ENVIRONMENT AGENCY AUSTRIA umweltbundesamt

Austria's Informative Inventory Report (IIR) 2011

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

PERSPEKTIVEN FÜR UMWELT & GESELLSCHAFT umweltbundesamt

AUSTRIA'S INFORMATIVE INVENTORY REPORT (IIR) 2011

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

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Project management

Traute Köther

Authors

Michael Anderl
Simone Haider
Traute Köther
Katja Pazdernik
Maria Purzner
Gudrun Stranner
Stephan Poupa
Manuela Wieser
Andreas Zechmeister

Editor

Brigitte Read

Layout and typesetting

Ute Kutschera

Title photograph

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For further information about the publications of the Umweltbundesamt please go to: **http://www.umweltbundesamt.at/**

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EXECUTIVE SUMMARY

The report "Austria's Informative Inventory Report (IIR) 2011" 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 2011 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 2011 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 2011).

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 2009 under the UNECE/LRTAP Convention) which are the result of continuous improvement of Austria's Air Emission Inventory. Data presented in this report replace data reported earlier under the reporting framework of the UNECE/LRTAP Convention.

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

The annex presents inter alia emission data for all pollutants for the year 2009 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 2011 is Traute Köther.

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

Specific responsibilities for the IIR 2011 have been as follows:

- Executive Summary — Traute Köther
- Chapter 1 Introduction — Traute Köther, Andreas Zechmeister
- Chapter 2 Trends — Simone Haider, Traute Köther
- Chapter 3 Energy — Stephan Poupa
- Chapter 3 Transport — Gudrun Stanner
- Chapter 3 Fugitive emission — Sabine Göttlicher
- Chapter 4 Industrial Processes — Maria Purzner
- Chapter 5 Solvents — Traute Köther
- Chapter 6 Agriculture — Michael Anderl
- Chapter 7 Waste — Katja Pazdernik
- Chapter 8 Other and Natural emissions — Traute Köther
- Chapter 9 Major Changes — Traute Köther
- 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 ("Umweltkontrollgesetz"; Federal Law Gazette 152/1998)[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.

Furthermore, the Environmental Control Act incorporates the Umweltbundesamt as private limited company; to assure that the Umweltbundesamt has the resources required to fulfil all listed tasks, the financing is set up as a fixed amount of money annually allocated to the Umweltbundesamt. The Umweltbundesamt is free to manage this so called "basic funding", provided that the tasks are fulfilled. Projects beyond the scope of the Envirionmental Control Act are financed on project basis by the contracting entity, that are national or EC authorities or private entities.

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.

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.

Within the Umweltbundesamt the department of *Emissions & 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 (see Figure 1). The quality system is maintained up to date under the responsibility of the Quality Manager. The Quality Manager has direct access to top management.

The "*Inspection body for GHG inventory*" within the Umweltbundesamt is responsible for the compilation of the greenhouse gas inventory (UNFCCC and Kyoto-Protocol as well as EC Monitoring mechanism), whereas the "*Air Emission Inventory-Team*" is responsible for the compilation of the air emission inventory (UNECE and NEC).

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.

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 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/ LeitfadenL10zur AnwendungderISO17020V2.pdf

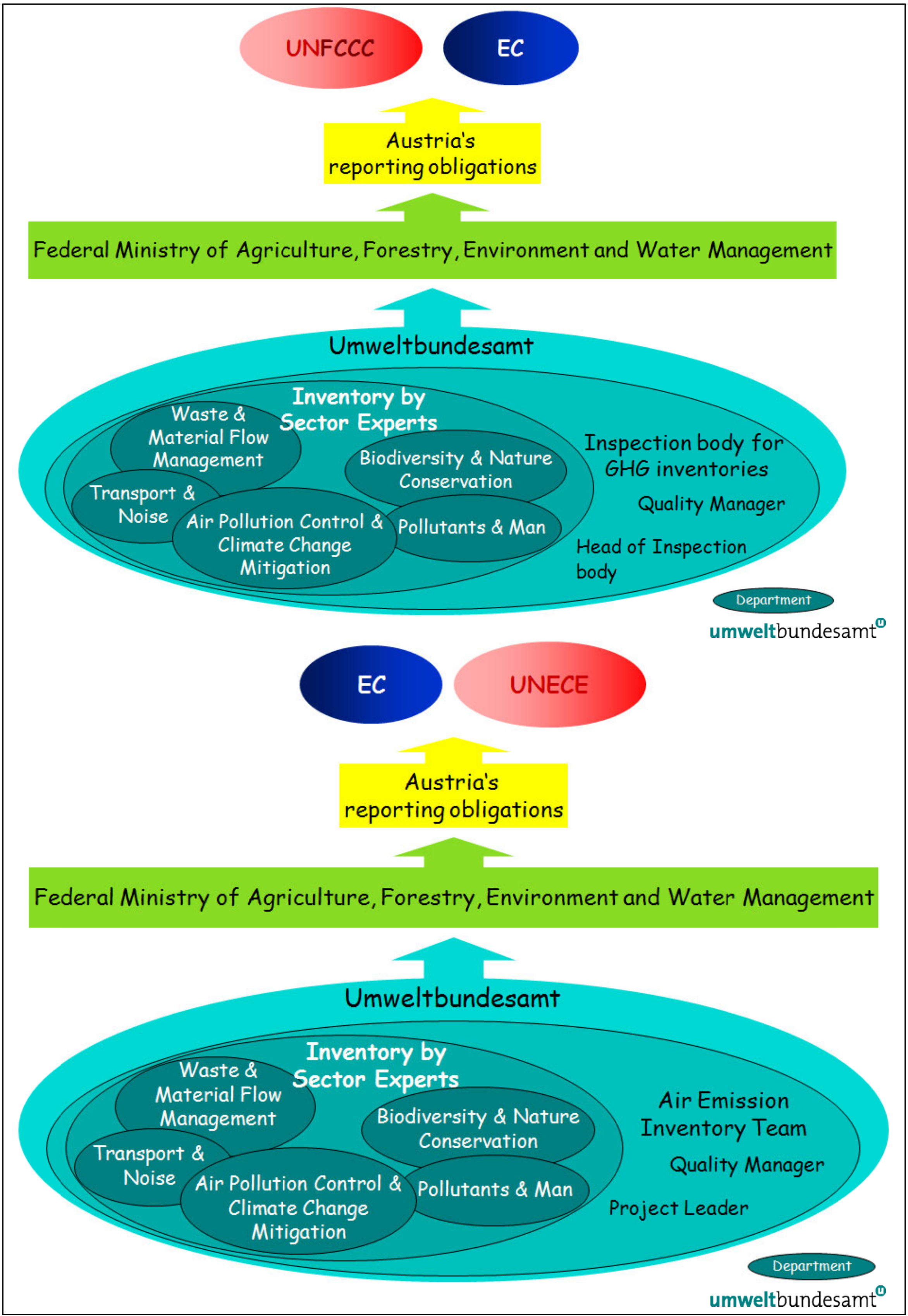

Figure 1: Responsibilities in the Austrian National System for Greenhouse Gas Inventories and Air Emission Inventories.

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) and its Protocols comprising the annual reporting of national emission data on SO2, NOX, NMVOCs, NH3, CO, TSP, PM10, and PM2.5 as well as on the heavy metals Pb, Cd and Hg and persistent organic hydrocarbons (PAHs), dioxins and furans (PCDD/F) and hexachlorobenzene (HCB). 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.
- 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 obligation under the „United Nations Framework Convention on Climate Change (UNFCCC) (1992)[11] and the Kyoto Protocol (1997)[12].
- Austria's annual obligations under the European Council Decision 280/2004/EC[13] "Monitoring Decision" concerning a mechanism for monitoring Community greenhouse gas emissions and for implementing the Kyoto Protocol.
- 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). EPER was displaced and upgraded by regulation (EC) No 166/2006[16] 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 (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.

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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://unfccc.int/files/essential_background/convention/status_of_ratification/application/pdf/ratlist.pdf

12 http://unfccc.int/files/essential_background/kyoto_protocol/application/pdf/kpstats.pdf

13 http://europa.eu.int/eur-lex/pri/de/oj/dat/2004/l_049/l_04920040219de00010008.pdf
(replacing Decision 389/1992/EEC amended by Decision 296/1999/EEC)

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/; 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

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)	43	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	25	02.09.1987	09.07.1985 (s) 04.06.1987 (r)
1988	Sofia Protocol concerning the Control of Nitrogen Oxides or their Transboundary Fluxes	34	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	24	29.09.1997	19.11.1991 (s) 23.08.1994 (r)
1994	Oslo Protocol on Further Reduction of Sulphur Emissions	29	05.08.1998	14.06.1994 (s) 27.08.1998 (r)
1998	Aarhus Protocol on Heavy Metals	30	29.12.2003	24.06.1998 (s) 17.12.2003 (r)
1998	Aarhus Protocol on Persistent Organic Pollutants (POPs)	30	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	26	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

1.1.2 National Inventory System Austria (NISA)

History of the National Inventory System Austria - 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)[17].
- As an EFTA[18] country Austria participated in CORINAIR 90[19/20], 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.
- Austria signed the UNFCCC on June 8, 1992 and subsequently submitted its instrument of ratification on February 28, 1994.[21]
- 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. On the 13th and 14th January 2011 a comprehensive external audit by the accreditation body took place at the Umweltbundesamt. This 'Re-Accreditation' is obligatory every 5 years and aims at examining the "Inspection Body for Emission Inventories" respectively its QM-System in detail.

For more details on NISA see the report "NISA – NATIONAL INVENTORY SYSTEM AUSTRIA – Implementation Report"[22] 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)[23].

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

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

[19] 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

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

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

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

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

Organisation of the National Inventory System Austria - NISA

Regulations under the UNECE/LRTAP Convention and its Protocols define standards for the preparation of and reporting on national emission inventories. In 2002, the Executive Body[24] 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[25] 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)[26] have been submitted to the Executive Body at its twenty-sixth session (in December 2008) for adoption.

The submission of the 2008 data, the time-series data and revisions to previous data as well as the are in accordance with the revised Guidelines for Reporting Emission Data under the Convention on Long-range Transboundary Air Pollution (ECE/EB.AIR/97; 27 January 2009).

As illustrated in Figure 2 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.

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).

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 2.

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

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

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

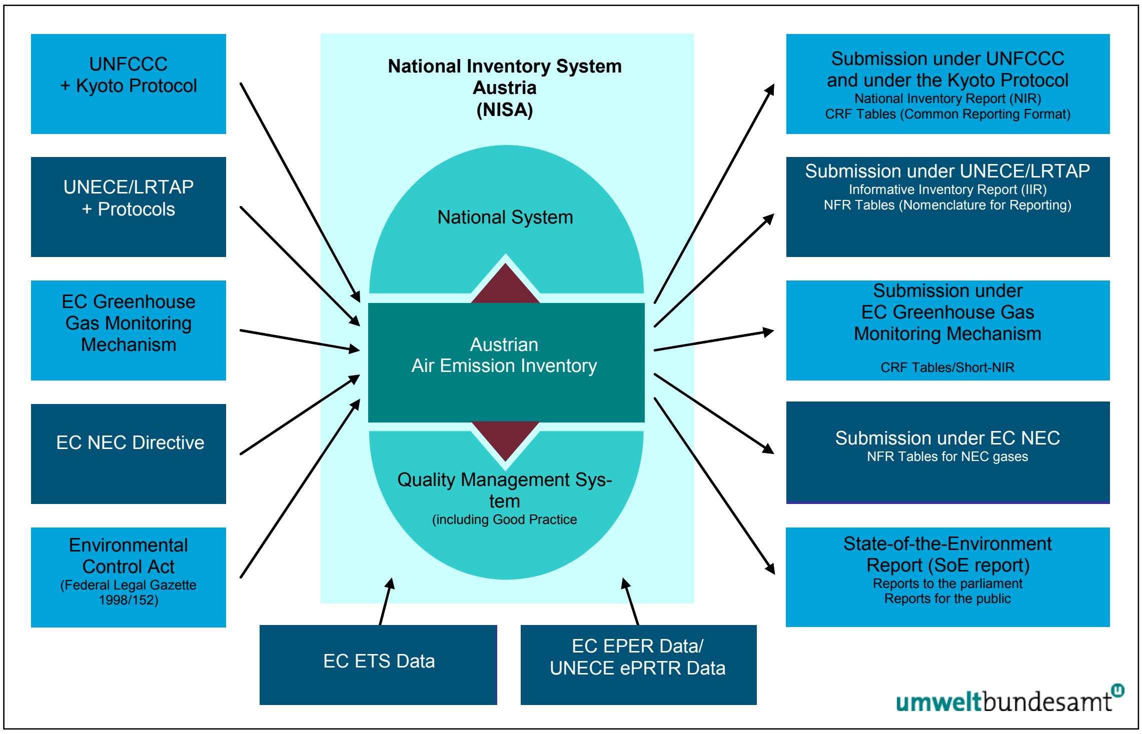

Figure 2: Structure of National Emission Inventory System Austria (NISA).

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 [1]
A. National totals		
1. Main pollutants	SO_x, NO_x, NH_3, NMVOC, CO	from 1980 to 2009
2. Particulate matter	PM2.5, PM10, TSP	for 1990, 1995, and for 1999 to 2009
3. Heavy metals	Pb, Cd, Hg, *As, Cr, Cu, Ni, Se, Zn*	from 1985 to 2009
4. POPs	Hexachlorobenzene (HCB), hexachlorocyclohexane (HCH), polychlorinated biphenyls (PCBs), dioxins/furans (PCDD/F), polycyclic aromatic hydrocarbons (PAHs) (See rev.Emission Reporting Guidelines ECE/EB.AIR/97	from 1985 to 2009
B. Sector emissions		
1. Main pollutants	SO_x, NO_x, NH_3, NMVOC, CO	from 1980 to 2009
2. Particulate matter	PM2.5, PM10, TSP	for 1990, 1995, and for 1999 to 2009
3. Heavy metals	Pb, Cd, Hg, *As, Cr, Cu, Ni, Se, Zn*	from 1985 to 2009
4. POPs	aldrin, chlordane, chlordecone, DDT, dieldrin, endrin, heptachlor, HCB, mirex, toxaphene, HCH, hexabromobiphenyl, PCBs, PCDD/F, PAHs, SCCP, PCP	from 1985 to 2009
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, HCH, HCB, PCBs, PCDD/F	1990, 1995, 2000, 2005 (PM: 2000 and 2005)
D. Emissions from large point sources		
	Main pollutants, PM, Pb, Cd, Hg, PAHs, HCH, HCB, PCBs, PCDD/F	1990, 1995, 2000, 2005 (PM for 2000 and 2005)
E. Historical and Projected activity data and projected national total emissions		
1. National total emissions	See table IV 2A in the Emission Reporting Guidelines ECE/EB.AIR/97 (27 January 2009)	2010, 2015, 2020, 2030 and 2050
2. National sector emissions	See tables IV 2B, 2C in the Emission Reporting Guidelines ECE/EB.AIR/97 (27 January 2009)	1990, 1995, 2000, 2005, 2010, 2015, 2020, 2030 and 2050
3. National projection activity data	See table IV 2D in the Emission Reporting Guidelines ECE/EB.AIR/97 (27 January 2009)	1990, 1995, 2000, 2005, 2010, 2015, 2020, 2030 and 2050
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**

(1) As a minimum, data for the base year of the relevant protocol and from the year of entry into force of that protocol to the latest year should be reported

1.2 Inventory Preparation Process

The present Austrian Air Pollutant Inventory (OLI) for the period 1980 to 2009 was compiled according to the recommendations for inventories as set out by the UNECE Executive Body[27] and in the guidelines mentioned above.

