-fertilizers	NA	NA	NA	NA	NA	*103.500.000,00*	*Use of synthetic fertilizers (kg N/yr)*
P_AgriOther	4 D 2 a		4 D 2 a Farm-level agricultural operations including storage, handling and transport of agricultural products	NA	NA	NA	NA	NA	*NO*	
P_AgriOther	4 D 2 b		4 D 2 b Off-farm storage, handling and transport of bulk agricultural products	NA	NA	NA	NA	NA	*NO*	
P_AgriOther	4 D 2 c		4 D 2 c N-excretion on pasture range and paddock Unspesified (Please specify the sources included/excluded in the notes column to the right)	NA	NA	NA	NA	NA	*22.883.910,08*	*kg N/yr*
Q_AgriWastes	4 F	(a)	4 F FIELD BURNING OF AGRICULTURAL WASTES	NA	NA	NA	NA	NA	*2,13*	*Area burned k ha/yr*
P_AgriOther	4 G	(a)	4 G Agriculture OTHER (c)	NA	NA	NA	NA	NA	*NA*	*NA*
L_OtherWasteDisp	6 A	(a)	6 A SOLID WASTE DISPOSAL ON LAND	NA	NA	NA	NA	NA	*540,50*	*Annual deposition of MSW at the SWDS [Gg]*
M_WasteWater	6 B	(a)	6 B WASTE-WATER HANDLING	NA	NA	NA	NA	NA	*843,85*	*Total organic product [Gg DC/yr]*
N_WasteIncin	6 C a		6 C a Clinical Waste Incineration (d)	NA	NA	NA	NA	NA	*3,10*	*Waste incinerated [Gg]*
N_WasteIncin	6 C b		6 C b Industrial Waste Incineration (d)	NA	NA	NA	NA	NA	*3,00*	*Waste incinerated [Gg]*
N_WasteIncin	6 C c		6 C c Municipal Waste Incineration (d)	NA	NA	NA	NA	NA	*NO*	*MSW incinerated [Gg]*
N_WasteIncin	6 C d		6 C d Cremation	NA	NA	NA	NA	NA	*9.137,00*	*Incineration of corpses [Number]*
N_WasteIncin	6 C e		6 C e Small Scale Waste Burning	NA	NA	NA	NA	NA	*NO*	*Amount of wast burned [kt]*
L_OtherWasteDisp	6 D	(a)	6 D OTHER WASTE (e)	NA	NA	NA	NA	NA	*NA*	*NA*
R_Other	7 A	(a)	7 A OTHER (included in National Total for Entire Territory)	NA	NA	NA	NA	NA	*NA*	*NA*
	NATIONAL TOTAL	(f)	**National Total for the entire territory**	**NA**	**NA**	**NA**	**NA**	**NA**	***NA***	***NA***
	Memo Items. NOT TO BE INCLUDED IN NATIONAL TOTALS UNLESS OTHERWISE STA									
	NECD TOTAL	(h)	National Total for the NEC Directive	NA	NA	NA	NA	NA	*NA*	*NA*
	GRID TOTAL	(g)	National Total for the EMEP grid domain	NA	NA	NA	NA	NA	*NA*	*NA*
	SNAP NATIONAL	(f)	National Total for the entire territory (1997 Guidelines)	NO	NO	NO	NO	NO	*NO*	
	UNFCCC national total		National Total as reported under UNFCCC	NO	NO	NO	NO	NO	*NO*	
z_Memo	1 A 3 a ii (ii)		1 A 3 a ii (ii) Civil Aviation (Domestic, Cruise)	NO	NA	NA	NA	NA	*NA*	TJ NCV
z_Memo	1 A 3 a i (ii)		1 A 3 a i (ii) International Aviation (Cruise)	NO	NA	NA	NA	NA	*NA*	TJ NCV
z_Memo	1 A 3 d i (i)	(a)	1 A 3 d i (i) International maritime Navigation	NO	NA	NA	NA	NA	*NA*	TJ NCV
S_Natural	7 B		7 B Other not included in National Total of the entire Territory (Please specify in your IIR)	NA	NA	NA	NA	NA	*NA*	*NA*
S_Natural	11A		X (11 08 Volcanoes)	NA	NA	NA	NA	NA	*NO*	
S_Natural	11 B		FF Forest fires	NA	NA	NA	NA	NA	*NO*	*Area of forest burned [ha]*
z_Memo	1 A 3	(i)	Transport (fuel used)	NO	NA	NA	NO	NA	*NA*	TJ NCV

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	DIOX, PAH HCB	No emission factors available. Assumed to be negligible.
1 B 2 a vi	All	No emission factors available. Assumed to be negligible.
2 C 2	All	No emission factors available. Assumed to be negligible.
2 C 5 e	TSP, PM2.5, PM10	No emission factors available. Assumed to be negligible.
3 D 3	DIOX, PAH HCB	No emission factors available. Assumed to be negligible.
6 C a	TSP, PM2.5, PM10	No emission factors available. Assumed to be negligible.
6 C b	TSP, PM2.5, PM10	No emission factors available. Assumed to be negligible.
6 C c	TSP, PM2.5, PM10	No emission factors available. Assumed to be negligible.
6 C d	SO_2, NO_x, TSP, PM2.5, PM10, Cd	No emission factors available. Assumed to be negligible.
6 C e	All	No activity data available

Table IV 1 F3: Explanation to the Notation key IE

NFR code	Substance(s)	Included in NFR code
1 A 1 b	CH_4	1 B 2 a iv
1 A 3 b vi	TSP, PM2.5, PM10	1 A 3 b vii
1 A 3 d i (ii)	All	1 A 3 d ii
1 A 4 a ii	All	1 A 3 b
1 A 5 a	All	1 A 4 a i
1 B 1 b	All	1 A 2 a
1 B 2 c	All	1 A 1 b
2 A 5	NMVOC	3
2 A 6	NMVOC	3
2 A 7 c	TSP, PM2.5, PM10	2 A 7 a
2 B 1	NMVOC	2 B 5 a
2 C 1	NH_3	1 A 2 a
4 B 7	All	4 B 6
4 B 9 b	All	4 B 9 a
4 B 9 c	All	4 B 9 a

Table IV 1 F4: Sub-sources accounted for in reporting codes „other“

NFR code	Sub-source description	Substance(s) reported
1 A 2 f		
1 A 3 e		
1 A 5 a		
1 A 5 b		
1 B 1 c		
1 B 2 a vi		
2 A 7		
2 B 5		
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		
5 E		

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	x		
1A3di (ii)	International inland waterways (Included in NEC totals only)	x		
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] 1980–2007.