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

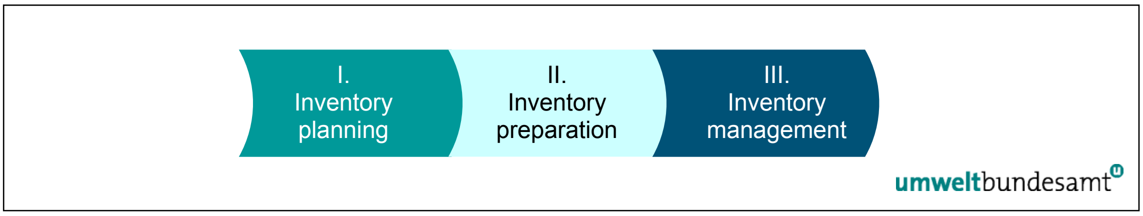

Figure 3: Three stages of inventory preparation.

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.

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

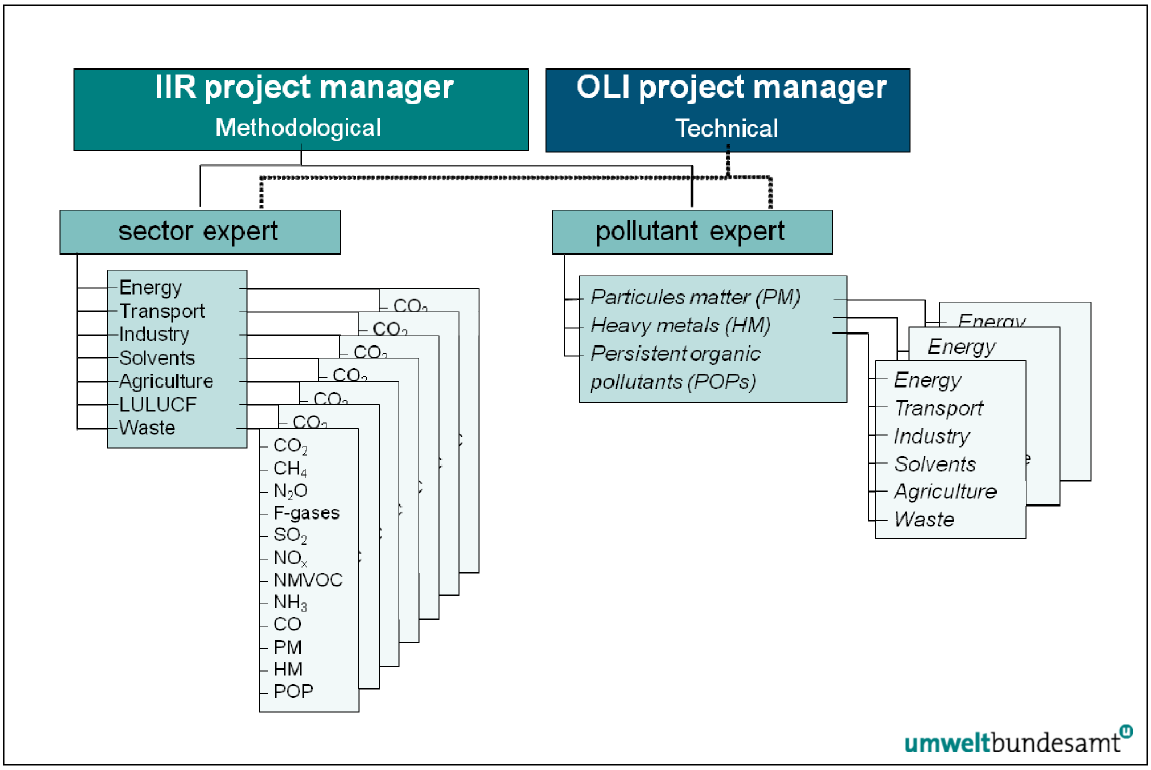

Figure 4: Roles and reponsibilieties within the National Emission Inventory System Austria (NISA).

Emissions of air pollutants are estimated together with greenhouse gases in a single data base based on the CORINAIR[28] systematic, which was formerly also used as reporting format under the UNECE. This nomenclature was designed by the ETC/ACC[29] to estimate emissions of all kind of air pollutants as well as greenhouse gases.

The CORINAIR system's nomenclature is called SNAP[30], which may be expanded to adapt to national circumstances by so-called SPLIT codes, and additionally each SNAP/SPLIT category can be extended using a fuel code.

II Inventory preparation

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

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

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[28] 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)

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

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

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[31] 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.

[31] 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

1.3 Methodologies and Data Sources Used

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

- EMEP/CORINAIR Emission Inventory Guidebook
  - 2nd edition – 1999. EEA Technical Report No. 30.
  - 3rd edition October 2002 UPDATE. EEA Technical report No 30[32]
  - 2006, EEA Technical report No 11/2006[33]
  - 2007, EEA Technical report No 16/2007[34]
- EMEP/EEA air pollutant emission inventory guidebook — 2009. Technical report No. 6/2009. [35] (previously know as EMEP/CORINAIR Emission Inventory Guidebook)
- EEA core set of indicators – Guide, EEA Technical report No 1/2005[36]
- Recommendations for Revised Data Systems for Air Emission Inventories, Topic report No. 12/1996[37]
- Guidance Report on preliminary assessment under EC air quality directives, EEA Technical report No. 11[38].

Further other internationally applied methodologies and guidelines including:

- Intergovernmental Panel on Climate Change (IPCC) Guidelines
  - Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories and the IPCC Good Practice Guidance[39];
  - 2000 IPCC Good Practice Guidance (GPG) and Uncertainty Management in National Greenhouse Gas Inventories[40];
  - 2003 Good Practice Guidance for Land Use, Land-Use Change and Forestry[41];
  - 2006 IPCC Guidelines for National Greenhouse Gas Inventories[42].
- Integrated Pollution Prevention and Control (IPPC)[43] and European Pollutant Emission Register (EPER)[44];

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

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

[34] Prepared by the UNECE/EMEP Task Force on Emissions Inventories and Projections (TFEIP) and published by the European Environment Agency (EEA). Copenhagen 2007. http://reports.eea.europa.eu/EMEPCORINAIR5/en/page002.html

[35] Prepared by the UNECE/EMEP Task Force on Emissions Inventories and Projections (TFEIP) and published by the European Environment Agency (EEA). Copenhagen 2009. http://www.eea.europa.eu/publications/emep-eea-emission-inventory-guidebook-2009

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

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

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

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

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

[41] http://www.ipcc-nggip.iges.or.jp/public/gpglulucf/gpglulucf.html

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

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

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

- Guidelines for Emission Inventory Reporting from the Large Combustion Plant Directive[45];
- IPPC Best Available Techniques Reference Documents[46];
- Organization for Economic Co-operation and Development (OECD) and Pollution Release and Transfer Register (PRTR) Guidance[47].

The following table presents the main data sources used for activity data as well as information on who did the actual calculations (for unpublished studies a detailed description of the methodologies is given in this report.

Table 3: Main data sources for activity data and emission values.

Sector	Data Sources for Activity Data	Emission Calculation
Energy	• Energy balance[48]/[49] from STATISTIK AUSTRIA • EU Emission Trading Scheme (ETS)[50] • Steam boiler data base[51] administrated by UMWELTBUNDESAMT • Data from industry und accociations[52] • National studies	Umweltbundesamt, plant operators
Transport	• Energy balance[48] from STATISTIK AUSTRIA[49]	Umweltbundesamt (Aviation) Technical University Graz[53] (Road and Off-road transport)
Industry	• National production statistics from STATISTIK AUSTRIA • Austrian foreign trade statistics from STATISTIK AUSTRIA • EU Emission Trading Scheme (ETS)[50] • direct information from industry • direct information from associations of industry	Umweltbundesamt, plant operators

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

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

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

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

[49] STATISTIK AUSTRIA (2009): Standard-Dokumentation Metainformationen (Definitionen, Erläuterungen, Methoden, Qualität) zu den Energiebilanzen für Österreich und die Bundesländer - Berichtszeitraum: 1970 – 2007 (Österreich), 1988 – 2007 (Bundesländer). Wien. http://www.statistik.at/web_de/wcmsprod/groups/gd/documents/stddok/023997.pdf#pagemode=bookmarks

[50] European Union Greenhouse Gas Emission Trading Scheme

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

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

[53] https://online.tu-graz.ac.at/tug_online/webnav.navigate_to?corg=123&cperson_nr=2416

Sector	Data Sources for Activity Data		Emission Calculation
Solvent and Other Product Use	• Short term statistics for trade & services • Austrian foreign trade statistics • Structural business statistics • Surveys at companies and associations	from STATISTIK AUSTRIA (first three items)	Umweltbundesamt, based on studies by: 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 „Gewässerschutzbericht” from LEBENSMINISTERIUM[56] • national studies • direct information from agricultural association		Umweltbundesamt, based on studies by: University of Natural Resources and Applied Life Sciences[57], ARC Seibersdorf research GesmbH[58]
Waste	• Database on landfills (1998-2007) administrated by UMWELTBUNDESAMT, • Electronic Data Management (EDM) (from 2008 on) administrated by LEBENSMINISTERIUM[59] • National reports from STATISTIK AUSTRIA • sewage plant inventory administrated by UMWELTBUNDESAMT • national report on water protection „Gewässerschutz bericht” from LEBENSMINISTERIUM[56]		Umweltbundesamt

Detailed information on data sources for activity and emission data or emission factors used by sector can be found in the Chapters 4–8.

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 EMEP/EEA air pollutant emission inventory guidebook 2009 are applied.

Table 4 presents the methods applied and the origin of emission factors used for the categories in the NFR format for the present Austrian inventory.

For key source categories (see Chapter 1.4) the most accurate methods for the preparation of the air emission inventory should be used. Required methodological changes and planned improvements are described in the corresponding sector analysis chapters (Chapters 4–8).

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[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

[57] http://www.nas.boku.ac.at

[58] http://www.systemsresearch.ac.at/index.php?cid=140

[59] https://secure.umweltbundesamt.at/edm_portal/home.do?wfjs_enabled=true&wfjs_orig_req=/home.do

Main Data Suppliers

- The main data supplier for the Austrian Air Emission Inventory is *STATISTIK AUSTRIA*[60], providing the underlying energy source data. The Austrian energy balances are based on several databases mainly prepared by the Federal Ministry of Economy, Family and Youth[61], "Bundeslastverteiler" and Statistik Austria. Their methodology follows the Energy Agency (IEA)[62] and Eurostat[63] conventions. The aggregated 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[64] classification.
- Information about activity data and emissions of the industry sector is obtained from *Association of the Austrian Industries*[65] 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. Activity data for some sources are obtained from Statistik Austria which provides statistics on production data[66]. The methodology of the statistics changed in 1996, no data are available for that year and there are some product groups no longer reported in the new statistics.
- Operators of steam boilers with more than 50 MW report their emissions (e. g. NO_x, SO_2, CO and TSP) and their activity data directly to the to the steam boiler data base[51] (Dampfkesseldatenbank) administrated by the Umweltbundesamt.
- Data from national and sometimes international studies are also used.
- Until 2008, operators of landfill sites reported their activity data directly to the Austrian Ministry of Environment or the Umweltbundesamt, where they were – after a check – in turn incorporated into a database on landfills. Emissions for the years 1998–2007 are calculated on basis of these data. Since 2009 landfill operators have to register and report their waste input directly at the portal of the Electronic Data Mangement. These data are evaluated by the responsible body at federal level (BMLFUW) and are made available for emission calculation. This was done for reporting year 2008 for the first time.
- 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.

Data from the EU Emission trading Scheme

The European Emissions Trading Scheme (EU ETS) has been established by Directive 2003/87/EC of the European Parliament and of the Council[67]. It includes heavy energy-consuming installations in power generation and manufacturing. The activities covered are energy activities, the production and processing of ferrous metals, the mineral industry and some

[60] www.statistik.at

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

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

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

[64] Classification of Economic Activities in the European Community

[65] Mainly organized in the Austrian Federal Economic Chamber; http://portal.wko.at/wk/startseite.wk

[66] "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 2006.

[67] Directive 2003/87/EC of the European Parliament and of the Council of 13 October 2003 establishing a scheme for greenhouse gas emission allowance trading within the Community and amending Council Directive 96/61/EC, OJ L 275/32

other production activities. For more detailed information on the included activities please refer to Annex I of the above mentioned directive. At the moment, the greenhouse gases covered under the EU ETS in Austria are CO_2 (since 2005) and N_2O (since 2010). However, other greenhouse gases and activities will be included in the scope of the EU ETS from 2013 onwards. About one third of total Austrian GHG emissions currently result from installations under the EU-ETS (~32 Tg CO_2 in 2008).

Plant operators have to report their activity data and CO_2 emissions annually; for the first time they reported their emissions of 2005 in March 2006.The first trading period of the EU ETS ran from 2005-2007. The second trading period, which coincides with the Kyoto commitment period, started in 2008 and will run until 2012.

An important feature of the activity data and CO_2 emissions reported under the EU-ETS is that these emissions have to pass independent verification. The Austrian Federal Ministry of Agriculture, Forestry, Environment and Water Management is in charge of granting the licence to independent verifiers. In addition, the Ministry has to fulfill a quality control function, which is implemented by the Umweltbundesamt on behalf of the Ministry.

Data from EPER/E-PRTR

The European Pollutant Emission Register (EPER) was the first Europe-wide register for emissions from industrial facilities both into air and water. The legal basis of EPER is Article 15 of the IPPC Directive (EPER Decision 2000/479/EG)[68], which stipulates that information on environmental pollution has to be provided to the public[69]. The reporting years under EPER were 2001 or 2002 and 2004. EPER was replaced by the European Pollutant Release and Transfer Register (E-PRTR) in 2007, which was established by the E-PRTR Regulation (EC) No 166/2006[70].

EPER covered 50 pollutants, including CO_2, CH_4, N_2O, SF_6 and PFCs from six activity groups. Under EPER Austrian industrial facilities had to report their annual emissions of 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 facilities reported emissions according to the EPER Regulation.

E-PRTR is an extension of EPER and covers 91 pollutants from nine activity groups, including all pollutants reported already under EPER. However, emissions only have to be reported if they exceed certain thresholds. In contrast to EPER, E-PRTR also included data on releases into soil, accidental releases, waste transfers and diffuse emissions.