	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	330.20	327.64	2.56	13.14	NA	0.04	NE	0.41	NO	343.79	0.11
1981	288.11	286.22	1.89	13.02	NA	0.04	NE	0.41	NO	301.58	0.12
1982	273.92	272.18	1.75	12.89	NA	0.04	NE	0.41	NO	287.27	0.11
1983	199.22	197.63	1.59	12.77	NA	0.04	NE	0.41	NO	212.45	0.13
1984	182.26	180.59	1.67	12.65	NA	0.04	NE	0.41	NO	195.37	0.18
1985	166.58	165.05	1.53	12.07	NA	0.05	NE	0.41	NO	179.11	0.20
1986	148.02	146.55	1.46	11.28	NA	0.04	NE	0.41	NO	159.75	0.17
1987	127.12	125.59	1.52	10.28	NA	0.04	NE	0.41	NO	137.85	0.19
1988	98.62	96.97	1.65	3.92	NA	0.05	NE	0.22	NO	102.81	0.21
1989	88.79	87.07	1.73	3.31	NA	0.05	NE	0.14	NO	92.29	0.26
1990	72.05	70.05	2.00	2.22	NA	0.00	NE	0.07	NO	74.34	0.26
1991	69.48	68.18	1.30	1.90	NA	0.00	NE	0.06	NO	71.44	0.29
1992	53.35	51.35	2.00	1.67	NA	0.00	NE	0.04	NO	55.05	0.31
1993	51.95	49.85	2.10	1.42	NA	0.00	NE	0.04	NO	53.41	0.33
1994	46.33	45.05	1.28	1.42	NA	0.00	NE	0.05	NO	47.80	0.34
1995	45.99	44.46	1.53	1.37	NA	0.00	NE	0.05	NO	47.41	0.38
1996	43.32	42.12	1.20	1.29	NA	0.00	NE	0.05	NO	44.66	0.43
1997	38.87	38.80	0.07	1.27	NA	0.00	NE	0.05	NO	40.19	0.44
1998	34.39	34.35	0.04	1.18	NA	0.00	NE	0.05	NO	35.62	0.46
1999	32.68	32.54	0.14	1.12	NA	0.00	NE	0.06	NO	33.86	0.45
2000	30.50	30.35	0.15	1.09	NA	0.00	NE	0.06	NO	31.64	0.48
2001	31.51	31.36	0.16	1.21	NA	0.00	NE	0.06	NO	32.79	0.47
2002	30.42	30.29	0.14	1.21	NA	0.00	NE	0.06	NO	31.69	0.43
2003	31.36	31.21	0.15	1.21	NA	0.00	NE	0.06	NO	32.63	0.40
2004	26.30	26.16	0.14	1.22	NA	0.00	NE	0.06	NO	27.58	0.47
2005	25.91	25.78	0.13	1.22	NA	0.00	NE	0.06	NO	27.19	0.55
2006	27.67	27.50	0.17	1.22	NA	0.00	NE	0.06	NO	28.94	0.58
2007	24.31	24.13	0.18	1.22	NA	0.00	NE	0.06	NO	25.60	0.61

Table A-2: Emission trends for NO_x [Gg] 1980–2007.

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	206.10	206.10	IE	13.98	NA	6.66	NE	0.25	NO	227.00	1.01
1981	193.92	193.92	IE	12.71	NA	6.63	NE	0.25	NO	213.51	1.10
1982	191.58	191.58	IE	11.45	NA	6.80	NE	0.25	NO	210.10	1.02
1983	194.38	194.38	IE	10.27	NA	6.91	NE	0.25	NO	211.82	1.27
1984	195.85	195.85	IE	9.07	NA	7.04	NE	0.25	NO	212.21	1.71
1985	201.56	201.56	IE	7.88	NA	7.06	NE	0.25	NO	216.76	1.86
1986	195.21	195.21	IE	6.68	NA	6.95	NE	0.25	NO	209.10	1.64
1987	191.64	191.64	IE	5.49	NA	7.19	NE	0.25	NO	204.58	1.82
1988	187.52	187.52	IE	5.27	NA	7.14	NE	0.17	NO	200.10	2.00
1989	182.51	182.51	IE	4.99	NA	6.92	NE	0.13	NO	194.56	2.46
1990	181.51	181.51	IE	4.80	NA	6.09	NE	0.10	NO	192.51	2.44
1991	191.40	191.40	IE	4.48	NA	6.31	NE	0.09	NO	202.28	2.76
1992	180.75	180.75	IE	4.55	NA	5.96	NE	0.06	NO	191.32	3.00
1993	177.77	177.77	IE	1.98	NA	5.72	NE	0.05	NO	185.52	3.18
1994	170.94	170.94	IE	1.92	NA	6.12	NE	0.04	NO	179.03	3.31
1995	171.50	171.50	IE	1.46	NA	6.18	NE	0.05	NO	179.18	3.73
1996	193.84	193.84	IE	1.42	NA	5.86	NE	0.05	NO	201.17	4.14
1997	181.84	181.84	IE	1.50	NA	5.92	NE	0.05	NO	189.30	4.29
1998	196.88	196.88	IE	1.46	NA	5.92	NE	0.05	NO	204.30	4.43
1999	189.41	189.41	IE	1.44	NA	5.76	NE	0.05	NO	196.66	4.33
2000	197.26	197.26	IE	1.54	NA	5.60	NE	0.05	NO	204.45	6.44
2001	207.82	207.82	IE	1.57	NA	5.57	NE	0.05	NO	215.01	6.32
2002	218.08	218.08	IE	1.63	NA	5.50	NE	0.05	NO	225.27	5.67
2003	230.06	230.06	IE	1.34	NA	5.40	NE	0.05	NO	236.85	5.21
2004	229.38	229.38	IE	1.28	NA	5.26	NE	0.05	NO	235.96	6.09
2005	232.60	232.60	IE	1.75	NA	5.22	NE	0.05	NO	239.62	6.99
2006	220.38	220.38	IE	1.82	NA	5.21	NE	0.05	NO	227.46	7.54
2007	213.07	213.07	IE	1.71	NA	5.27	NE	0.05	NO	220.10	7.99

Table A-3: Emission trends for NMVOC [Gg] 1980–2007.

	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	164.24	151.50	12.74	17.73	206.56	4.55	NE	0.16	NO	393.25	0.07
1981	166.38	154.14	12.24	17.12	182.78	4.48	NE	0.16	NO	370.93	0.08
1982	166.19	154.66	11.53	16.76	180.30	4.60	NE	0.16	NO	368.02	0.08
1983	167.76	156.41	11.35	16.24	177.85	4.51	NE	0.16	NO	366.53	0.09
1984	172.39	160.89	11.50	15.73	175.43	4.57	NE	0.16	NO	368.28	0.13
1985	172.10	160.58	11.52	15.21	172.64	4.61	NE	0.16	NO	364.72	0.14
1986	166.75	155.15	11.60	14.83	172.26	4.52	NE	0.16	NO	358.51	0.12
1987	163.77	152.01	11.76	14.36	171.88	4.54	NE	0.16	NO	354.70	0.14
1988	153.49	141.83	11.67	14.57	171.48	4.66	NE	0.16	NO	344.36	0.15
1989	149.78	137.88	11.91	14.54	149.04	4.61	NE	0.16	NO	318.14	0.18
1990	146.10	133.89	12.22	11.10	114.43	1.85	NE	0.16	NO	273.64	0.18
1991	153.76	140.60	13.16	12.58	96.93	1.85	NE	0.16	NO	265.27	0.20
1992	145.46	132.33	13.12	13.78	78.54	1.79	NE	0.15	NO	239.71	0.22
1993	142.98	130.12	12.86	15.05	79.91	1.76	NE	0.15	NO	239.85	0.24
1994	131.45	121.20	10.26	13.57	75.02	1.81	NE	0.14	NO	221.99	0.25
1995	126.84	118.01	8.83	11.95	81.27	1.82	NE	0.13	NO	222.01	0.29
1996	124.06	116.16	7.90	10.37	77.47	1.80	NE	0.12	NO	213.83	0.34
1997	105.14	97.77	7.37	9.06	83.48	1.88	NE	0.12	NO	199.69	0.37
1998	99.32	93.47	5.85	7.71	75.46	1.84	NE	0.11	NO	184.45	0.40
1999	93.67	88.54	5.13	6.04	69.41	1.88	NE	0.11	NO	171.11	0.39
2000	86.88	81.71	5.16	4.96	82.32	1.79	NE	0.10	NO	176.04	0.42
2001	87.08	83.77	3.31	4.38	86.89	1.86	NE	0.10	NO	180.31	0.41
2002	85.55	82.07	3.47	4.57	93.30	1.86	NE	0.10	NO	185.38	0.37
2003	87.16	83.72	3.44	4.26	95.52	1.73	NE	0.10	NO	188.77	0.34
2004	82.58	79.31	3.27	4.40	81.45	1.98	NE	0.10	NO	170.50	0.40
2005	79.94	76.85	3.09	4.71	92.11	1.86	NE	0.09	NO	178.71	0.47
2006	76.15	73.03	3.12	4.87	103.81	1.79	NE	0.09	NO	186.70	0.50
2007	68.93	66.19	2.74	4.90	104.09	1.81	NE	0.08	NO	179.81	0.53

Table A-4: Emission trends for NH_3 [Gg] 1980–2007.

	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	1.51	1.51	IE	0.31	NA	62.09	NE	0.01	NO	63.91	0.00
1981	1.41	1.41	IE	0.30	NA	62.88	NE	0.01	NO	64.59	0.00
1982	1.39	1.39	IE	0.29	NA	63.42	NE	0.01	NO	65.11	0.00
1983	1.37	1.37	IE	0.28	NA	64.86	NE	0.01	NO	66.51	0.00
1984	1.40	1.40	IE	0.29	NA	65.51	NE	0.01	NO	67.21	0.00
1985	1.44	1.44	IE	0.28	NA	65.14	NE	0.01	NO	66.86	0.00
1986	1.45	1.45	IE	0.26	NA	64.47	NE	0.01	NO	66.19	0.00
1987	1.44	1.44	IE	0.26	NA	64.76	NE	0.01	NO	66.47	0.00
1988	2.29	2.29	IE	0.28	NA	63.39	NE	0.01	NO	65.97	0.00
1989	3.40	3.40	IE	0.27	NA	63.54	NE	0.01	NO	67.21	0.00
1990	4.40	4.40	IE	0.27	NA	66.13	NE	0.38	NO	71.18	0.00
1991	5.97	5.97	IE	0.51	NA	66.87	NE	0.39	NO	73.74	0.00
1992	6.80	6.80	IE	0.37	NA	64.57	NE	0.45	NO	72.19	0.00
1993	7.58	7.58	IE	0.22	NA	64.59	NE	0.54	NO	72.93	0.00
1994	7.79	7.79	IE	0.17	NA	65.55	NE	0.62	NO	74.13	0.00
1995	7.60	7.60	IE	0.10	NA	67.12	NE	0.64	NO	75.46	0.00
1996	7.12	7.12	IE	0.10	NA	65.33	NE	0.67	NO	73.22	0.00
1997	6.63	6.63	IE	0.10	NA	65.61	NE	0.65	NO	72.99	0.00
1998	6.67	6.67	IE	0.10	NA	65.66	NE	0.67	NO	73.10	0.00
1999	6.02	6.02	IE	0.12	NA	64.39	NE	0.71	NO	71.23	0.00
2000	5.53	5.53	IE	0.10	NA	62.90	NE	0.72	NO	69.25	0.00
2001	5.41	5.41	IE	0.08	NA	62.68	NE	0.73	NO	68.90	0.00
2002	5.37	5.37	IE	0.06	NA	61.59	NE	0.74	NO	67.76	0.00
2003	5.21	5.21	IE	0.08	NA	61.39	NE	0.75	NO	67.42	0.00
2004	4.72	4.72	IE	0.06	NA	60.90	NE	0.95	NO	66.64	0.00
2005	4.33	4.33	IE	0.07	NA	60.67	NE	1.04	NO	66.11	0.00
2006	3.94	3.94	IE	0.07	NA	60.93	NE	1.07	NO	66.01	0.00
2007	3.59	3.59	IE	0.08	NA	61.66	NE	1.09	NO	66.41	0.00

Table A-5: Emission trends for CO [Gg] 1980–2007.

	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	1 687.4	1 687.4	IE	52.8	NA	31.1	NE	10.7	NO	1 782.0	0.2
1981	1 677.2	1 677.2	IE	50.7	NA	28.6	NE	10.8	NO	1 767.3	0.2
1982	1 685.2	1 685.2	IE	48.3	NA	32.9	NE	10.8	NO	1 777.2	0.2
1983	1 674.5	1 674.5	IE	47.9	NA	32.8	NE	10.8	NO	1 765.9	0.3
1984	1 723.0	1 723.0	IE	48.1	NA	35.1	NE	10.8	NO	1 816.9	0.3
1985	1 697.3	1 697.3	IE	46.7	NA	36.3	NE	10.7	NO	1 791.0	0.4
1986	1 637.6	1 637.6	IE	44.7	NA	33.2	NE	10.6	NO	1 726.2	0.3
1987	1 574.6	1 574.6	IE	44.9	NA	34.2	NE	10.6	NO	1 664.3	0.4
1988	1 501.5	1 501.5	IE	45.9	NA	38.2	NE	10.9	NO	1 596.5	0.4
1989	1 487.9	1 487.9	IE	46.3	NA	36.4	NE	11.3	NO	1 581.9	0.5
1990	1 373.6	1 373.6	IE	46.4	NA	1.3	NE	11.4	NO	1 432.6	0.5
1991	1 448.9	1 448.9	IE	41.7	NA	1.2	NE	11.3	NO	1 503.2	0.5
1992	1 413.0	1 413.0	IE	45.0	NA	1.2	NE	11.0	NO	1 470.2	0.6
1993	1 378.4	1 378.4	IE	47.2	NA	1.2	NE	10.9	NO	1 437.6	0.6
1994	1 307.9	1 307.9	IE	48.6	NA	1.2	NE	10.3	NO	1 368.0	0.7
1995	1 200.9	1 200.9	IE	45.1	NA	1.2	NE	9.7	NO	1 256.9	0.7
1996	1 186.5	1 186.5	IE	39.4	NA	1.2	NE	9.2	NO	1 236.3	0.8
1997	1 096.1	1 096.1	IE	38.3	NA	1.3	NE	8.7	NO	1 144.5	0.9
1998	1 055.6	1 055.6	IE	34.9	NA	1.3	NE	8.4	NO	1 100.2	0.9
1999	986.8	986.8	IE	30.6	NA	1.3	NE	8.1	NO	1 026.8	0.9
2000	919.0	919.0	IE	27.4	NA	1.2	NE	7.7	NO	955.3	0.8
2001	914.4	914.4	IE	24.2	NA	1.3	NE	7.4	NO	947.3	0.8
2002	898.7	898.7	IE	23.9	NA	1.3	NE	7.3	NO	931.2	0.7
2003	921.7	921.7	IE	23.6	NA	1.2	NE	7.5	NO	953.9	0.6
2004	879.7	879.7	IE	23.9	NA	1.8	NE	7.0	NO	912.3	0.7
2005	837.8	837.8	IE	24.2	NA	1.1	NE	6.6	NO	869.7	0.9
2006	807.0	807.0	IE	24.5	NA	1.0	NE	6.3	NO	838.8	0.9
2007	737.4	737.4	IE	24.7	NA	1.1	NE	5.9	NO	769.0	1.0

Table A-6: Emission trends for Cd [Mg] 1985–2007.