The Umweltbundesamt implemented E-PRTR in Austria using an electronic system enabling the facilities and the authorities to fulfil the requirements of the E-PRTR Regulation electronically via the internet. In 2008, installations reported for the first time releases and transfers of pollutants from 2007 under E-PRTR, which is an annual reporting obligation. The plausibility of the reports is checked by the competent authorities and the Umweltbundesamt. The Umweltbundesamt also checks the data for consistency with the national inventory.

Data from EPER / E-PRTR has so far not been used as a data source for the national inventory. On the one hand, this is due to the high reporting thresholds. On the other hand, the EPER / E-PRTR reports contain only very little information other than emission data. Concerning methodology the only information included is whether emissions are estimated, measured or calculated. For activity data facilities report one value that is often not useful in the context of emissions and may be different between producers of the same product.

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

[69] Data can be downloaded from: http://www.umweltbundesamt.at/umweltdaten/datenbanken10/eper/

[70] http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2006:033:0001:0017:EN:PDF

In addition, EPER / E-PRTR data is not complete for IPCC sectors and it is difficult to include this point source information because no background information (such as fuel consumption data) is available.

Thus the top-down approach of the national inventory has been considered more reliable and data of EPER / E-PRTR has not been used as point source data for the national inventory, but for verification purposes only where plausible.

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[71]. With these data and other Austrian publications as a basis comprehensive emission inventories of HM, POPs and PM for different years were prepared by contractors of the Umweltbundesamt and incorporated into the inventory system afterwards.

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

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

- Österreichische Emissionsinventur für Cadmium, Quecksilber und Blei.

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

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

  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.

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

Summary of methodologies applied for estimating emissions

In Table 4 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 4: 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/D	CS/D	CS/D	CS/D	CS/D	CS/D	CS/D	CS/D	CS/D	CS/D	CS/D			
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 Chapter 2 of the EMEP/EEA emission inventory guidebook 2009 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", it is good practice

- to identify the national key categories in a systematic and objective manner. This can be achieved by a quantitative analysis of the relationship between the magnitude of emission in any one year (level) and the change in emission year to year (trend) of each category's emissions compared to the total national emissions;
- to choose the 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.

Methodology – Appraoch 1

The methodology follows the IPCC approach to produce pollutant-specific key categories and covers for both level and trend assessments. In Approach 1, key categories are identified using a predetermined cumulative emissions threshold. Key categories are those which, when summed together in descending order of magnitude, cumulatively add up to 80 % of the total level.

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.

For the first time the suggested aggregation level of analysis for Approach 1 provided in Table 2-1 of Chapter 2 of the EMEP/EEA emission inventory guidebook 2009. No special considerations like disaggregation to main fuel types have been made.

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

The presented key category analysis was performed by the Umweltbundesamt with data for air emissions of the submission 2011 to the UNECE/LRTAP and comprises for all gases a level assessment for all years between 1990 and 2009 and a trend assessment for the trend of the year 1990 to 2008 with respect to the emissions of 1990.

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.

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).

NFR	Description	NFR	Description
1 A 1 a	Public Electricity and Heat Production	1 A 3 a	Civil Aviation
1 A 1 b	Petroleum refining	1 A 3 b 1	R.T., Passenger cars
1 A 1 c	Manufacture of Solid fuels and Other Energy Industries	1 A 3 b 2	R.T., Light duty vehicles
1 A 2 a	Iron and Steel	1 A 3 b 3	R.T., Heavy duty vehicles
1 A 2 b	Non-ferrous Metals	1 A 3 b 4	R.T., Mopeds & Motorcycles
1 A 2 c	Chemicals	1 A 3 b 5	R.T., Gasoline evaporation
1 A 2 d	Pulp, Paper and Print	1 A 3 b 6	R.T., Automobile tyre and break wear
1 A 2 e	Food Processing, Beverages and Tobacco	1 A 3 b 7	R.T., Automobile road abrasion
1 A 2 f 1	Stationary Combustion in Manufacturing Industries and Construction: Other	1 A 3 c	Railways
1 A 2 f 2	Mobile Combustion in Manufacturing Industries and Construction: Other	1 A 3 d	Navigation
1 A 4 a 1	Commercial/Institutional: Stationary	1 A 3 e	Pipeline compressors
1 A 4 a 2	Commercial/Institutional: Mobile		
1 A 4 b 1	Residential: stationary	1 A 5 a	Other, Stationary (including Military)
1 A 4 b 2	Residential: Household and gardening (mobile)	1 A 5 b	Other, Mobile (including Military)
1 A 4 c 1	Agriculture/Forestry/Fishing: Stationary		
1 A 4 c 2	Agriculture/Forestry/Fishing: Off-road Vehicles and Other Machinery		
1 A 4 c 3	Agriculture/Forestry/Fishing: National Fishing		

1 B Fugitive Emission

For fugitive emissions a split following the third level of the NFR was used.

NFR	Description	NFR	Description
1 B 1 a	Coal Mining and Handling	1 B 2 a	Oil
1 B 1 b	Solid fuel transformation	1 B 2 b	Natural gas
1 B 1 c	Other	1 B 2 c	Venting and flaring

2 Industrial Processes

For sources categories from Industrial procecces a split following the third level of the NFR was used, for sources categories 2 A 7 even the fourth level. For sources categories NFR 2 E – NFR 2 G level two of the NFR was used.

NFR	Description	NFR	Description
2 A 1	Cement Production	2 C 1	Iron and Steel Production
2 A 2	Lime Production	2 C 2	Ferroalloys Production
2 A 3	Limestone and Dolomite Use	2 C 3	Aluminium production
2 A 4	Soda Ash Production and use	2 C 5	Other metal production
2 A 5	Asphalt Roofing	2 D 1	Pulp and Paper
2 A 6	Road Paving with Asphalt	2 D 2	Food and Drink
2 A 7 a	Quarrying and mining of minerals other than coal	2 D 3	Wood processing
2 A 7 b	Construction and demolition		
2 A 7 c	Storage, handling and transport of mineral products		
2 A 7 d	Other Mineral products (Please specify)		
2 B 1	Ammonia Production		
2 B 2	Nitric Acid Production		
2 B 3	Adipic Acid Production	2 E	Production of POPs
2 B 4	Carbide Production	2 F	Consumption of POPs and Heavy Metals (e.g. electricial and scientific equipment)
2 B 5	Other	2 G	2 G Other production, consumption, storage, transp. or handling of bulk products

3 Solvent and Other Product Use

Level two of the NFR was used.

NFR	Description	NFR	Description
3 A	PAINT APPLICATION	3 C	3 C Chemical products
3 B	DEGREASING AND DRY CLEANING	3 D	OTHER including products containing HMs and POPs

4 Agriculture

Level two of the NFR was used; only the sub category 4 B was further disaggre-gated as this is an important source for NH3 and the methodology is different for the animal categories.

NFR	Description	NFR	Description
4 B 1	Cattle	4 C	RICE CULTIVATION
4 B 2	Buffalo	4 D 1	Direct Soil Emissions
4 B 3	Sheep	4 D 2	Soil operations
4 B 4	Goats	4 F	FIELD BURNING OF AGRICULTURAL RESIDUES
4 B 5	Camels and Llamas	4 G	Agriculture OTHER
4 B 6	Horses		
4 B 7	Mules and Asses		
4 B 8	Swine		
4 B 9	Poultry		
4 B-13	Other		

6 Waste

Level two of the NFR was used.

NFR	Description	NFR	Description
6 A	SOLID WASTE DISPOSAL ON LAND	6 C	WASTE INCINERATION
6 B	WASTEWATER HANDLING	6 D	OTHER WASTE

Results of the Level and Trend 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, 35 key sources were identified.

Table 5: Summary of Key Categories for the year 2009 – Level and Trend Assessment as well as Rank.

NFR Code	NFR Category	SO_2		NO_X		NMVOC		NH_3		CO		Cd		Pb		Hg		PAH		DIOX		HCB		TSP		PM10		PM2.5		Number	Rank
		LA[72]	TA[73]	LA	TA	LA	TA	LA	TA	LA	TA	LA	TA	LA	TA	LA	TA	LA	TA	LA	TA	LA	TA	LA	TA	LA	TA	LA	TA		
1 A 1 a	Public Electricity and Heat Production	4	5	5	6							4	4	3	4	4										10		8	9	**12**	**4**
1 A 1 b	Petroleum refining				5							3	2																	**3**	**16**
1 A 2 a	Iron and Steel	2	1							3	4																			**4**	**13**
1 A 2 b	Non-ferrous Metals												5	5	6					5	2		2							**6**	**10**
1 A 2 d	Pulp, Paper and Print	5										6					4								8		7		5	**6**	**10**
1 A 2 f 1	Stationary Combustion in Manufactur. Industries and Construction: Other	3	3	3	8					5	6	5		4		2	3			3	5			5	3	5	2	3	3	**18**	**2**
1 A 2 f 2	Mobile Combustion in Manufactur. Industries and Construction: Other			7	3																							10		**3**	**16**
1 A 3 b 1	R.T., Passenger cars		7	2	2	5	2		2	2	1				1			2	3						7	6	6	2	2	**16**	**3**
1 A 3 b 2	R.T., Light duty vehicles				7						3				5															**3**	**16**
1 A 3 b 3	R.T., Heavy duty vehicles		6	1	1													3	2							9	9	5	8	**9**	**6**
1 A 3 b 4	R.T., Mopeds & Motor-cycles									4	5																			**2**	**21**
1 A 3 b 5	R.T., Gasoline evaporation						3																							**1**	**28**

[72] LA Level Assesment

[73] TA Trend Assesment

NFR Code	NFR Category	SO_2		NO_X		NMVOC		NH_3		CO		Cd		Pb		Hg		PAH		DIOX		HCB		TSP		PM10		PM2.5		**Number**	**Rank**
		LA[72]	TA[73]	LA	TA	LA	TA	LA	TA	LA	TA	LA	TA	LA	TA	LA	TA	LA	TA	LA	TA	LA	TA	LA	TA	LA	TA	LA	TA		
1 A 3 b 7	R.T., Automobile road abrasion												3											3	2	4	5	7	6	**7**	**7**
1 A 3 c	Railways																							7						**1**	**28**
1 A 4 a 1	Commercial/ Institutional: Stationary		4																										10	**2**	**21**
1 A 4 b 1	Residential: stationary	1	2	4		2	6			1	2	1		2	3	3		1	1	1	1	1	1	4	4	1	3	1	4	**23**	**1**
1 A 4 c 1	Agriculture/Forestry/ Fishing: Stationary										7		7					4	4	4		2	3							**7**	**7**
1 A 4 c 2	Agriculture/Forestry/ Fishing: Off-road Vehicles and Other Machinery			6		7	9																	8		7		4	7	**7**	**7**
1 B 2 a	Oil						4																							**1**	**28**
2 A 7 a	Quarrying & mining of minerals other than coal																							2	5	3	4	9		**5**	**12**
2 A 7 b	Construction and demolition																							6	6	8	8			**4**	**13**
2 B 5	Other	6			4		8										2													**4**	**13**
2 C 1	Iron and Steel Production											2	1	1	2	1	1			2	3				1		1		1	**11**	**5**
2 D 2	Food and Drink																		5											**1**	**28**
3 A	PAINT APPLICATION					3	7																							**2**	**21**
3 B	DEGREASING AND DRY CLEANING					4	5																							**2**	**21**

NFR Code	NFR Category	SO_2		NO_X		NMVOC		NH_3		CO		Cd		Pb		Hg		PAH		DIOX		HCB		TSP		PM10		PM2.5		Number	Rank
		LA[72]	TA[73]	LA	TA	LA	TA	LA	TA	LA	TA	LA	TA	LA	TA	LA	TA	LA	TA	LA	TA	LA	TA	LA	TA	LA	TA	LA	TA		
3 C	3 C Chemical products					6																								**1**	**28**
3 D	OTHER including products containing HMs and POPs					1	1																					11		**3**	**16**
4 B 1	Cattle							1	5																					**2**	**21**
4 B 8	Swine							2	1																					**2**	**21**
4 B 9	Poultry							3																						**1**	**28**
4 D 1	Direct Soil Emissions								3																					**1**	**28**
4 D 2	Soil operations																							1		2		6		**3**	**16**
6 C	WASTE INCINERATION												6								4									**2**	**21**
6 D	OTHER WASTE								4																					**1**	**28**

Table 6: Key Categories for SO_2 gases for the year 2009.

Level Assessment				
NFR Code	**NFR Category**	**Latest Year (2009) Estimate [Gg] $E_{x,t}$**	**Level Assessment $L_{x,t}$**	**Cumulative Total of $L_{x,t}$**
1 A 4 b 1	Residential: stationary	4.92	23.9%	23.9%
1 A 2 a	Iron and Steel	4.75	23.1%	47.0%
1 A 2 f 1	Stationary Combustion in Manufacturing Industries and Construction: Other	3.15	15.3%	62.3%
1 A 1 a	Public Electricity and Heat Production	2.56	12.5%	74.7%
1 A 2 d	Pulp, Paper and Print	1.06	5.1%	79.9%
2 B 5	Other	0.77	3.7%	83.6%
	National Total	**21.58**		

Trend Assessment						
NFR Code	**NFR Category**	**'Base Year' (1990) Estimate [Gg] $E_{x,0}$**	**Latest Year (2009) Estimate [Gg] $E_{x,t}$**	**Trend Assessment $L_{x,t}$**	**Contribution to the trend**	**Cumulative Total of $L_{x,t}$**
1 A 2 a	Iron and Steel	6.73	4.75	0.507	24.2%	24.2%
1 A 4 b 1	Residential: stationary	25.87	4.92	0.393	18.7%	42.9%
1 A 2 f 1	Stationary Combustion in Manufacturing Industries and Construction: Other	4.13	3.15	0.352	16.8%	59.7%
1 A 4 a 1	Commercial/Institutional: Stationary	5.23	0.68	0.135	6.5%	66.2%
1 A 1 a	Public Electricity and Heat Production	11.79	2.56	0.123	5.8%	72.0%
1 A 3 b 3	R.T., Heavy duty vehicles	2.60	0.05	0.118	5.6%	77.6%
1 A 3 b 1	R.T., Passenger cars	1.59	0.07	0.066	3.1%	80.8%
	National Total	**74.38**	**21.58**			

Table 7: Key Categories for NO_x gases for the year 2009.