	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	2,084	2,084	NA	0,837	0,000	0,043	NE	0,138	NO	3,103	0,000
1986	1,824	1,824	NA	0,710	0,000	0,040	NE	0,121	NO	2,695	0,000
1987	1,406	1,406	NA	0,654	0,000	0,041	NE	0,105	NO	2,206	0,000
1988	1,196	1,196	NA	0,620	0,000	0,046	NE	0,078	NO	1,939	0,000
1989	1,058	1,058	NA	0,581	0,000	0,044	NE	0,061	NO	1,744	0,000
1990	1,060	1,060	NA	0,457	0,000	0,002	NE	0,059	NO	1,578	0,000
1991	1,092	1,092	NA	0,385	0,000	0,002	NE	0,048	NO	1,527	0,000
1992	0,976	0,976	NA	0,264	0,000	0,002	NE	0,005	NO	1,247	0,000
1993	0,940	0,940	NA	0,216	0,000	0,002	NE	0,005	NO	1,163	0,000
1994	0,880	0,880	NA	0,177	0,000	0,002	NE	0,004	NO	1,063	0,000
1995	0,811	0,811	NA	0,160	0,000	0,002	NE	0,002	NO	0,975	0,000
1996	0,845	0,845	NA	0,147	0,000	0,002	NE	0,002	NO	0,996	0,000
1997	0,803	0,803	NA	0,163	0,000	0,002	NE	0,002	NO	0,970	0,000
1998	0,736	0,736	NA	0,160	0,000	0,002	NE	0,002	NO	0,901	0,000
1999	0,805	0,805	NA	0,168	0,000	0,002	NE	0,002	NO	0,977	0,000
2000	0,761	0,761	NA	0,183	0,000	0,002	NE	0,002	NO	0,948	0,000
2001	0,818	0,818	NA	0,180	0,000	0,002	NE	0,002	NO	1,002	0,000
2002	0,842	0,842	NA	0,189	0,000	0,002	NE	0,002	NO	1,036	0,000
2003	0,893	0,893	NA	0,190	0,000	0,002	NE	0,002	NO	1,087	0,000
2004	0,892	0,892	NA	0,198	0,000	0,003	NE	0,002	NO	1,094	0,000
2005	0,944	0,944	NA	0,218	0,000	0,002	NE	0,002	NO	1,166	0,000
2006	0,984	0,984	NA	0,222	0,000	0,002	NE	0,001	NO	1,210	0,001
2007	0,980	0,980	NA	0,235	0,000	0,002	NE	0,001	NO	1,219	0,001

Table A-7: Emission trends for Hg [Mg] 1985–2007.

	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	2.980	2.980	NA	0.671	NA	0.008	NE	0.086	NO	3.744	0.000
1986	2.602	2.602	NA	0.629	NA	0.007	NE	0.079	NO	3.317	0.000
1987	2.157	2.157	NA	0.607	NA	0.007	NE	0.072	NO	2.843	0.000
1988	1.782	1.782	NA	0.594	NA	0.008	NE	0.064	NO	2.447	0.000
1989	1.592	1.592	NA	0.579	NA	0.008	NE	0.057	NO	2.236	0.000
1990	1.561	1.561	NA	0.528	NA	0.000	NE	0.054	NO	2.142	0.000
1991	1.500	1.500	NA	0.492	NA	0.000	NE	0.046	NO	2.038	0.000
1992	1.181	1.181	NA	0.435	NA	0.000	NE	0.024	NO	1.640	0.000
1993	0.956	0.956	NA	0.412	NA	0.000	NE	0.023	NO	1.391	0.000
1994	0.759	0.759	NA	0.398	NA	0.000	NE	0.021	NO	1.178	0.000
1995	0.713	0.713	NA	0.466	NA	0.000	NE	0.020	NO	1.200	0.000
1996	0.709	0.709	NA	0.431	NA	0.000	NE	0.018	NO	1.158	0.000
1997	0.683	0.683	NA	0.434	NA	0.000	NE	0.016	NO	1.133	0.000
1998	0.602	0.602	NA	0.333	NA	0.000	NE	0.014	NO	0.949	0.000
1999	0.649	0.649	NA	0.276	NA	0.000	NE	0.012	NO	0.937	0.000
2000	0.645	0.645	NA	0.241	NA	0.000	NE	0.010	NO	0.897	0.000
2001	0.712	0.712	NA	0.245	NA	0.000	NE	0.010	NO	0.967	0.000
2002	0.683	0.683	NA	0.261	NA	0.000	NE	0.010	NO	0.954	0.000
2003	0.730	0.730	NA	0.261	NA	0.000	NE	0.015	NO	1.006	0.000
2004	0.684	0.684	NA	0.272	NA	0.000	NE	0.019	NO	0.975	0.000
2005	0.700	0.700	NA	0.305	NA	0.000	NE	0.021	NO	1.026	0.000
2006	0.731	0.731	NA	0.311	NA	0.000	NE	0.021	NO	1.063	0.000
2007	0.704	0.704	NA	0.329	NA	0.000	NE	0.021	NO	1.054	0.000

Table A-8: Emission trends for Pb [Mg] 1985–2007.

	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	258.18	258.18	NA	62.45	0.02	0.23	258.18	258.18	NA	62.45	0.02
1986	254.98	254.98	NA	52.38	0.02	0.21	254.98	254.98	NA	52.38	0.02
1987	249.11	249.11	NA	47.85	0.02	0.22	249.11	249.11	NA	47.85	0.02
1988	223.88	223.88	NA	45.16	0.02	0.24	223.88	223.88	NA	45.16	0.02
1989	195.33	195.33	NA	41.74	0.02	0.23	195.33	195.33	NA	41.74	0.02
1990	174.07	174.07	NA	32.09	0.02	0.01	174.07	174.07	NA	32.09	0.02
1991	143.71	143.71	NA	27.09	0.02	0.01	143.71	143.71	NA	27.09	0.02
1992	100.58	100.58	NA	18.61	0.02	0.01	100.58	100.58	NA	18.61	0.02
1993	70.54	70.54	NA	15.15	0.02	0.01	70.54	70.54	NA	15.15	0.02
1994	47.27	47.27	NA	12.03	0.02	0.01	47.27	47.27	NA	12.03	0.02
1995	11.34	11.34	NA	4.68	0.02	0.01	11.34	11.34	NA	4.68	0.02
1996	11.18	11.18	NA	4.26	0.02	0.01	11.18	11.18	NA	4.26	0.02
1997	9.64	9.64	NA	4.79	0.02	0.01	9.64	9.64	NA	4.79	0.02
1998	8.24	8.24	NA	4.70	0.02	0.01	8.24	8.24	NA	4.70	0.02
1999	7.55	7.55	NA	4.91	0.02	0.01	7.55	7.55	NA	4.91	0.02
2000	6.45	6.45	NA	5.48	0.02	0.01	6.45	6.45	NA	5.48	0.02
2001	6.87	6.87	NA	5.35	0.02	0.01	6.87	6.87	NA	5.35	0.02
2002	7.04	7.04	NA	5.65	0.02	0.01	7.04	7.04	NA	5.65	0.02
2003	7.39	7.39	NA	5.68	0.02	0.01	7.39	7.39	NA	5.68	0.02
2004	7.59	7.59	NA	5.90	0.02	0.02	7.59	7.59	NA	5.90	0.02
2005	7.60	7.60	NA	6.49	0.02	0.01	7.60	7.60	NA	6.49	0.02
2006	8.17	8.17	NA	6.61	0.02	0.01	8.17	8.17	NA	6.61	0.02
2007	8.29	8.29	NA	7.00	0.02	0.01	8.29	8.29	NA	7.00	0.02

Table A-9: Emission trends for PAH [Mg] 1985–2007.