Level Assessment				
NFR Code	**NFR Category**	**Latest Year (2009) Estimate [Gg] $E_{x,t}$**	**Level Assessment $L_{x,t}$**	**Cumulative Total of $L_{x,t}$**
1 A 3 b 3	R.T., Heavy duty vehicles	65.09	34.7%	34.7%
1 A 3 b 1	R.T., Passenger cars	37.45	20.0%	54.7%
1 A 2 f 1	Stationary Combustion in Manufacturing Industries and Construction: Other	11.24	6.0%	60.7%
1 A 4 b 1	Residential: stationary	11.00	5.9%	66.6%
1 A 1 a	Public Electricity and Heat Production	9.60	5.1%	71.7%
1 A 4 c 2	Agriculture/Forestry/Fishing: Off-road Vehicles and Other Machinery	8.94	4.8%	76.5%
1 A 2 f 2	Mobile Combustion in Manufacturing Industries and Construction: Other	8	4.5%	81.0%
	National Total	**187.32**		

Trend Assessment						
NFR Code	**NFR Category**	**'Base Year' (1990) Estimate [Gg] $E_{x,0}$**	**Latest Year (2009) Estimate [Gg] $E_{x,t}$**	**Trend Assessment $L_{x,t}$**	**Contribution to the trend**	**Cumulative Total of $L_{x,t}$**
1 A 3 b 3	R.T., Heavy duty vehicles	48.80	65.09	0.101	34.7%	34.7%
1 A 3 b 1	R.T., Passenger cars	45.14	37.45	0.033	11.3%	46.0%
1 A 2 f 2	Mobile Combustion in Manufacturing Industries and Construction: Other	3.03	8.43	0.031	10.5%	56.6%
2 B 5	Other	4.07	0.07	0.021	7.3%	63.9%
1 A 1 b	Petroleum refining	4.32	1.05	0.017	5.9%	69.8%
1 A 1 a	Public Electricity and Heat Production	12.05	9.60	0.011	3.8%	73.6%
1 A 3 b 2	R.T., Light duty vehicles	7.78	5.50	0.011	3.8%	77.4%
1 A 2 f 1	Stationary Combustion in Manufacturing Industries and Construction: Other	13.72	11.24	0.011	3.7%	81.1%
	National Total	**194.88**	**187.32**			

Table 8: Key Categories for NMVOC gases for the year 2009.

Level Assessment

NFR Code	NFR Category	Latest Year (2009) Estimate [Gg] $E_{x,t}$	Level Assessment $L_{x,t}$	Cumulative Total of $L_{x,t}$
3 D	OTHER including products containing HMs and POPs	31.86	25.9%	25.9%
1 A 4 b 1	Residential: stationary	25.34	20.6%	46.5%
3 A	PAINT APPLICATION	18.00	14.6%	61.1%
3 B	DEGREASING AND DRY CLEANING	8.81	7.2%	68.2%
1 A 3 b 1	R.T., Passenger cars	6.78	5.5%	73.7%
3 C	3 C Chemical products	5.44	4.4%	78.2%
1 A 4 c 2	Agriculture/Forestry/Fishing: Off-road Vehicles and Other Machinery	3.72	3.0%	81.2%
	National Total	**123.12**		

Trend Assessment

NFR Code	NFR Category	'Base Year' (1990) Estimate [Gg] $E_{x,0}$	Latest Year (2009) Estimate [Gg] $E_{x,t}$	Trend Assessment $L_{x,t}$	Contribution to the trend	Cumulative Total of $L_{x,t}$
3 D	OTHER including products containing HMs and POPs	42.15	31.86	0.237	22.6%	22.6%
1 A 3 b 1	R.T., Passenger cars	43.11	6.78	0.227	21.6%	44.1%
1 A 3 b 5	R.T., Gasoline evaporation	19.20	2.18	0.116	11.1%	55.2%
1 B 2 a	Oil	12.10	2.09	0.060	5.7%	60.9%
3 B	DEGREASING AND DRY CLEANING	13.70	8.81	0.049	4.7%	65.6%
1 A 4 b 1	Residential: stationary	51.21	25.34	0.045	4.3%	69.9%
3 A	PAINT APPLICATION	45.79	18.00	0.044	4.2%	74.1%
2 B 5	Other	8.29	1.32	0.043	4.1%	78.2%
1 A 4 c 2	Agriculture/Forestry/Fishing: Off-road Vehicles and Other Machinery	4.27	3.72	0.033	3.1%	81.4%
	National Total	**275.89**	**123.12**			

Table 9: Key Categories for NH_3 gases for the year 2009.

Level Assessment

NFR Code	NFR Category	Latest Year (2009) Estimate [Gg] $E_{x,t}$	Level Assessment $L_{x,t}$	Cumulative Total of $L_{x,t}$
4 B 1	Cattle	35.43	55.8%	55.8%
4 B 8	Swine	11.38	17.9%	73.7%
4 B 9	Poultry	5.19	8.2%	81.9%
	National Total	**63.50**		

Trend Assessment

NFR Code	NFR Category	'Base Year' (1990) Estimate [Gg] $E_{x,0}$	Latest Year (2009) Estimate [Gg] $E_{x,t}$	Trend Assessment $L_{x,t}$	Contribution to the trend	Cumulative Total of $L_{x,t}$
4 B 8	Swine	13.53	11.38	0.028	23.2%	23.2%
1 A 3 b 1	R.T., Passenger cars	2.70	1.31	0.021	17.5%	40.7%
4 D 1	Direct Soil Emissions	3.77	4.89	0.020	16.4%	57.1%
6 D	OTHER WASTE	0.35	1.44	0.018	14.6%	71.7%
4 B 1	Cattle	35.76	35.43	0.012	9.8%	81.5%
	National Total	**65.46**	**63.50**			

Table 10: Key Categories for CO gases for the year 2009.

Level Assessment

NFR Code	NFR Category	Latest Year (2009) Estimate [Gg] $E_{x,t}$	Level Assessment $L_{x,t}$	Cumulative Total of $L_{x,t}$
1 A 4 b 1	Residential: stationary	240.53	37.1%	37.1%
1 A 3 b 1	R.T., Passenger cars	127.27	19.6%	56.7%
1 A 2 a	Iron and Steel	117.04	18.0%	74.7%
1 A 3 b 4	R.T., Mopeds & Motorcycles	21.92	3.4%	78.1%
1 A 2 f 1	Stationary Combustion in Manufacturing Industries and Construction: Other	18.34	2.8%	80.9%
	National Total	**648.78**		

Trend Assessment

NFR Code	NFR Category	'Base Year' (1990) Estimate [Gg] $E_{x,0}$	Latest Year (2009) Estimate [Gg] $E_{x,t}$	Trend Assessment $L_{x,t}$	Contribution to the trend	Cumulative Total of $L_{x,t}$
1 A 3 b 1	R.T., Passenger cars	567.46	127.27	0.441	39.8%	39.8%
1 A 4 b 1	Residential: stationary	416.19	240.53	0.178	16.0%	55.8%
1 A 3 b 2	R.T., Light duty vehicles	59.66	4.54	0.077	6.9%	62.7%
1 A 2 a	Iron and Steel	210.72	117.04	0.074	6.7%	69.4%
1 A 3 b 4	R.T., Mopeds & Motorcycles	10.22	21.92	0.059	5.3%	74.7%
1 A 2 f 1	Stationary Combustion in Manufacturing Industries and Construction: Other	11.00	18.34	0.045	4.1%	78.8%
1 A 4 c 1	Agriculture/Forestry/Fishing: Stationary	12.75	15.56	0.033	3.0%	81.8%
	National Total	**1 433.22**	**648.78**			

Table 11: Key Categories for TSP gases for the year 2009.

Level Assessment				
NFR Code	**NFR Category**	**Latest Year (2009) Estimate [Mg] $E_{x,t}$**	**Level Assessment $L_{x,t}$**	**Cumulative Total of $L_{x,t}$**
4 D 2	Soil operations	10,899.33	18.2%	18.2%
2 A 7 a	Quarrying and mining of minerals other than coal	10,309.04	17.2%	35.4%
1 A 3 b 7	R.T., Automobile road abrasion	9,936.95	16.6%	51.9%
1 A 4 b 1	Residential: stationary	7,393.35	12.3%	64.3%
1 A 2 f 1	Stationary Combustion in Manufacturing Industries and Construction: Other	3,324.25	5.5%	69.8%
2 A 7 b	Construction and demolition	2,820.95	4.7%	74.5%
1 A 3 c	Railways	1,806.64	3.0%	77.5%
1 A 4 c 2	Agriculture/Forestry/Fishing: Off-road Vehicles and Other Machinery	1,741.20	2.9%	80.4%
	National Total	**59,977.31**		

Trend Assessment						
NFR Code	**NFR Category**	**'Base Year' (1990) Estimate [Mg] $E_{x,0}$**	**Latest Year (2009) Estimate [Mg] $E_{x,t}$**	**Trend Assessment $L_{x,t}$**	**Contribution to the trend**	**Cumulative Total of $L_{x,t}$**
2 C 1	Iron and Steel Production	6,434.81	905.37	0.092	22.7%	22.7%
1 A 1 b	Petroleum refining	6,845.51	9,936.95	0.058	14.4%	37.1%
1 A 3 b 7	R.T., Automobile road abrasion	734.82	3,324.25	0.045	11.2%	48.4%
1 A 1 a	Public Electricity and Heat Production	10,273.26	7,393.35	0.043	10.6%	59.0%
1 A 2 b	Non-ferrous Metals	8,215.54	10,309.04	0.042	10.4%	69.4%
6 C	WASTE INCINERATION	1,758.62	2,820.95	0.020	4.9%	74.2%
1 A 4 c 1	Agriculture/Forestry/Fishing: Stationary	679.56	1,647.32	0.017	4.3%	78.5%
	National Total	**62,453.33**	**59,977.31**			

Table 12: Key Categories for PM10 gases for the year 2009.

Level Assessment

NFR Code	NFR Category	Latest Year (2009) Estimate [Mg] $E_{x,t}$	Level Assessment $L_{x,t}$	Cumulative Total of $L_{x,t}$
1 A 4 b 1	Residential: stationary	6,730.29	19.2%	19.2%
4 D 2	Soil operations	4,906.11	14.0%	33.1%
2 A 7 a	Quarrying and mining of minerals other than coal	4,830.07	13.7%	46.9%
1 A 3 b 7	R.T., Automobile road abrasion	3,312.32	9.4%	56.3%
1 A 2 f 1	Stationary Combustion in Manufacturing Industries and Construction: Other	2,177.11	6.2%	62.5%
1 A 3 b 1	R.T., Passenger cars	1,647.32	4.7%	67.2%
1 A 4 c 2	Agriculture/Forestry/Fishing: Off-road Vehicles and Other Machinery	1,496.77	4.3%	71.4%
2 A 7 b	Construction and demolition	1,410.47	4.0%	75.4%
1 A 3 b 3	R.T., Heavy duty vehicles	1,177.38	3.4%	78.8%
1 A 1 a	Public Electricity and Heat Production	1,090.40	3.1%	81.9%
	National Total	**35,141.01**		

Trend Assessment

NFR Code	NFR Category	'Base Year' (1990) Estimate [Mg] $E_{x,0}$	Latest Year (2009) Estimate [Mg] $E_{x,t}$	Trend Assessment $L_{x,t}$	Contribution to the trend	Cumulative Total of $L_{x,t}$
2 C 1	Iron and Steel Production	4,560.81	638.15	0.109	22.4%	22.4%
1 A 2 f 1	Stationary Combustion in Manufacturing Industries and Construction: Other	505.24	2,177.11	0.056	11.4%	33.7%
1 A 4 b 1	Residential: stationary	9,322.22	6,730.29	0.049	10.0%	43.8%
2 A 7 a	Quarrying and mining of minerals other than coal	3,848.90	4,830.07	0.046	9.4%	53.1%
1 A 3 b 7	R.T., Automobile road abrasion	2,281.84	3,312.32	0.042	8.5%	61.6%
1 A 3 b 1	R.T., Passenger cars	679.56	1,647.32	0.034	6.9%	68.5%
1 A 2 d	Pulp, Paper and Print	950.40	206.01	0.020	4.2%	72.7%
2 A 7 b	Construction and demolition	879.31	1,410.47	0.020	4.2%	76.8%
1 A 3 b 3	R.T., Heavy duty vehicles	1,914.81	1,177.38	0.017	3.4%	80.2%
	National Total	**2.14**	**0.91**			

Table 13: Key Categories for PM2.5 gases for the year 2009.

Level Assessment				
NFR Code	**NFR Category**	**Latest Year (2009) Estimate [Mg] $E_{x,t}$**	**Level Assessment $L_{x,t}$**	**Cumulative Total of $L_{x,t}$**
1 A 4 b 1	Residential: stationary	6,067.24	30.7%	30.7%
1 A 3 b 1	R.T., Passenger cars	1,647.32	8.3%	39.0%
1 A 2 f 1	Stationary Combustion in Manufacturing Industries and Construction: Other	1,352.58	6.8%	45.8%
1 A 4 c 2	Agriculture/Forestry/Fishing: Off-road Vehicles and Other Machinery	1,350.12	6.8%	52.7%
1 A 3 b 3	R.T., Heavy duty vehicles	1,177.38	6.0%	58.6%
4 D 2	Soil operations	1,092.92	5.5%	64.1%
1 A 3 b 7	R.T., Automobile road abrasion	993.69	5.0%	69.2%
1 A 1 a	Public Electricity and Heat Production	913.50	4.6%	73.8%
2 A 7 a	Quarrying and mining of minerals other than coal	540.66	2.7%	76.5%
1 A 2 f 2	Mobile Combustion in Manufacturing Industries and Construction: Other	517.58	2.6%	79.1%
3 D	OTHER including products containing HMs and POPs	443.24	2.2%	81.4%
1 A 4 b 1	Residential: stationary	6,067.24	30.7%	30.7%
1 A 3 b 1	R.T., Passenger cars	1,647.32	8.3%	39.0%
1 A 2 f 1	Stationary Combustion in Manufacturing Industries and Construction: Other	1,352.58	6.8%	45.8%
	National Total	**19,778.52**		

Trend Assessment							
NFR Code	**NFR Category**	**'Base Year' (1990) Estimate [Mg] $E_{x,0}$**	**Latest Year (2009) Estimate [Mg] $E_{x,t}$**	**Trend Assessment $L_{x,t}$**	**Contribution to the trend**	**Cumulative Total of $L_{x,t}$**
2 C 1	Iron and Steel Production	2,065.90	282.14	0.087	17.2%	17.2%
1 A 3 b 1	R.T., Passenger cars	679.56	1,647.32	0.067	13.2%	30.4%
1 A 2 f 1	Stationary Combustion in Manufacturing Industries and Construction: Other	332.57	1,352.58	0.067	13.1%	43.5%
1 A 4 b 1	Residential: stationary	8,371.17	6,067.24	0.049	9.7%	53.2%
1 A 2 d	Pulp, Paper and Print	781.44	169.39	0.029	5.7%	59.0%
1 A 3 b 7	R.T., Automobile road abrasion	684.55	993.69	0.027	5.2%	64.2%
1 A 4 c 2	Agriculture/Forestry/Fishing: Off-road Vehicles and Other Machinery	2,140.14	1,350.12	0.025	4.9%	69.1%
1 A 3 b 3	R.T., Heavy duty vehicles	1,914.81	1,177.38	0.024	4.8%	73.9%
1 A 1 a	Public Electricity and Heat Production	639.77	913.50	0.024	4.7%	78.6%
1 A 4 a 1	Commercial/Institutional: Stationary	676.23	332.58	0.014	2.7%	81.3%
	National Total	**24,103.39**	**19,778.52**			

Table 14: Key Categories for PAH gases for the year 2009.