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	11.953	11.953	NA	7.884	0.152	7.066	NE	0.000	NO	27.055	NE
1986	11.296	11.296	NA	7.816	0.152	7.063	NE	0.000	NO	26.326	NE
1987	11.108	11.108	NA	7.911	0.152	7.063	NE	0.000	NO	26.234	NE
1988	9.996	9.996	NA	7.460	0.152	7.063	NE	0.000	NO	24.671	NE
1989	9.501	9.501	NA	7.567	0.152	7.063	NE	0.000	NO	24.282	NE
1990	9.496	9.496	NA	7.437	0.152	0.250	NE	0.000	NO	17.334	NE
1991	10.343	10.343	NA	7.175	0.152	0.250	NE	0.000	NO	17.920	NE
1992	9.423	9.423	NA	3.585	0.109	0.250	NE	0.000	NO	13.368	NE
1993	9.309	9.309	NA	0.524	0.074	0.248	NE	0.000	NO	10.156	NE
1994	8.418	8.418	NA	0.592	0.056	0.248	NE	0.000	NO	9.314	NE
1995	8.876	8.876	NA	0.492	0.036	0.247	NE	0.000	NO	9.651	NE
1996	9.591	9.591	NA	0.898	0.015	0.247	NE	0.000	NO	10.750	NE
1997	8.607	8.607	NA	0.467	0.007	0.243	NE	0.000	NO	9.323	NE
1998	8.325	8.325	NA	0.410	NA	0.243	NE	0.000	NO	8.979	NE
1999	8.336	8.336	NA	0.250	NA	0.242	NE	0.000	NO	8.827	NE
2000	7.807	7.807	NA	0.192	NA	0.242	NE	0.000	NO	8.241	NE
2001	9.109	9.109	NA	0.183	NA	0.242	NE	0.000	NO	9.534	NE
2002	9.414	9.414	NA	0.190	NA	0.242	NE	0.000	NO	9.846	NE
2003	10.417	10.417	NA	0.191	NA	0.238	NE	0.000	NO	10.846	NE
2004	10.493	10.493	NA	0.197	NA	0.304	NE	0.000	NO	10.994	NE
2005	10.644	10.644	NA	0.216	NA	0.208	NE	0.000	NO	11.068	NE
2006	10.342	10.342	NA	0.220	NA	0.197	NE	0.000	NO	10.759	NE
2007	9.346	9.346	NA	0.230	NA	0.205	NE	0.000	NO	9.782	NE

Table A-10: Emission trends for Dioxin [g] 1985–2007.

	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	187.94	NE
1988	110.09	110.09	NA	41.60	1.06	5.05	NE	15.48	NO	173.27	NE
1989	101.81	101.81	NA	41.13	1.06	5.05	NE	15.29	NO	164.34	NE
1990	101.92	101.92	NA	39.00	1.06	0.18	NE	18.19	NO	160.36	NE
1991	80.97	80.97	NA	35.15	1.04	0.18	NE	17.75	NO	135.09	NE
1992	53.96	53.96	NA	21.89	0.02	0.18	NE	0.53	NO	76.57	NE
1993	49.45	49.45	NA	17.01	0.02	0.18	NE	0.22	NO	66.88	NE
1994	44.63	44.63	NA	11.26	NA	0.18	NE	0.08	NO	56.16	NE
1995	45.90	45.90	NA	12.23	NA	0.18	NE	0.08	NO	58.39	NE
1996	48.33	48.33	NA	11.17	NA	0.18	NE	0.08	NO	59.76	NE
1997	46.99	46.99	NA	12.15	NA	0.18	NE	0.08	NO	59.41	NE
1998	44.58	44.58	NA	11.45	NA	0.18	NE	0.08	NO	56.29	NE
1999	40.83	40.83	NA	12.60	NA	0.18	NE	0.08	NO	53.69	NE
2000	37.84	37.84	NA	14.05	NA	0.18	NE	0.08	NO	52.15	NE
2001	43.37	43.37	NA	13.55	NA	0.18	NE	0.08	NO	57.18	NE
2002	44.06	44.06	NA	3.24	NA	0.18	NE	0.08	NO	47.56	NE
2003	48.00	48.00	NA	2.98	NA	0.17	NE	0.12	NO	51.27	NE
2004	47.98	47.98	NA	3.30	NA	0.22	NE	0.16	NO	51.66	NE
2005	48.46	48.46	NA	4.02	NA	0.15	NE	0.17	NO	52.80	NE
2006	47.64	47.64	NA	4.76	NA	0.15	NE	0.17	NO	52.71	NE
2007	43.58	43.58	NA	4.08	NA	0.15	NE	0.17	NO	47.98	NE

Table A-11: Emission trends for HCB [kg] 1985–2007.

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	83.214	83.214	NA	13.269	7.708	1.011	NE	1.113	NO	106.31	NE
1986	80.309	80.309	NA	13.215	8.118	1.010	NE	1.112	NO	103.76	NE
1987	83.139	83.139	NA	13.181	8.113	1.010	NE	1.111	NO	106.55	NE
1988	76.966	76.966	NA	11.160	8.218	1.010	NE	0.704	NO	98.06	NE
1989	72.892	72.892	NA	11.064	9.342	1.010	NE	0.519	NO	94.83	NE
1990	72.690	72.690	NA	9.712	9.053	0.037	NE	0.392	NO	91.88	NE
1991	69.836	69.836	NA	8.032	6.392	0.037	NE	0.275	NO	84.57	NE
1992	57.073	57.073	NA	4.941	7.491	0.037	NE	0.106	NO	69.65	NE
1993	53.731	53.731	NA	3.702	6.473	0.037	NE	0.045	NO	63.99	NE
1994	48.166	48.166	NA	2.453	1.252	0.037	NE	0.017	NO	51.93	NE
1995	50.352	50.352	NA	2.670	0.003	0.036	NE	0.017	NO	53.08	NE
1996	53.297	53.297	NA	2.440	0.003	0.036	NE	0.017	NO	55.79	NE
1997	49.219	49.219	NA	2.655	0.003	0.036	NE	0.017	NO	51.93	NE
1998	46.619	46.619	NA	2.500	0.003	0.036	NE	0.017	NO	49.17	NE
1999	44.861	44.861	NA	2.756	0.003	0.036	NE	0.017	NO	47.67	NE
2000	41.248	41.248	NA	3.074	0.004	0.036	NE	0.017	NO	44.38	NE
2001	47.498	47.498	NA	2.978	0.004	0.036	NE	0.016	NO	50.53	NE
2002	47.100	47.100	NA	3.170	NE	0.036	NE	0.016	NO	50.32	NE
2003	50.679	50.679	NA	3.178	NE	0.035	NE	0.024	NO	53.92	NE
2004	49.583	49.583	NA	3.301	NE	0.044	NE	0.032	NO	52.96	NE
2005	49.839	49.839	NA	3.691	NE	0.031	NE	0.034	NO	53.60	NE
2006	48.020	48.020	NA	3.762	NE	0.029	NE	0.034	NO	51.85	NE
2007	42.408	42.408	NA	3.979	NE	0.030	NE	0.034	NO	46.45	NE

Table A-12: Emission trends for TSP [Mg] 1990–2007.