Level Assessment				
NFR Code	**NFR Category**	**Latest Year (2009) Estimate [Mg] $E_{x,t}$**	**Level Assessment $L_{x,t}$**	**Cumulative Total of $L_{x,t}$**
1 A 4 b 1	Residential: stationary	4.60	61.3%	61.3%
1 A 3 b 1	R.T., Passenger cars	0.71	9.5%	70.9%
1 A 3 b 3	R.T., Heavy duty vehicles	0.64	8.5%	79.4%
1 A 4 c 1	Agriculture/Forestry/Fishing: Stationary	0.51	6.8%	86.2%
	National Total	**7.50**		

Trend Assessment						
NFR Code	**NFR Category**	**'Base Year' (1990) Estimate [Mg] $E_{x,0}$**	**Latest Year (2009) Estimate [Mg] $E_{x,t}$**	**Trend Assessment $L_{x,t}$**	**Contribution to the trend**	**Cumulative Total of $L_{x,t}$**
1 A 4 b 1	Residential: stationary	7.92	4.60	0.364	35.8%	35.8%
1 A 3 b 3	R.T., Heavy duty vehicles	0.28	0.64	0.160	15.7%	51.5%
1 A 3 b 1	R.T., Passenger cars	0.50	0.71	0.154	15.1%	66.6%
1 A 4 c 1	Agriculture/Forestry/Fishing: Stationary	0.35	0.51	0.110	10.8%	77.4%
2 D 2	Food and Drink	0.55	0.04	0.061	6.0%	83.5%
	National Total	**17.36**	**7.50**			

Table 15: Key Categories for PCDD/F/Furan gases for the year 2009.

Level Assessment

NFR Code	NFR Category	Latest Year (2009) Estimate [g] $E_{x,t}$	Level Assessment $L_{x,t}$	Cumulative Total of $L_{x,t}$
1 A 4 b 1	Residential: stationary	21.28	59.1%	59.1%
2 C 1	Iron and Steel Production	2.60	7.2%	66.3%
1 A 2 f 1	Stationary Combustion in Manufacturing Industries and Construction: Other	2.48	6.9%	73.2%
1 A 4 c 1	Agriculture/Forestry/Fishing: Stationary	2.30	6.4%	79.6%
1 A 2 b	Non-ferrous Metals	2.22	6.2%	85.8%
	National Total	**35.99**		

Trend Assessment

NFR Code	NFR Category	'Base Year' (1990) Estimate [g] $E_{x,0}$	Latest Year (2009) Estimate [g] $E_{x,t}$	Trend Assessment $L_{x,t}$	Contribution to the trend	Cumulative Total of $L_{x,t}$
1 A 4 b 1	Residential: stationary	41.73	21.28	1.479	30.6%	30.6%
1 A 2 b	Non-ferrous Metals	50.34	2.22	1.123	23.2%	53.8%
2 C 1	Iron and Steel Production	37.21	2.60	0.712	14.7%	68.5%
6 C	WASTE INCINERATION	18.19	0.17	0.485	10.0%	78.5%
1 A 2 f 1	Stationary Combustion in Manufacturing Industries and Construction: Other	0.68	2.48	0.289	6.0%	84.5%
	National Total	**160.65**	**35.99**			

Table 16: Key Categories for HCB gases for the year 2009.

Level Assessment				
NFR Code	**NFR Category**	**Latest Year (2009) Estimate [kg] $E_{x,t}$**	**Level Assessment $L_{x,t}$**	**Cumulative Total of $L_{x,t}$**
1 A 4 b 1	Residential: stationary	28.43	74.3%	74.3%
1 A 4 c 1	Agriculture/Forestry/Fishing: Stationary	3.75	9.8%	84.1%
	National Total	**38.26**		

Trend Assessment						
NFR Code	**NFR Category**	**'Base Year' (1990) Estimate [kg] $E_{x,0}$**	**Latest Year (2009) Estimate [kg] $E_{x,t}$**	**Trend Assessment $L_{x,t}$**	**Contribution to the trend**	**Cumulative Total of $L_{x,t}$**
1 A 4 b 1	Residential: stationary	50.29	28.43	0.471	40.8%	40.8%
1 A 2 b	Non-ferrous Metals	17.15	1.00	0.386	33.4%	74.2%
1 A 4 c 1	Agriculture/Forestry/Fishing: Stationary	2.55	3.75	0.169	14.7%	88.9%
	National Total	**91.94**	**38.26**			

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 (TACCC) 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/IEC 17020 *General Criteria for the operation of various types of bodies performing inspections*[74]. 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[75] and Chapter 6 of the EMEP/EEA emission inventory guidebook 2009[76].

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/IEC 17020 accredited inspection body for Greenhouse Gas Inventories (Id. No. 241) in accordance with the Austrian Accreditation Law (AkkG)[77] by decree of the Minister of Economics and Labour (BMWA), issued on 19.01.2006, valid from 23.12.2005.[78] The requirements of ISO/IEC 17020 (Type A)[79] are fulfilled.[80/81]

In 2009 the starting signal has been given for to accreditation for air pollutants under the NEC directive but due to the experience in the last years an application for accreditation needs resources and time.

Table 17 presents the timetable for the implementation of the quality management system.

Table 17: Timetable for the implementation of the Austrian QMS.

	Date
Development of a quality management system including quality manual	1999–2002
Development of the quality management system Implementation of the quality management system	2003–2005
Accreditation Audit Accreditation as Inspection Body for *Greenhouse Gas Inventories*	September 2005 December 2005

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

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

[76] http://www.eea.europa.eu/publications/emep-eea-emission-inventory-guidebook-2009

[77] 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

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

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

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

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

The Austrian Quality Management System (QMS) and requirements of IPCC GPG and Good Practice for LRTAP Emission Inventories

The implementation of QA/QC procedures as required by the IPCC-GPG and the Good Practice for LRTAP Emission Inventories support the development of national greenhouse gas inventories that can be readily assessed in terms of quality and completeness. The QMS as implemented in the Austrian inventory includes all elements of the QA/QC system outlined in the IPCC-GPG Chapter 8 „Quality Assurance and Quality Control" and the EMEP/EEA emission inventory guidebook 2009 Chapter 6 "Inventory management, improvement and QA/QC" (see next subchapter), and goes beyond. It also comprises supporting and management processes in addition to the QA/QC procedures in inventory compilation and thus ensures agreed standards not only within (i) the inventory compilation process and (ii) supporting processes (e.g. archiving), but also for (iii) management processes (e.g. annual management reviews, internal audits, regular training of personnel, definition of procedures for external communication).

Design of the Austrian QMS

The design of the QMS of the *Inspection Body for Greenhouse Gas Inventories* at the Umweltbundesamt follows a *process based approach*. **As already outlined above in the first instance the inspection body applied to accreditation for greenhouse gases only however all air pollutants are covered by the QMS.** The QMS is illustrated in Figure 5.

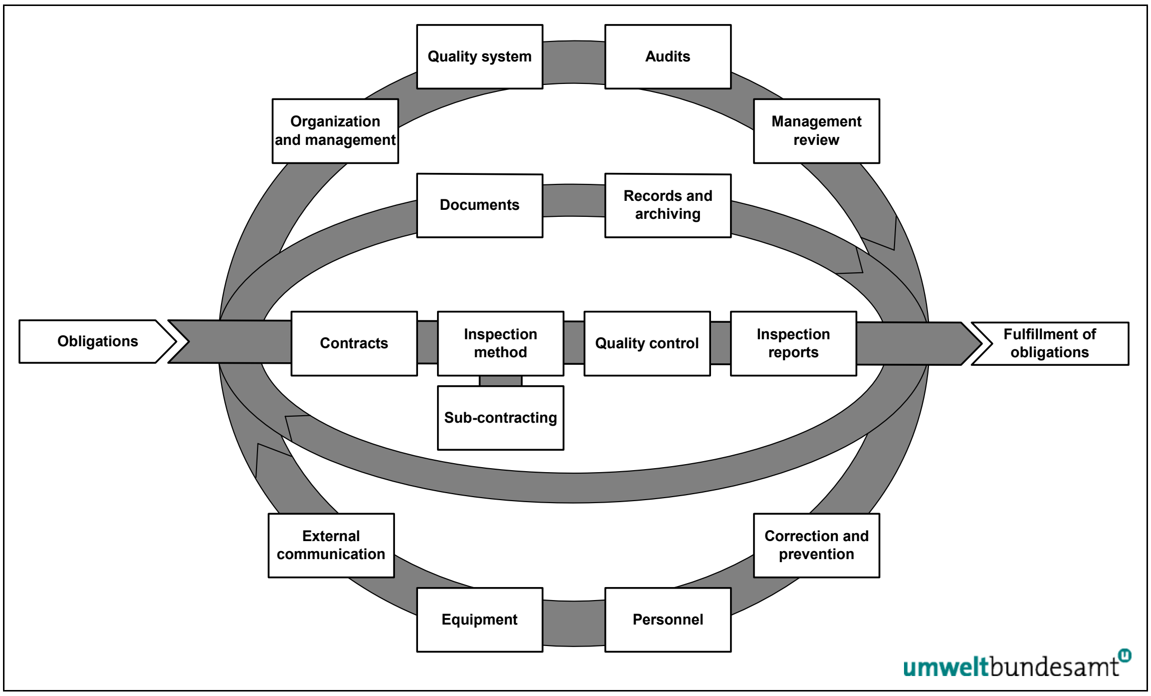

Figure 5: Process-based QMS (the outer circle corresponds to management processes, the straight line to realisation processes and the inner circle to supporting processes).

QA/QC procedures

QA/QC Plan

Activities to be conducted by the personnel of the inspection body are written down in the Quality Manual. Such activities are:

- QC activities
- procedures for country specific methodologies
- internal audits (QM specific)
- procedures for sub-contracting
- inventory improvement plan
- documentation and archiving
- plan of methodologies (needs approval from the formal contracting body)
- treatment of confidential data

Quality Manual

The Quality Manual is divided into three levels, where the activities as listed above form Level 2:

- Level 1: General (the actual "quality manual": general information, description of QMS, general responsibilities, etc.)
- Level 2: Detailed description of activities to be conducted and checklists and forms to be filled out.
- Level 3: Documentation of QC activities (filled out checklists, ...)

QC Activities

QC activities are mainly performed by the sector experts themselves (first party) after inventory work has been finished. However, where possible the deputy of the sector experts conducts QC checks (second party).

QC activities are conducted following QC checklists, which cover Tier 1 QC (general QC) such as formal aspects (check of IPCC quality objectives TACCC) as well as Tier 2 QC (source specific QC).

The checklists cover questions like:

- ✓ Are all references clearly made?
- ✓ Are all assumptions documented?
- ✓ Are the correct values used (check for transcription errors, etc.)?
- ✓ check of calculations, units, etc.
- ✓ Is the data set complete for the whole time series?
- ✓ check of plausibility of results (time-series, order of magnitude, etc.)
- ✓ correct transformation/transcription into NFR
- ✓ Are all recalculations clearly explained?
- ✓ Is the data applicable?
- ✓ Where possible data is checked with data from other sources, order of magnitude checks, etc.

The checklists cover all aspects as required according to Table 8.1 of the IPCC GPG (2000) and Chapter 6 of the EMEP/EEA emission inventory guidebook 2009.

Additionally electronic checks (e.g. check for completeness and comparison with last year's inventory) are performed by the project manager, who is also responsible for data management of the inventory.

QC activities proved to be helpful to identify errors as well as lack in transparency before inventory data is published.

QA Activities

The following QA activities are performed:

Annual second party audits for every sector: check of emission estimation and reporting process (from archiving of underlying information, emission calculation, input into the data management system, documentation, information in the IIR etc.) for transparency, reproducibility, clearness and completeness. This tool proved to be very helpful in order to further improve the documentation and the implementation of (new) QA/QC routines.

Second party audits for work performed by sub-contractors:

The sector expert at the Umweltbundesamt is responsible for incorporation of results in inventory database and additional QA/QC (works as second party audit).

Audits of data suppliers

In 2007, the Audit[82] of the main data supplier Statistik Austria (energy balance) in 2007 took place. In 2009, the main data supplier for estimates of the waste sector (landfill data base), and agricultural statistical data from Statistik Austria was audited. Furthermore the Institut of Industrial Ecology (IIÖ), which developed (2002) and updated (2008) the solvent model, have been audited.

Error correction and continuous improvement

All issues regarding transparency, accuracy, completeness, consistency or comparability identified by experts from different backgrounds are incorporated in the inventory improvement plan. Sources of these findings are:

- UNFCCC and UNECE/LRATP Reviews
- external experts (e.g. experts from federal provinces: some of them who prepare a partly independent emission inventory for their federal province compare their results with the disaggregated national inventory),
- stakeholders (e.g. industrial facilities or association of industries: the NIR is communicated to every data supplier and Austrian experts involved in emission inventorying after submission)
- personnel of the inspection body (head of inspection body, project leader sector experts, etc.)

Archiving and documentation

Within the inventory system, a system for transparent documentation of inventory data and information (assumptions etc.) that allows the reproduction of the inventory is implemented. To allow clear references in documentation of the inventory, an archiving system for literature, mails, documents (e.g. review reports), calculations, with an access database containing the archived information is used. The archived documents are stored on an server and/or in the inventory archive (paper).

[82] www.statistik.at/web_de/static/subdokumente/r_energiebilanzen_auditbericht_stat.pdf

For each sector the documentation includes:

- responsibilities (where relevant)
- "logbook" (who did what and when)
- and for each source category:
  - description (source, emissions, key source)
  - information on completeness
  - methodology
  - references for activity data, emission factor and emissions
  - uncertainty
  - recalculations
  - planned improvement

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.[81]

However, the quality of estimates for all relevant pollutants has been rated using qualitative indicators as suggested in Chapter 5 of the EMEP/EEA emission inventory guidebook 2009. The definition of the ratings is given in Table 18, the ratings for the emission estimates are presented in Table 20.

Table 18: 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 200%
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: Table 3-2 Rating definitions, Chapter 5 of the EMEP/EEA emission inventory guidebook 2009.

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:

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

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

Uncertainty[83]	**1999**			**2000**	
	Emission [kg]	**Variation**		**Emission [t]**	**Variation**
PCDD/F/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

[83] 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 20: 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 18;

(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 emission data presented in this report were compiled according to the Guidelines for Reporting Emission Data (ECE/EB.AIR/97) approved by the Executive Body for the UNECE/LRTAP Convention at its 26th session.

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.

According to the 2009 Revised Guidelines for Reporting Emission Data, Parties within the EMEP region should calculate and report emissions, consistent with national energy balances reported to Eurostat or the International Energy Agency (IEA). Emissions from road vehicle transport should therefore be calculated and reported on the basis of the fuel sold. In addition, Parties may report emissions from road vehicles based on fuel used in the geographic area of the Party.

In the report to the UNECE Convention on Long-range Transboundary Air Pollution (LRTAP) emissions of the Austrian road transport sector are reported on the basis of fuel sold whereas in the report[84] under the National Emissions Ceiling Directive (NECD) they are accounted on the basis of 'fuel used'. The Austrian NEC Totals therefore differ from the LRTAP Totals presented in this report (see Annex, chapter 11.3).