	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	30 418	29 771	647	23 733	407	12 649	NE	145	NO	67 352	280
1995	31 083	30 538	545	26 472	421	12 471	NE	159	NO	70 606	416
1999	31 779	31 279	500	24 822	424	12 376	NE	60	NO	69 461	482
2000	31 549	30 991	558	29 289	425	12 299	NE	90	NO	73 652	524
2001	32 943	32 357	585	28 359	426	12 303	NE	87	NO	74 118	512
2002	33 417	32 818	599	27 960	428	12 276	NE	110	NO	74 191	462
2003	34 728	34 084	644	27 390	430	12 346	NE	129	NO	75 024	428
2004	34 623	34 015	608	28 166	433	12 393	NE	170	NO	75 784	506
2005	34 854	34 240	614	27 026	436	12 160	NE	189	NO	74 666	594
2006	35 067	34 474	593	29 166	439	12 129	NE	186	NO	76 987	626
2007	34 201	33 670	531	27 406	440	12 149	NE	213	NO	74 409	663

Table A-13: Emission trends for PM10 [Mg] 1990–2007.

	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	22 744	22 439	305	12 903	407	5 781	NE	70	NO	41 904	280
1995	22 691	22 434	257	13 673	421	5 699	NE	75	NO	42 560	416
1999	22 856	22 621	236	12 831	424	5 658	NE	29	NO	41 797	482
2000	22 473	22 210	263	14 876	425	5 618	NE	43	NO	43 435	524
2001	23 664	23 388	276	14 430	426	5 624	NE	41	NO	44 186	512
2002	23 976	23 694	283	13 888	428	5 612	NE	52	NO	43 956	462
2003	24 982	24 678	304	13 614	430	5 636	NE	61	NO	44 723	428
2004	24 721	24 435	287	13 947	433	5 691	NE	80	NO	44 873	506
2005	24 827	24 537	290	13 362	436	5 552	NE	89	NO	44 267	594
2006	24 781	24 501	280	14 188	439	5 531	NE	88	NO	45 027	626
2007	23 737	23 485	251	13 214	440	5 544	NE	101	NO	43 036	663

Table A-14: Emission trends for PM2.5 [Mg] 1990–2007.

	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	18 822	18 727	95	3 500	407	1 406	NE	23	NO	24 158	280
1995	18 682	18 602	80	3 014	421	1 385	NE	24	NO	23 526	416
1999	18 664	18 590	74	2 589	424	1 378	NE	9	NO	23 063	482
2000	18 253	18 171	82	2 930	425	1 363	NE	13	NO	22 984	524
2001	19 300	19 214	86	2 863	426	1 369	NE	13	NO	23 972	512
2002	19 540	19 452	88	2 463	428	1 367	NE	16	NO	23 815	462
2003	20 343	20 248	95	2 424	430	1 362	NE	19	NO	24 578	428
2004	20 033	19 943	90	2 426	433	1 418	NE	25	NO	24 336	506
2005	20 086	19 995	91	2 323	436	1 343	NE	28	NO	24 216	594
2006	19 856	19 768	88	2 236	439	1 330	NE	28	NO	23 888	626
2007	18 794	18 715	79	1 974	440	1 337	NE	32	NO	22 577	663

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'[137] – as submitted under Directive 2001/81/EC.

Table A-15: Austria's emissions 1990–2007 without 'fuel export' according to Directive 2001/81/EC, Article 8 (1).

	SO_2 [Gg]	NO_x [Gg]	NMVOC [Gg]	NH_3 [Gg]
1990	73,67	179,28	272,62	71,15
1991	70,48	180,91	260,95	73,31
1992	54,10	172,72	237,72	72,02
1993	52,35	166,18	239,17	73,00
1994	46,86	163,21	222,73	74,49
1995	46,52	162,04	222,92	75,92
1996	43,95	162,25	214,51	73,94
1997	39,77	164,86	201,37	73,79
1998	34,94	163,13	183,53	73,41
1999	33,36	164,13	171,35	71,74
2000	31,08	163,86	175,50	69,64
2001	32,09	165,09	178,36	68,98
2002	30,93	164,74	181,38	67,32
2003	31,79	167,41	183,72	66,76
2004	27,51	165,84	165,47	65,98
2005	27,13	165,92	173,74	65,51
2006	28,90	165,91	182,49	65,51
2007	25,55	162,59	175,91	65,96
Ceilings 2010	39.00	103.00	159.00	66.00

[137] For information regarding fuel export please refer to Chapter 1.7 Completeness

Table A-16: SO_2 Emissions trends and source categories 1990–2007 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	**73,67**	71,37	69,37	14,04	17,89	4,48	32,95	0,01	2,00	2,22	NA	0,00	0,07
1991	**70,48**	68,52	67,22	15,42	17,15	4,79	29,84	0,01	1,30	1,90	NA	0,00	0,06
1992	**54,10**	52,39	50,39	8,58	10,59	5,07	26,13	0,01	2,00	1,67	NA	0,00	0,04
1993	**52,35**	50,89	48,79	10,06	11,23	5,32	22,16	0,01	2,10	1,42	NA	0,00	0,04
1994	**46,86**	45,39	44,11	7,72	10,95	5,65	19,78	0,01	1,28	1,42	NA	0,00	0,05
1995	**46,52**	45,10	43,57	8,92	10,60	5,12	18,91	0,01	1,53	1,37	NA	0,00	0,05
1996	**43,95**	42,60	41,40	7,80	12,05	2,30	19,23	0,01	1,20	1,29	NA	0,00	0,05
1997	**39,77**	38,45	38,38	9,09	13,75	2,17	13,35	0,01	0,07	1,27	NA	0,00	0,05
1998	**34,94**	33,70	33,66	7,33	11,75	2,13	12,43	0,01	0,04	1,18	NA	0,00	0,05
1999	**33,36**	32,19	32,04	7,24	10,22	2,03	12,54	0,01	0,14	1,12	NA	0,00	0,06
2000	**31,08**	29,93	29,79	7,11	9,61	1,92	11,13	0,01	0,15	1,09	NA	0,00	0,06
2001	**32,09**	30,82	30,66	7,96	9,36	1,86	11,46	0,01	0,16	1,21	NA	0,00	0,06
2002	**30,93**	29,66	29,52	7,69	9,60	1,69	10,52	0,01	0,14	1,21	NA	0,00	0,06
2003	**31,79**	30,52	30,37	7,92	9,90	1,61	10,93	0,01	0,15	1,21	NA	0,00	0,06
2004	**27,51**	26,24	26,09	7,30	9,04	0,33	9,40	0,01	0,14	1,22	NA	0,00	0,06
2005	**27,13**	25,85	25,72	6,80	10,11	0,27	8,52	0,01	0,13	1,22	NA	0,00	0,06
2006	**28,90**	27,62	27,45	7,85	11,17	0,26	8,15	0,01	0,17	1,22	NA	0,00	0,06
2007	**25,55**	24,27	24,09	5,97	11,17	0,27	6,66	0,01	0,18	1,22	NA	0,00	0,06
Trend													
1990–2007	*-65,3%*	*-66,0%*	*-65,3%*	*-57,5%*	*-37,5%*	*-94,1%*	*-79,8%*	*11,7%*	*-90,9%*	*-44,9%*		*-14,5%*	*-20,4%*
2006–2007	*-11,6%*	*-12,1%*	*-12,3%*	*-23,9%*	*<0,1%*	*1,5%*	*-18,3%*	*1,0%*	*9,6%*	*0,4%*		*6,4%*	*<0,1%*
Share in NFR 1 A													
1990				*20,2%*	*25,8%*	*6,5%*	*47,5%*	*<0,1%*					
2007				*24,8%*	*46,4%*	*1,1%*	*27,6%*	*0,1%*					
Share in National Total													
1990	***100.0%***	*96,9%*	*94,2%*	*19,1%*	*24,3%*	*6,1%*	*44,7%*	*<0,1%*	*2,7%*	*3,0%*		*<0,1%*	*0,1%*
2007	***100.0%***	*95,0%*	*94,3%*	*23,4%*	*43,7%*	*1,0%*	*26,1%*	*0,1%*	*0,7%*	*4,8%*		*<0,1%*	*0,2%*

Table A-17: NO_x Emissions trends and source categories 1990–2007 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	**179,28**	168,29	168,29	17,78	32,80	89,96	27,68	0,07	IE	4,80	NA	6,09	0,10
1991	**180,91**	170,02	170,02	17,20	33,72	90,45	28,57	0,08	IE	4,48	NA	6,31	0,09
1992	**172,72**	162,15	162,15	14,71	30,35	89,27	27,76	0,07	IE	4,55	NA	5,96	0,06
1993	**166,18**	158,44	158,44	12,10	31,10	88,07	27,09	0,08	IE	1,98	NA	5,72	0,05
1994	**163,21**	155,11	155,11	11,09	30,81	87,48	25,65	0,09	IE	1,92	NA	6,12	0,04
1995	**162,04**	154,36	154,36	12,70	29,34	85,60	26,65	0,07	IE	1,46	NA	6,18	0,05
1996	**162,25**	154,92	154,92	11,05	30,46	85,09	28,24	0,08	IE	1,42	NA	5,86	0,05
1997	**164,86**	157,39	157,39	11,94	32,11	84,82	28,45	0,08	IE	1,50	NA	5,92	0,05
1998	**163,13**	155,71	155,71	10,84	31,30	85,44	28,04	0,09	IE	1,46	NA	5,92	0,05
1999	**164,13**	156,88	156,88	10,89	30,11	86,57	29,22	0,09	IE	1,44	NA	5,76	0,05
2000	**163,86**	156,67	156,67	11,00	30,82	87,40	27,36	0,09	IE	1,54	NA	5,60	0,05
2001	**165,09**	157,90	157,90	12,62	29,61	85,95	29,63	0,09	IE	1,57	NA	5,57	0,05
2002	**164,74**	157,55	157,55	12,88	30,50	85,13	28,96	0,09	IE	1,63	NA	5,50	0,05
2003	**167,41**	160,62	160,62	14,28	30,73	85,49	30,03	0,09	IE	1,34	NA	5,40	0,05
2004	**165,84**	159,25	159,25	15,15	29,90	85,44	28,67	0,09	IE	1,28	NA	5,26	0,05
2005	**165,92**	158,90	158,90	14,53	31,38	84,70	28,20	0,09	IE	1,75	NA	5,22	0,05
2006	**165,91**	158,83	158,83	15,43	32,71	83,17	27,43	0,09	IE	1,82	NA	5,21	0,05
2007	**162,59**	155,56	155,56	14,60	32,29	83,99	24,60	0,09	IE	1,71	NA	5,27	0,05
Trend													
1990–2007	***-9,3%***	*-7,6%*	*-7,6%*	*-17,9%*	*-1,6%*	*-6,6%*	*-11,1%*	*14,9%*		*-64,3%*		*-13,6%*	*-49,6%*
2006–2007	***-2,0%***	*-2,1%*	*-2,1%*	*-5,4%*	*-1,3%*	*1,0%*	*-10,3%*	*-1,4%*		*-5,8%*		*1,1%*	*<0,1%*
Share in NFR 1 A													
1990				*9.4%*	*23.4%*	*47.6%*	*19.5%*	*<0,1%*					
2007				*9.2%*	*21.3%*	*49.1%*	*20.2%*	*0.1%*					
Share in National Total													
1990	***100.0%***	*93,9%*	*93,9%*	*9,9%*	*18,3%*	*50,2%*	*15,4%*	*<0,1%*		*2,7%*		*3,4%*	*0,1%*
2007	***100.0%***	*95,7%*	*95,7%*	*9,0%*	*19,9%*	*51,7%*	*15,1%*	*0,1%*		*1,1%*		*3,2%*	*<0,1%*