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 1980–2008 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 CLRTAP (ECE/EB.AIR/97) (see Table 21) to indicate where emissions are not occurring in Austria, where emissions have not been estimated or have been included elsewhere as suggested by EMEP/EEA emission inventory guidebook 2009. 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 Additional info.

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[84] For more information, see UMWELTBUNDESAMT (2009): Austria's National Air Emission Inventory 1990–2008: Submission under Directive 2001/81/EC on national emission ceilings for certain atmospheric pollutants. Vienna. http://www.umweltbundesamt.at/fileadmin/site/publikationen/REP0195.pdf

Table 21: 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

2.1.1 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.[85] Twenty-one 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 21 Parties to the 1985 Sulphur Protocol reduced 1980 sulphur emissions by more than 50% by 1993 (using the latest available figure, where no data were available for 1993). Also individually, based on the latest available data, all Parties to the Protocol have reached the reduction target. Eleven Parties have achieved reductions of at least 60%. Given the target year 1993 for the 1985 Sulphur Protocol, it can be concluded that all Parties to that Protocol have reached the target of reducing emissions by at least 30%.

In Austria, SO_2 emissions in the base year 1980 amouned to 344 Gg, by the year 1993 emissions were reduced to 53 Gg corresponding to a reduction of 84%. In 2009, SO_2 emissions in Austria amounted to 21 Gg, which is a decrease by 94% 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).[86] This Protocol requires as a first step, to freeze emissions of nitrogen oxides or their transboundary fluxes. The general reference year is 1987[87].

Taking the sum of emissions of Parties to the NO_x Protocol in 1994, or a previous year, where no recent data are available, also a reduction of 9% compared to 1987 can be noted. Nineteen of the 25 Parties to the 1988 NO_x Protocol have reached the target and stabilized emissions at 1987[88] levels or reduced emissions below that level according to the latest emission data reported.

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.

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

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

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

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

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. However, since then emissions have been increasing again and the NO_x emissions had reached an all-time high in 2005 with 237 Gg. In 2005 emissions significantly 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 208 Gg, by the year 1995 emissions were reduced to 181 Gg corresponding to a reduction of 13%. In 2009, NO_x emissions in Austria amounted to 187 Gg, which is a decrease by 10% compared to 1987.[89]

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.[90]

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;[91]

(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;[92]

(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.[93]

Austria met the reduction target: in the base year NMVOC emissions amounted to 354 Gg, in 1999 emissions were reduced by 51% to 174 Gg. From 1999 to 2009 a further reduction by 29% took place (123 Gg in 2009), whereas from 2000 to 2003 a stagnation and from 2004 to 2006 a temporary increase could be noted.

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[89] Please note that emissions from mobile sources are calculated based on fuel sold (which is consistent with submission under the UNFCCC and the Kyoto Protocol), which for the last few years is considerably higher than fuel used: emissions for 2009 based on fuel used amount to 145 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 Chapter 12.3 'Austria's emissions for SO_2, NO_x, NMVOC and NH_3 according to the submission under NEC directive' (Annex Table A-15 and Table A-17). In the related report 'AUSTRIA'S ANNUAL AIR EMISSION INVENTORY 1990–2009. Submission under National Emission Ceilings Directive 2001/81/EC' is published on the following website:

http://www.umweltbundesamt.at/aktuell/publikationen/publikationssuche/publikationsdetail/?&pub_id=1897

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

[91] 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

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

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

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).[94] 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)[95]. 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 (PCDD/F), 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).

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

[95] http://www.unece.org/env/lrtap/pops_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[96].

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.

[96] http://www.unece.org/env/lrtap/multi_h1.htm

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

National total emissions and trends (1990–2009) as well as emission targets[97] for air pollutants covered by the Multi-Effect Protocol are shown in Table 22. Please note that emissions from mobile sources are calculated based on fuel sold in Austria, thus national total emissions include 'fuel export'.[98]

[97] 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).

[98] For NO_x the emissions calculated based on fuel used are by 42 Gg lower in 2009 and show a 20% decrease from 1990 to 2009.

Austria's emissions based on fuel used – thus excluding 'fuel export' – are presented in Chapter 12.3 'Austria's emissions for SO_2, NO_x, NMVOC and NH_3 according to the submission under NEC directive' (Annex Table A-15 and Table A-17). In the related report 'AUSTRIA'S ANNUAL AIR EMISSION INVENTORY 1990–2009. Submission under National Emission Ceilings Directive 2001/81/EC' is published on the following website:

http://www.umweltbundesamt.at/aktuell/publikationen/publikationssuche/publikationsdetail/?&pub_id=1897

Table 22: National total emissions and trends 1990–2009 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	74.38	194.88	275.89	65.46	1 433.22
1991	71.49	202.16	266.37	67.98	1 497.15
1992	55.09	192.54	241.48	66.97	1 468.04
1993	53.46	187.18	242.45	68.28	1 436.08
1994	47.83	181.49	226.47	70.02	1 382.85
1995	47.41	181.43	226.31	70.77	1 269.84
1996	44.67	203.46	220.40	68.68	1 243.63
1997	40.21	191.58	204.54	68.79	1 147.74
1998	35.59	205.49	188.04	69.20	1 105.84
1999	33.77	198.22	174.32	67.08	1 027.83
2000	31.68	206.33	178.53	64.65	954.24
2001	32.80	216.00	177.40	64.52	916.58
2002	31.28	222.81	176.69	63.73	881.06
2003	32.10	233.42	173.60	63.64	874.89
2004	27.49	231.48	154.85	62.90	836.72
2005	27.29	236.75	164.47	62.70	820.92
2006	28.26	223.16	173.17	62.58	772.25
2007	24.87	216.87	159.85	63.47	720.85
2008	22.48	204.65	150.43	62.73	681.48
2009	20.58	187.32	123.12	63.50	648.78
Trend 1990–2009	**-72.3%**	**-3.9%**	**-55.4%**	**-3.0%**	**-54.7%**
Absolute Emission Target 2010	**39.00**	**107.00**	**159.00**	**66.00**	**–**

2.2.1 SO_2 Emissions

In 1990, national total SO_2 emissions amounted to 74 Gg; emissions have decreased steadily since then and by the year 2009 emissions were reduced by 72% mainly due to lower emissions from residential heating, combustion in industries and in energy industries.

As shown in Table 23 the main source for SO_2 emissions in Austria, with a share of 94% in 1990 and 93% in 2009, 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 22). In 2009, Austrian total SO_2 emissions (21 Gg) were well below the ceiling.

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 2009: as can be seen in Table 23 in 1990 emissions amounted to 70 Gg. In 2009, they were 73% lower (19 Gg). The share of SO_2 emissions from this category in national total emissions was about 94% in 1990 and 93% in 2009. In 2009, within this source, the main sources for SO_2 emissions are:

	Contribution in Total SO_2 emission
● NFR 1 A 1 Energy Industries	15%
● NFR 1 A 2 Manufacturing Industries and Construction	48%
● NFR 1 A 3 Transport	1%
● NFR 1 A 4 Other Sectors (Comercial, Institutional and Residential heating, etc.)	28%

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[99]),
- 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[100]),
- 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 2009, these emissions contributed 1% to national total SO_2 emissions. SO_2 emissions from NFR Category 1 B decreased by 88% between 1990 and 2009 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 2009. As can be seen in Table 23, in 1990, emissions amounted to 2.2 Gg, in 2009, they were 46% lower (1.2 Gg).

The share of SO_2 emissions from this category in national total emissions was about 3% in 1990 and about 6% in 2009 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 following sub-categories:

	Contribution in Total SO_2 emission
● NFR 2 B *Chemical Industry* (covers processes in inorganic chemical industries)	4%
● NFR 2 C *Metal Production*	2%

[99] BGBl_II_417-04_Kraftstoffverordnung; Umsetzung der Richtlinie 2003/30/EG

[100] 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

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.

SO_2 Emission Trend in NFR Category 3 Solvent Use and Other Product Use

No SO_2 emissions occur from NFR 3 Solvent Use and Other Product Use.

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 2009, emissions only contribute less than 0.1% 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 2009 the *Sector Waste* contributed only less than 0.3% to Austria's SO_2 emissions.

Table 23: SO_2 emissions per NFR Category 1990 and 2009, their trends 1990–2009 and their share in total emissions.

NFR Category		SO_2 Emission in [Gg]		Trend		Share in National Total	
		1990	2009	1990–2009	2008-2009	1990	2009
1	ENERGY	72.09	19.32	-73%	-9%	97%	94%
1 A	FUEL COMBUSTION ACTIVITIES	70.09	19.08	-73%	-9%	94%	93%
1 A 1	Energy Industries	14.04	3.14	-78%	-8%	19%	15%
1 A 1 a	Public Electricity and Heat Production	11.79	2.56	-78%	<1%	16%	12%
1 A 1 b	Petroleum refining	2.25	0.58	-74%	-32%	3%	3%
1 A 1 c	Manufacture of Solid fuels & Other Energy Ind.	0.00	NA	NA	NA	<1%	NA
1 A 2	Manufacturing Industries and Construction	17.91	9.86	-45%	-10%	24%	48%
1 A 2 a	Iron and Steel	6.73	4.75	-29%	-10%	9%	23%
1 A 2 b	Non-ferrous Metals	0.15	0.11	-28%	-4%	<1%	1%
1 A 2 c	Chemicals	0.76	0.46	-39%	3%	1%	2%
1 A 2 d	Pulp, Paper and Print	4.30	1.06	-75%	-3%	6%	5%
1 A 2 e	Food Processing, Beverages and Tobacco	1.65	0.33	-80%	-14%	2%	2%
1 A 2 f	Other	4.33	3.16	-27%	-13%	6%	15%
1 A 3	Transport	5.18	0.29	-94%	-5%	7%	1%
1 A 3 a	Civil Aviation	0.03	0.09	184%	-8%	<1%	<1%
1 A 3 b	Road Transportation	4.85	0.12	-97%	<1%	7%	1%
1 A 3 c	Railways	0.26	0.06	-78%	-12%	<1%	<1%
1 A 3 d	Navigation	0.04	0.02	-46%	2%	<1%	<1%
1 A 3 e	Pipeline compressors	NA	NA	NA	NA	NA	NA
1 A 4	Other Sectors	32.95	5.77	-82%	-9%	44%	28%
1 A 4 a	Commercial/Institutional	5.23	0.68	-87%	-40%	7%	3%
1 A 4 b	Residential	25.93	4.92	-81%	-2%	35%	24%
1 A 4 c	Agriculture/Forestry/Fisheries	1.79	0.17	-91%	-16%	2%	1%
1 A 5	Other	0.01	0.01	15%	1%	<1%	<1%
1 B	FUGITIVE EMISSIONS FROM FUELS	2.00	0.24	-88%	47%	3%	1%
2	INDUSTRIAL PROCESSES	2.22	1.21	-46%	-1%	3%	6%
2 A	MINERAL PRODUCTS	NA	NA	NA	NA	NA	NA
2 B	CHEMICAL INDUSTRY	1.56	0.77	-51%	--	2%	4%
2 C	METAL PRODUCTION	0.66	0.44	-33%	-4%	1%	2%
2 C 1	Iron and Steel Production	0.25	0.04	-84%	-28%	<1%	<1%
2 C 2	Ferroalloys Production	NA	NA	NA	NA	NA	NA
2 C 3	Aluminium production	NA	NO	NO	NO	NA	NO
2 C 5	Other metal production	0.41	0.40	-1%	<1%	1%	2%
2 D	OTHER PRODUCTION	NA	NA	NA	NA	NA	NA
2 E	PRODUCTION OF POPs	NO	NO	NO	NO	NO	NO
2 F	CONSUMPTION OF POPS & HEAVY METAL	NA	NA	NA	NA	NA	NA
2 G	OTHER PRODUCTION, CONSUMPTION, etc.	NA	NA	NA	NA	NA	NA
3	SOLVENT AND OTHER PRODUCT USE	NA	NA	NA	NA	NA	NA
4	AGRICULTURE	0.00	0.00	-31%	-7%	<1%	<1%
6	WASTE	0.07	0.06	-20%	--	<1%	<1%
	Total without sinks	**74.38**	**20.58**	**-72%**	**-8%**		

2.2.2 NO_x Emissions

In 1990, national total NO_x emissions amounted to 195 Gg; emissions were slightly decreasing until the mid-1990 but have increased in the last years. Between 2008 and 2009 emissions decreased significantly and in 2009 they were about 4% lower than in 1990.

As can be seen in Table 24, the main source for NO_x emissions in Austria, with a share of 94% in 1990 and 96% in 2009, are the *Fuel Combustion Activities.* Within this source, *road transport*, with about 58% 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[101]. With 187 Gg NO_x emissions in 2009, emissions in Austria are at the moment with 75% well above this ceiling – see Table 22.

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 2009 based on fuel used amount to 145 Gg, which is about 29% less, but still well above the emission ceiling set out in Annex II of the Multi-Effects Protocol.[102]

NO_x Emission Trends in Category 1 A Fuel Combustion Activities

As can be seen in Table 24, NO_x emissions from the Sector 1 A *Fuel Combustion Activities* decreased over the period from 1990 to 2009. In 1990, they amounted to 183 Gg. In 2009, they were about 2% lower than 1990 levels (180 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 96% in 2009. The main source for NO_x emissions in NFR 1 A are:

	Contribution in Total NO_x emission
● NFR 1 A 1 Energy Industries	6%
● NFR 1 A 2 Manufacturing Industries and Construction	17%
● NFR 1 A 3 Transport *of which Road Transport*	60% *58%*
● NFR 1 A 4 Other Sectors (Comercial, Institutional and Residential heating, etc.)	12%

[101] In the European National Emissions Ceiling Directive the national emission ceiling is 103 Gg

[102] Austria's emissions based on fuel used – thus excluding 'fuel export' – are presented in Chapter 12.3 'Austria's emissions for SO_2, NO_x, NMVOC and NH_3 according to the submission under NEC directive' (Annex Table A-15 and Table A-17). In the related report 'AUSTRIA'S ANNUAL AIR EMISSION INVENTORY 1990–2009. Submission under National Emission Ceilings Directive 2001/81/EC' is published on the following website:

http://www.umweltbundesamt.at/aktuell/publikationen/publikationssuche/publikationsdetail/?&pub_id=1897

In all subcategories, except NFR 1 A 3 Transport, 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 8% 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 2009 (see Table 24) 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.

As shown in Table 24, NO_x emissions from the Category 2 *industrial processes* decreased over the period from 1990 to 2009. In 1990 they amounted to 4.8 Gg, in the year 2009, they were 74% below 1990 levels (1.26 Gg).

The relevant sources for NO_x emissions of this NFR Category are:

	Contribution in Total NO_x emission
● NFR 2 B Chemical Industry (covers processes in inorganic chemical industries)	<1%
● NFR 2 C Metal Production	<1%
● NFR 2 D Other Production (only Pulp and Paper)	<1%

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.

NOx Emission Trend in NFR Category 3 Solvent Use and Other Product Use

No NO_x emissions occur from NFR 3 Solvent Use and Other Product Use.

NO_x Emission Trend in NFR Category 4 Agriculture

In 1990, national NO_x emissions of the Sector *Agriculture* amounted to 6.5 Gg, which is a share of about 3% of the Austrian total NO_x emissions. Until 2009, emissions have decreased by 11% and amounted to 5.8 Gg, which is a share in national total NO_x emissions of 3%. This downwards trend is mainly due to reduced use of synthetic N-fertilizers.

	Contribution in Total NO_x emission
● NFR 4 B Manure Management (Cattle, Sheep, Goats, Horses, Swine, Poultry, Other)	2%
● NFR 4 D Agricultural Soils (nitrogen inputs into Agricultural soils)	1%
● NFR 4 F Field Burning of Agricultural Residues	<1%
● NFR 4 G Agriculture Other	<1%

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 2009. As shown in the table below, NO_x emissions from the waste sector decreased by about 50% over the period from 1990 to 2009 to 0.05 Gg. Emissions result from Waste Incineration (non-energy use).

Table 24: NO_x emissions per NFR Category 1990 and 2009, their trend 1990–2009 and their share in total emissions.

NFR Category		NO_x Emission in [Gg]		Trend		Share in National Total	
		1990	2009	1990–2009	2008–2009	1990	2009
1	ENERGY	183.47	180.21	-2%	-9%	94%	96%
1 A	FUEL COMBUSTION ACTIVITIES	183.47	180.21	-2%	-9%	94%	96%
1 A 1	Energy Industries	17.74	12.03	-32%	-9%	9%	6%
1 A 1 a	Public Electricity and Heat Production	12.05	9.60	-20%	-10%	6%	5%
1 A 1 b	Petroleum refining	4.32	1.05	-76%	-13%	2%	1%
1 A 1 c	Manufacture of Solid fuels & Other Energy Ind.	1.37	1.39	1%	-3%	1%	1%
1 A 2	Manufacturing Industries and Construction	32.83	31.64	-4%	-7%	17%	17%
1 A 2 a	Iron and Steel	5.41	4.56	-16%	-10%	3%	2%
1 A 2 b	Non-ferrous Metals	0.25	0.24	-8%	2%	<1%	<1%
1 A 2 c	Chemicals	1.69	1.22	-28%	-7%	1%	1%
1 A 2 d	Pulp, Paper and Print	7.00	5.11	-27%	1%	4%	3%
1 A 2 e	Food Processing, Beverages & Tobacco	1.74	0.86	-51%	-3%	1%	<1%
1 A 2 f	Other	16.74	19.67	17%	-9%	9%	10%
1 A 3	Transport	105.15	113.12	8%	-10%	54%	60%
1 A 3 a	Civil Aviation	0.41	1.11	172%	-7%	<1%	1%
1 A 3 b	Road Transportation	101.85	108.50	7%	-9%	52%	58%
1 A 3 c	Railways	1.82	1.66	-9%	-13%	1%	1%
1 A 3 d	Navigation	0.46	0.69	49%	<1%	<1%	<1%
1 A 3 e	Pipeline compressors	0.61	1.16	90%	-26%	<1%	1%
1 A 4	Other Sectors	27.68	23.33	-16%	-5%	14%	12%
1 A 4 a	Commercial/Institutional	3.44	1.85	-46%	-26%	2%	1%
1 A 4 b	Residential	13.85	11.64	-16%	-2%	7%	6%
1 A 4 c	Agriculture/Forestry/Fisheries	10.40	9.84	-5%	-4%	5%	5%
1 A 5	Other	0.07	0.08	12%	-1%	<1%	<1%
1 B	FUGITIVE EMISSIONS FROM FUELS	IE	IE	IE	IE	IE	IE
2	INDUSTRIAL PROCESSES	4.80	1.26	-74%	-21%	2%	1%
2 B	CHEMICAL INDUSTRY	4.07	0.30	-93%	-29%	2%	<1%
2 C	METAL PRODUCTION	0.17	0.09	-49%	-25%	<1%	<1%
2 D	OTHER PRODUCTION	0.55	0.88	59%	-17%	<1%	<1%
2 E	PRODUCTION OF POPs	NO	NO	NO	NO	NO	NO
2 F	CONSUMPTION OF POPS AND HEAVY METAL	NA	NA	NA	NA	NA	NA
2 G	OTHER PRODUCTION, CONSUMPTION, etc.	NA	NA	NA	NA	NA	NA
3	SOLVENT AND OTHER PRODUCT USE	NA	NA	NA	NA	NA	NA
4	AGRICULTURE	6.51	5.80	-11%	<1%	3%	3%
4 B	MANURE MANAGEMENT	5.09	4.64	-9%	1%	3%	2%
4 D	AGRICULTURAL SOILS	1.35	1.09	-19%	-7%	1%	1%
4 F	FIELD BURNING OF AGRICULTURAL RESIDUE	0.03	0.02	-35%	-10%	<1%	<1%
4 G	Agriculture OTHER	0.04	0.05	27%	2%	<1%	<1%
6	WASTE	0.10	0.05	-50%	<1%	<1%	<1%
	Total without sinks	**194.88**	**187.32**	**-4%**	**-8%**		

2.2.3 NMVOC Emissions

In 1990, national total NMVOC emissions amounted to 276 Gg; emissions have decreased steadily since then and by the year 2009 emissions were reduced by 55%.

As can be seen in Table 25, in 2009 the main sources of NMVOC emissions in Austria are *Fuel Combustion Activities* with a share of 41%, and *Solvent and Other Product Use* with a contribution to the national total of 52%.

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 22). In 2009 Austria's NMVOC emissions amounted to 123 Gg, and thus Austria is 23% below its target.

NMVOC Emission Trends in NFR Category 1 A Fuel Combustion Activities

In 2009, 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 41% (50 Gg) in 2009 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 2009 emissions decreased by 63%, 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 2009 it was 2%. Fugitive NMVOC emissions decreased: in 2009, they were 83% 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 Gg) compared to 4% (5 Gg). The decrease is due to abatement techniques in this sector 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 2009 emissions decreased by 59%, mainly due to decreasing emissions from NFR *2 B Chemical Industry.*

In 2009 the relevant sources for NMVOC emissions of NFR Category 2 Industrial Processes are:

	Contribution in Total NO_x emission
• NFR 2 B Chemical Industry (covers processes in inorganic chemical industries)	1%
• NFR 2 C Metal Production	<1%
• NFR 2 D Other Production (Pulp and Paper (chipboard industry) as well as Food and Drink)	2%

As can be seen in Table 25 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 Other.

NMVOC Emission Trend in NFR Category 3 Solvent and 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 41% (114 Gg) compared to 52% (64 Gg) in 2009 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 2009 emissions decreased by 44%, 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.[103]

- 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 51% to about 8 Gg in the period 1990–2009 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 66% to about 10 Gg in the period 1990-2009, 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 or even increased due to intensified activities which compensate the measures.

[103] see Chapter 6.1

- NMVOC emissions from sub sector *3 B Degreasing and Dry Cleaning,* which had a share of 7% in National Total NMVOC emission, arose in 2009 from the following sub categories:
  - NFR 3 B 1 Degreasing, where the emissions decreased by 36% to about 8 Gg,
  - NFR 3 B 2 Dry Cleaning, where the emissions decreased by 23% to 0.3 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 increased within the period 1990-2009, 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 4 % in 2009, whereas an emission reduction of 57% 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 15% in 1990 and about 26% in 2009, which represents an increase of 11%. In 2009 the relevant sources for NMVOC emissions of NFR 3 D *Other* are:

	Contribution in Total NMVOC emission
● NFR 3 D 1 Printing	4%
● NFR 3 D 2 Domestic solvent use including fungicides	12%
● NFR 3 D 3 Other product use	9%

However, in NFR 3 D 2 Domestic solvent use (including fungicides) an emission increase of 29% could be noted.

- 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 until 2006 is due to a considerable increase of do-it-yourself activities. Due to the crisis the emission decreased by 27% between 2008 and 2009.

NMVOC Emission Trend in NFR Category 4 Agriculture

In 2009 NMVOC emissions of category Agriculture only contributed 1% (1.8 Gg) to the Austrian total NMVOC emissions. From 1990 to 2009 NMVOC from Agriculture decreased by 1%.

	Contribution in Total NMVOC emission
● NFR 4 F Field Burning of Agricultural Residues	<1%
● NFR 4 G Agriculture Other (use of sewage sludge)	1%

NMVOC Emission Trend in NFR Category 6 Waste

In 2009, NMVOC emissions from category *Waste* contributed less than 0.1% (0.07 Gg) to Austria's total NMVOC emissions. From 1990 to 2009 NMVOC from NFR Sector 6 *Waste* decreased by 57%.

In 2009, 96% of the NMVOC emissions from the Sector Waste arose from NFR Sector 6 A Solid Waste Disposal on *Land*.

Table 25: NMVOC emissions per NFR Category 1990 and 2009, their trend 1990–2009 and their share in total emissions.

NFR Category		**NMVOC Emission in [Gg]**		**Trend**		**Share in National Total**	
		1990	**2009**	**1990–2009**	**2008–2009**	**1990**	**2009**
1	ENERGY	148.35	52.57	-65%	-5%	54%	43%
1 A	FUEL COMBUSTION ACTIVITIES	136.22	50.46	-63%	-5%	49%	41%
1 A 1	Energy Industries	0.42	0.76	80%	3%	<1%	1%
1 A 2	Manufacturing Industries and Construction	1.71	2.25	32%	-4%	1%	2%
1 A 3	Transport	72.81	14.24	-80%	-11%	26%	12%
1 A 3 a	Civil Aviation	0.20	0.48	138%	-6%	<1%	<1%
1 A 3 b	Road Transportation	71.63	13.10	-82%	-11%	26%	11%
1 A 3 c	Railways	0.37	0.25	-31%	-13%	<1%	<1%
1 A 3 d	Navigation	0.61	0.41	-33%	-4%	<1%	<1%
1 A 3 e	Pipeline compressors	<0.01	<0.01	90%	-26%	<1%	<1%
1 A 4	Other Sectors	61.28	33.19	-46%	-3%	22%	27%
1 A 4 a	Commercial/Institutional	0.67	0.51	-24%	-13%	<1%	<1%
1 A 4 b	Residential	55.99	27.33	-51%	-2%	20%	22%
1 A 4 c	Agriculture/Forestry/Fisheries	4.62	5.35	16%	-4%	2%	4%
1 A 5	Other	0.01	0.02	7%	1%	<1%	<1%
1 B	FUGITIVE EMISSIONS FROM FUELS	12.13	2.11	-83%	-6%	4%	2%
2	INDUSTRIAL PROCESSES	11.10	4.56	-59%	-5%	4%	4%
2 A	MINERAL PRODUCTS	IE	IE	IE	IE	IE	IE
2 B	CHEMICAL INDUSTRY	8.29	1.32	-84%	--	3%	1%
2 C	METAL PRODUCTION	0.52	0.35	-33%	-30%	<1%	<1%
2 D	OTHER PRODUCTION	2.29	2.89	26%	-3%	1%	2%
2 E	PRODUCTION OF POPs	NO	NO	NO	NO	NO	NO
2 F	CONSUMPTION OF POPS & HEAVY METAL	NA	NA	NA	NA	NA	NA
2 G	OTHER PRODUCTION, CONSUMPTION, etc.	NA	NA	NA	NA	NA	NA
3	SOLVENT AND OTHER PRODUCT USE	114.43	64.10	-44%	-27%	41%	52%
3 A	PAINT APPLICATION	45.79	18.00	-61%	-27%	17%	15%
3 B	DEGREASING AND DRY CLEANING	13.70	8.81	-36%	-27%	5%	7%
3 C	3 C Chemical products	12.79	5.44	-57%	-27%	5%	4%
3 D	OTHER including products containing HMs and POPs	42.15	31.86	-24%	-27%	15%	26%
4	AGRICULTURE	1.85	1.83	-1%	-6%	1%	1%
4 B	MANURE MANAGEMENT	NA	NA	NA	NA	NA	NA
4 D	AGRICULTURAL SOILS	NA	NA	NA	NA	NA	NA
4 F	FIELD BURNING OF AGRICULTURAL RESIDU	0.14	0.10	-23%	1%	<1%	<1%
4 G	AGRICULTURE OTHER	1.72	1.73	1%	-6%	1%	1%
6	WASTE	0.16	0.07	-57%	-7%	<1%	<1%
6 A	SOLID WASTE DISPOSAL ON LAND	0.15	0.06	-56%	-7%	<1%	<1%
6 B	WASTEWATER HANDLING	NA	NA	NA	NA	NA	NA
6 C	WASTE INCINERATION	0.01	<0.01	-75%	--	<1%	<1%
6 D	OTHER WASTE	NA	NA	NA	NA	NA	NA
	Total without sinks	**275.89**	**123.12**	**-55%**	**-18%**		

2.2.4 NH_3 Emissions

In 1990, national total NH_3 emissions amounted to 65 Gg; emissions have slightly decreased over the period from 1990 to 2009. In 2009, emissions were 3% below 1990 levels. As can be seen in Table 26, 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 2009. Within this source manure management – cattle has the highest contribution to national total NH_3 emissions.

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 22). In 2009, Austria's total NH_3 emissions (64 Gg) were just below this ceiling.

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 4% in 2009. NH_3 emissions from NFR *1* A are decreasing: in 1990, emissions amounted to about 4.0 Gg. In the year 2009, they were about 29% lower than 1990 levels and amounted to about 2.9 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 2009 respectively.

The trend concerning NH_3 emissions from NFR 2 *Industrial Processes* is generally decreasing: in the period from 1990 to 2009 emissions decreased by 67% from 0.27 Gg in 1990 to 0.09 Gg (see Table 26). Extensive abatement techniques are the reasons for the emission reduction.

NH_3 emissions of NFR 2 C *Metal Production* are included in NFR 1 A 2 a *Manufacturing Industries and Construction - Iron and Steel.*

NH_3 Emission Trend in NFR Category 3 Solvent Use and Other Product Use

No NH_3 emissions occur from NFR 3 Solvent Use and Other Product Use.

NH_3 Emission Trend in NFR Category 4 Agriculture

In 1990 national NH_3 emissions from the Sector *Agriculture* amounted to 60.8 Gg; emissions have decreased since then and by the year 2009 emissions were reduced by 3% to 59.1 Gg mainly due to reduced dairy cattle rearing (see Table 26). In 2009 the category *Agriculture* contributed 93% to Austria's NH_3 emissions.

Within this category:

- *Manure Management* (NFR 4 B), with a share of 83%, has the highest contribution to national total NH_3 emissions in 2009. 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 56% in National Total NH_3 emission and an emission reduction of 1% (35 Gg);
  - NFR *4 B 8 Swine* share of 18% in National Total NH_3 emission and an emission reduction of 16% (11 Gg);
  - NFR 4 B 9 Poultry share of 8% in National Total NH_3 emission and an emissions reduction of 5% (5 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 1% in National Total NH_3 emission.
- *Agricultural Soils* (NFR 4 D) has a share of 9% in national total NH_3 emissions in 2009. 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 8% in National Total NH_3 and an emissions increase of 30% (4.9 Gg);
  - 4 D 2 Soil operations: share of 2% in National Total NH_3 and an emissions reduction of 25% (1.0 Gg);
- *Field burning of agricultural residues* (NFR 4 F): NH_3 emissions are negligible low (<0.1% to total NH_3 emissions in 2009).