Table A-18: NMVOC Emissions trends and source categories 1990–2007 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	**272,62**	145,07	132,86	0,42	1,73	69,41	61,28	0,02	12,22	11,10	114,43	1,85	0,16
1991	**260,95**	149,44	136,27	0,49	1,83	69,16	64,78	0,02	13,16	12,58	96,93	1,85	0,16
1992	**237,72**	143,46	130,34	0,41	1,78	69,01	59,11	0,01	13,12	13,78	78,54	1,79	0,15
1993	**239,17**	142,30	129,44	0,42	1,77	68,19	59,05	0,02	12,86	15,05	79,91	1,76	0,15
1994	**222,73**	132,19	121,94	0,39	1,72	65,18	54,62	0,02	10,26	13,57	75,02	1,81	0,14
1995	**222,92**	127,75	118,92	0,39	1,69	60,51	56,32	0,01	8,83	11,95	81,27	1,82	0,13
1996	**214,51**	124,74	116,84	0,42	1,80	55,26	59,35	0,02	7,90	10,37	77,47	1,80	0,12
1997	**201,37**	106,82	99,45	0,41	1,81	50,24	46,98	0,02	7,37	9,06	83,48	1,88	0,12
1998	**183,53**	98,40	92,55	0,43	1,73	45,31	45,07	0,02	5,85	7,71	75,46	1,84	0,11
1999	**171,35**	93,91	88,78	0,38	1,65	40,79	45,94	0,02	5,13	6,04	69,41	1,88	0,11
2000	**175,50**	86,33	81,17	0,38	1,74	36,13	42,91	0,02	5,16	4,96	82,32	1,79	0,10
2001	**178,36**	85,13	81,81	0,50	1,75	32,01	47,54	0,02	3,31	4,38	86,89	1,86	0,10
2002	**181,38**	81,55	78,08	0,48	1,67	28,45	47,46	0,02	3,47	4,57	93,30	1,86	0,10
2003	**183,72**	82,11	78,67	0,55	1,77	25,42	50,91	0,02	3,44	4,26	95,52	1,73	0,10
2004	**165,47**	77,55	74,28	0,54	1,90	22,89	48,93	0,02	3,27	4,40	81,45	1,98	0,10
2005	**173,74**	74,97	71,87	0,51	1,96	20,61	48,77	0,02	3,09	4,71	92,11	1,86	0,09
2006	**182,49**	71,94	68,82	0,71	2,18	18,61	47,30	0,02	3,12	4,87	103,81	1,79	0,09
2007	**175,91**	65,03	62,29	0,68	2,19	17,17	42,24	0,02	2,74	4,90	104,09	1,81	0,08
Trend													
1990–2007	***-35,5%***	*-55,2%*	*-53,1%*	*60,2%*	*26,4%*	*-75,3%*	*-31,1%*	*7,9%*	*-77,6%*	*-55,9%*	*-9,0%*	*-2,3%*	*-50,2%*
2006–2007	***-3,6%***	*-9,6%*	*-9,5%*	*-4,8%*	*0,6%*	*-7,8%*	*-10,7%*	*<0,1%*	*-12,3%*	*0,6%*	*0,3%*	*1,4%*	*-6,3%*
Share in NFR 1 A													
1990				*0,3%*	*1,3%*	*52,2%*	*46,1%*	*<0,1%*					
2007				*1,1%*	*3,5%*	*27,6%*	*67,8%*	*<0,1%*					
Share in National Total													
1990	***100.0%***	*53,2%*	*48,7%*	*0,2%*	*0,6%*	*25,5%*	*22,5%*	*<0,1%*	*4,5%*	*4,1%*	*42,0%*	*0,7%*	*0,1%*
2007	***100.0%***	*37,0%*	*35,4%*	*0,4%*	*1,2%*	*9,8%*	*24,0%*	*<0,1%*	*1,6%*	*2,8%*	*59,2%*	*1,0%*	*<0,1%*

Table A-19: NH_3 Emissions trends and source categories 1990–2007 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	**71,15**	4,37	4,37	0,20	0,33	3,21	0,63	0,00	IE	0,27	NA	66,13	0,38
1991	**73,31**	5,54	5,54	0,21	0,34	4,29	0,69	0,00	IE	0,51	NA	66,87	0,39
1992	**72,02**	6,63	6,63	0,21	0,33	5,43	0,66	0,00	IE	0,37	NA	64,57	0,45
1993	**73,00**	7,65	7,65	0,24	0,36	6,39	0,67	0,00	IE	0,22	NA	64,59	0,54
1994	**74,49**	8,15	8,15	0,24	0,37	6,92	0,61	0,00	IE	0,17	NA	65,55	0,62
1995	**75,92**	8,06	8,06	0,23	0,34	6,80	0,68	0,00	IE	0,10	NA	67,12	0,64
1996	**73,94**	7,84	7,84	0,26	0,34	6,49	0,75	0,00	IE	0,10	NA	65,33	0,67
1997	**73,79**	7,43	7,43	0,26	0,38	6,10	0,69	0,00	IE	0,10	NA	65,61	0,65
1998	**73,41**	6,97	6,97	0,28	0,35	5,65	0,69	0,00	IE	0,10	NA	65,66	0,67
1999	**71,74**	6,53	6,53	0,25	0,36	5,19	0,72	0,00	IE	0,12	NA	64,39	0,71
2000	**69,64**	5,92	5,92	0,23	0,36	4,67	0,66	0,00	IE	0,10	NA	62,90	0,72
2001	**68,98**	5,48	5,48	0,25	0,36	4,12	0,75	0,00	IE	0,08	NA	62,68	0,73
2002	**67,32**	4,93	4,93	0,26	0,34	3,58	0,75	0,00	IE	0,06	NA	61,59	0,74
2003	**66,76**	4,55	4,55	0,28	0,34	3,10	0,83	0,00	IE	0,08	NA	61,39	0,75
2004	**65,98**	4,06	4,06	0,31	0,33	2,64	0,78	0,00	IE	0,06	NA	60,90	0,95
2005	**65,51**	3,73	3,73	0,33	0,37	2,25	0,77	0,00	IE	0,07	NA	60,67	1,04
2006	**65,51**	3,43	3,43	0,37	0,43	1,88	0,76	0,00	IE	0,07	NA	60,93	1,07
2007	**65,96**	3,14	3,14	0,38	0,50	1,61	0,65	0,00	IE	0,08	NA	61,66	1,09
Trend													
1990–2007	***-7,3%***	*-28,3%*	*-28,3%*	*85,3%*	*50,5%*	*-49,8%*	*3,4%*	*13,2%*		*-71,3%*		*-6,8%*	*186,7%*
2006–2007	***0,7%***	*-8,6%*	*-8,6%*	*3,6%*	*16,3%*	*-14,2%*	*-14,5%*	*-8,7%*		*4,0%*		*1,2%*	*1,4%*
Share in NFR 1 A													
1990				*4,7%*	*7,5%*	*73,4%*	*14,4%*	*<0,1%*					
2007				*12,1%*	*15,8%*	*51,4%*	*20,8%*	*<0,1%*					
Share in National Total													
1990	***100.0%***	*6,1%*	*6,1%*	*0,3%*	*0,5%*	*4,5%*	*0,9%*	*<0,1%*		*0,4%*		*92,9%*	*0,5%*
2007	***100.0%***	*4,8%*	*4,8%*	*0,6%*	*0,8%*	*2,4%*	*1,0%*	*<0,1%*		*0,1%*		*93,5%*	*1,6%*

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

<u>BGBl 1994/ 447 Verordnung für Gießereien</u>

§ 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

BGBl 1994/ 498 Verordnung für Anlagen zur Glaserzeugung

§ 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 Normungsinstitut, 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

BGBl 1988/ 380 idF (BGBl 1993/ 185, BGBl I 1997/ 115, BGBl I 1998/ 158) Luftreinhaltegesetz für Kesselanlagen

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.

BGBl 1989/ 19 idF (BGBl 1990/ 134, BGBl 1994/ 785, BGBl II 1997/ 324) Luftreinhalteverordnung für Kesselanlagen

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.

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The Informative Inventory Report 2009 (IIR 2009) presents a comprehensive and detailed method description of the Austrian air emission inventory (OLI) for the air pollutants

- sulphur dioxide (SO_2), nitrogen oxides (NO_x), non-methane volatile organic compounds (NMVOCs), ammonia (NH_3)
- carbon monoxide (CO)
- particulate matter (TSP, PM10, PM2.5)

as well as the air pollutant groups

- heavy metals: cadmium (Cd), mercury (Hg), lead (Pb) and
- persistent organic pollutants (POPs): polycyclic aromatic hydrocarbons (PAHs), dioxins and furans (PCDD/Fs) and hexachlorobenzene (HCB).

With the IIR, Austria meets the criterion of documentation to ensure transparency and understandability as required for reporting under the Geneva Convention on Long-range Transboundary Air Pollution (LRTAP).

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