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 302% to 1.4 Gg in 2009 mainly due to increasing mechanical biological treatment of waste and collection of bio-waste, lopping, etc. In the year 2009 the Sector W*aste* contributed 2% to Austria's NH_3 emissions.

Table 26: NH_3 emissions per NFR Category 1990 and 2009, their trend 1990–2009 and their share in total emissions.

NFR Category		NH_3 Emission in [Gg]		Trend		Share in National Total	
		1990	2009	1990–2009	2008–2009	1990	2009
1	ENERGY	4.04	2.85	-29%	-11%	6%	4%
1 A	FUEL COMBUSTION ACTIVITIES	4.04	2.85	-29%	-11%	6%	4%
1 A 1	Energy Industries	0.20	0.42	110%	5%	<1%	1%
1 A 2	Manufacturing Industries and Construction	0.34	0.39	14%	-19%	1%	1%
1 A 3	Transport	2.87	1.40	-51%	-15%	4%	2%
1 A 4	Other Sectors	0.63	0.64	1%	-5%	1%	1 %
1 A 5	Other	<0.01	<0.01	16%	1%	<1%	<1%
1 B	FUGITIVE EMISSIONS FROM FUELS	IE	IE	IE	IE	IE	IE
2	INDUSTRIAL PROCESSES	0.27	0.09	-67%	9%	<1%	<1%
2 A	MINERAL PRODUCTS	NA	NA	NA	NA	NA	NA
2 B	CHEMICAL INDUSTRY	0.27	0.09	-68%	9%	<1%	<1%
2 C	METAL PRODUCTION	IE	IE	IE	IE	IE	IE
2 E	PRODUCTION OF POPs	NO	NO	NO	NO	NO	NO
2F	CONSUMPTION OF POPS AND HEAVY METAI	NA	NA	NA	NA	NA	NA
2 G	OTHER PRODUCTION, CONSUMPTION, etc.	<0.01	<0.01	--	--	<1%	<1%
3	SOLVENT AND OTHER PRODUCT USE	NA	NA	NA	NA	NA	NA
4	AGRICULTURE	60.80	59.12	-3%	2%	93%	93%
4 B	MANURE MANAGEMENT	55.21	52.65	-5%	1%	84%	83%
4 B 1	Cattle	35.76	35.43	-1%	1%	55%	56%
4 B 2	Buffalo	NO	NO	NO	NO	NO	NO
4 B 3	Sheep	0.14	0.16	11%	3%	<1%	<1%
4 B 4	Goats	0.02	0.03	83%	9%	<1%	<1%
4 B 5	Camels and Llamas	NO	NO	NO	NO	NO	NO
4 B 6	Horses	0.25	0.44	77%	--	<1%	1%
4 B 7	Mules and Asses	IE	IE	IE	IE	IE	IE
4 B 8	Swine	13.53	11.38	-16%	2%	21%	18%
4 B 9	Poultry	5.49	5.19	-5%	--	8%	8%
4 B-13	Other	0.02	0.02	11%	--	<1%	<1%
4 D	AGRICULTURAL SOILS	5.12	5.90	15%	6%	8%	9%
4 D 1	Direct Soil Emissions	3.77	4.89	30%	7%	6%	8%
4 D 2	Soil operations	1.35	1.01	-25%	2%	2%	2%
4 F	FIELD BURNING OF AGRICULTURAL RESIDUI	0.04	0.03	-32%	-8%	<1%	<1%
4 G	Agriculture OTHER	0.43	0.54	27%	1%	1%	1%
6	WASTE	0.36	1.44	302%	2%	1%	2%
6 A	SOLID WASTE DISPOSAL ON LAND	<0.01	<0.01	-56%	-7%	<1%	<1%
6 B	WASTEWATER HANDLING	NA	NA	NA	NA	NA	NA
6 C	WASTE INCINERATION	<0.01	<0.01	34%	--	<1%	<1%
6 D	OTHER WASTE	0.35	1.44	307%	2%	1%	2%
	Total without sinks	**65.46**	**63.50**	**-3%**	**1%**		

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 2009. In 2009, emissions were with 649 Gg 55% below 1990 levels.

As can be seen in Table 27, 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 1990 and 2009. Emissions decreased mainly due to decreasing emissions from road transport and residential heating, which is due to the switch-over to improved technologies.

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 27, CO emissions from *Fuel Combustion Activities* decreased by 55% over the period 1990–2009. CO emissions amounted to about 1 375 Gg in 1990 and to about 620 Gg in 2009. The main source for CO emissions in NFR 1 A in 2009 are:

	Contribution in Total CO emission
• NFR 1 A 1 Energy Industries	1%
• NFR 1 A 2 Manufacturing Industries and Construction *of which Iron and Steel*	22% *18%*
• NFR 1 A 3 Transport *of which Road Transport*	27% *26%*
• NFR 1 A 4 Other Sectors (Comercial, Institutional and Residential heating, etc.)	46%

In the period 1990–2009, the share of CO emissions from this category in national total emissions has been stable in spite of growing activities 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 4% in 2009 (see Table 27) 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 27, CO emissions from the *industrial processes sector* decreased over the period from 1990 to 2009. In 1990, they amounted to 46 Gg. In the year 2009, they were 49% below 1990 levels (23 Gg).

The relevant sources for CO emissions of this NFR Category are:

	Contribution in Total CO emission
● NFR 2 A Mineral Products	2%
● NFR 2 B Chemical Industry (mainly processes in inorganic chemical industries)	2%
● NFR 2 C Metal Production	<1%
● NFR 2 D Other Production (only Pulp and Paper)	<1%

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

CO Emission Trend in NFR Category 3 Solvent Use and Other Product Use

No CO emissions occur from NFR 3 Solvent Use and Other Product Use.

CO Emission Trend in NFR Category 4 Agriculture

NFR 4 F *Field Burning of Agricultural Waste* is the only emission source for CO emissions of the Sector *Agriculture*. In 2009, emissions only contributed 0.1% (0.7 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 2009, CO emissions of category *Waste* only contributed about 1% (4.9 Gg) to the Austrian total CO emissions. From 1990 to 2009, CO emissions from NFR Sector 6 *WASTE* decreased by about 56%.

The relevant sources for CO emissions of this NFR Category are:

	Contribution in Total CO emission
● NFR 6 A Solid Waste Disposal on Land	1%
● NFR 6 C WASTE INCINERATION (without energy recovery)	<0.1%

Table 27: CO emissions per NFR Category 1990 and 2009, their trend 1990–2009 and their share in total emissions.

NFR Category		CO Emission in [Gg]		Trend		Share in National Total	
		1990	2009	1990–2009	2008-2009	1990	2009
1	ENERGY	1 374.69	619.78	-55%	-5%	96%	96%
1 A	FUEL COMBUSTION ACTIVITIES	1 374.69	619.78	-55%	-5%	96%	96%
1 A 1	Energy Industries	6.07	4.81	-21%	6%	<1%	1%
1 A 2	Manufacturing Industries and Construction	229.76	144.74	-37%	-6%	16%	22%
1 A 2 a	Iron and Steel	210.72	117.04	-44%	-6%	15%	18%
1 A 2 b	Non-ferrous Metals	0.05	0.05	<1%	8%	<1%	<1%
1 A 2 c	Chemicals	0.80	1.04	31%	-12%	<1%	<1%
1 A 2 d	Pulp, Paper and Print	4.08	2.12	-48%	14%	<1%	<1%
1 A 2 e	Food Processing, Beverages and Tobacco	0.20	0.13	-33%	-3%	<1%	<1%
1 A 2 f	Other	13.92	24.35	75%	-6%	1%	4%
1 A 3	Transport	656.44	174.17	-73%	-9%	46%	27%
1 A 3 a	Civil Aviation	2.47	4.08	65%	3%	<1%	1%
1 A 3 b	Road Transportation	648.83	166.06	-74%	-9%	45%	26%
1 A 3 c	Railways	2.04	1.47	-28%	-13%	<1%	<1%
1 A 3 d	Navigation	3.06	2.48	-19%	-1%	<1%	<1%
1 A 3 e	Pipeline compressors	0.04	0.08	90%	-26%	<1%	<1%
1 A 4	Other Sectors	482.20	295.78	-39%	-2%	34%	46%
1 A 4 a	Commercial/Institutional	11.40	6.57	-42%	-15%	1%	1%
1 A 4 b	Residential	437.90	257.53	-41%	-1%	31%	40%
1 A 4 c	Agriculture/Forestry/Fisheries	32.90	31.68	-4%	-3%	2%	5%
1 A 5	Other	0.22	0.27	24%	1%	<1%	<1%
1 B	FUGITIVE EMISSIONS FROM FUELS	IE	IE	IE	IE	IE	IE
2	INDUSTRIAL PROCESSES	46.37	23.42	-49%	-4%	3%	4%
2 A	MINERAL PRODUCTS	9.78	9.78	<1%	--	1%	2%
2 B	CHEMICAL INDUSTRY	12.67	11.11	-12%	<1%	1%	2%
2 C	METAL PRODUCTION	23.52	1.89	-92%	-34%	2%	<1%
2 D	OTHER PRODUCTION	0.40	0.64	59%	-17%	<1%	<1%
2 E	PRODUCTION OF POPs	NO	NO	NO	NO	NO	NO
2F	CONSUMPTION OF POPS & HEAVY METAL	NA	NA	NA	NA	NA	NA
2 G	OTHER PRODUCTION, CONSUMPTION, etc.	NA	NA	NA	NA	NA	NA
3	SOLVENT AND OTHER PRODUCT USE	NA	NA	NA	NA	NA	NA
4	AGRICULTURE	0.99	0.69	-31%	-7%	<1%	<1%
4 B	MANURE MANAGEMENT	NA	NA	NA	NA	NA	NA
4 D	AGRICULTURAL SOILS	NA	NA	NA	NA	NA	NA
4 F	FIELD BURNING OF AGRICULT. RESIDUES	0.99	0.69	-31%	-7%	<1%	<1%
4 G	AGRICULTURE OTHER	NA	NA	NA	NA	NA	NA
6	WASTE	11.16	4.89	-56%	-7%	1%	1%
6 A	SOLID WASTE DISPOSAL ON LAND	11.11	4.88	-56%	-7%	1%	1%
6 B	WASTEWATER HANDLING	NA	NA	NA	NA	NA	NA
6 C	WASTE INCINERATION	0.05	0.01	-75%	--	<1%	<1%
6 D	OTHER WASTE	NA	NA	NA	NA	NA	NA
	Total without sinks	**1 433.22**	**648.78**	**-55%**	**-5%**		

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 (PCDD/F). 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.

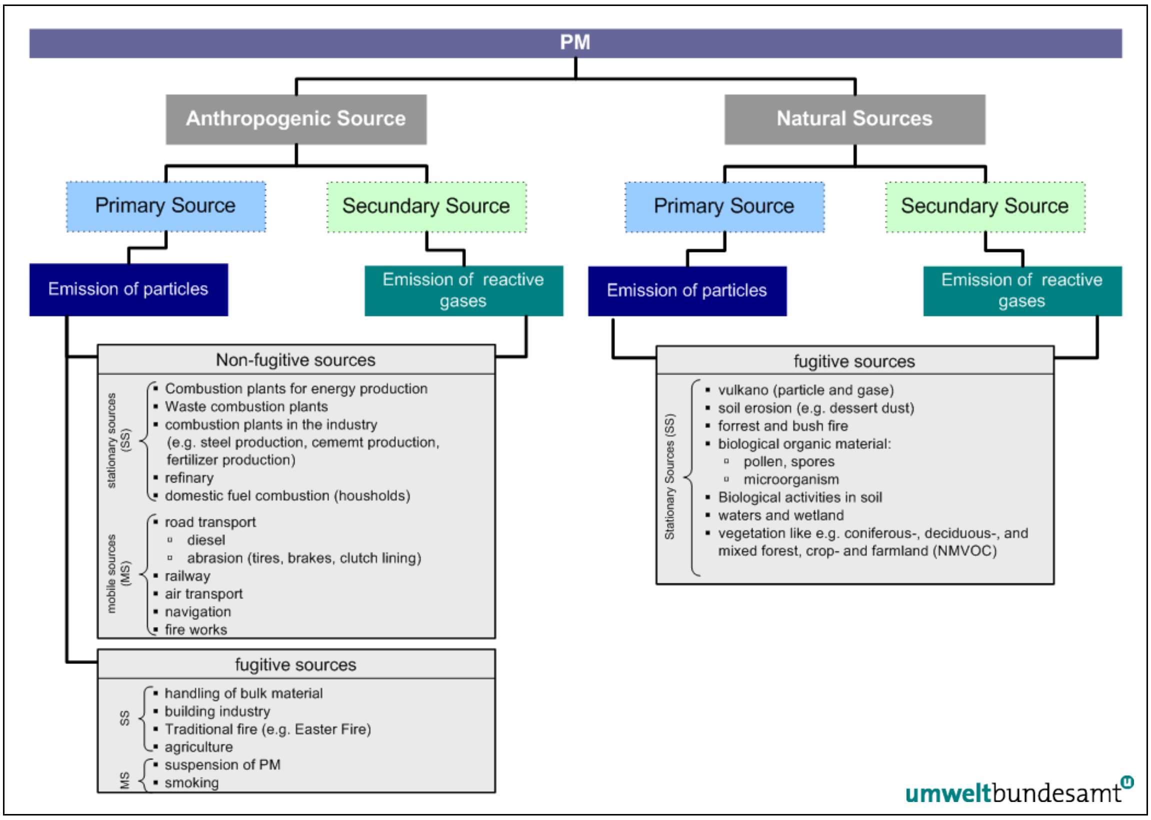

Figure 6: Schematic classification of PM sources.

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 7).

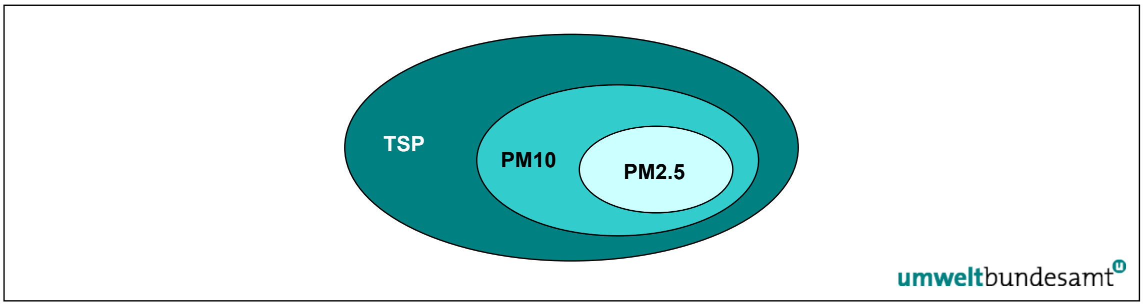

Figure 7: Distribution of TSP, PM10 and PM2.5 (schematic).

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.

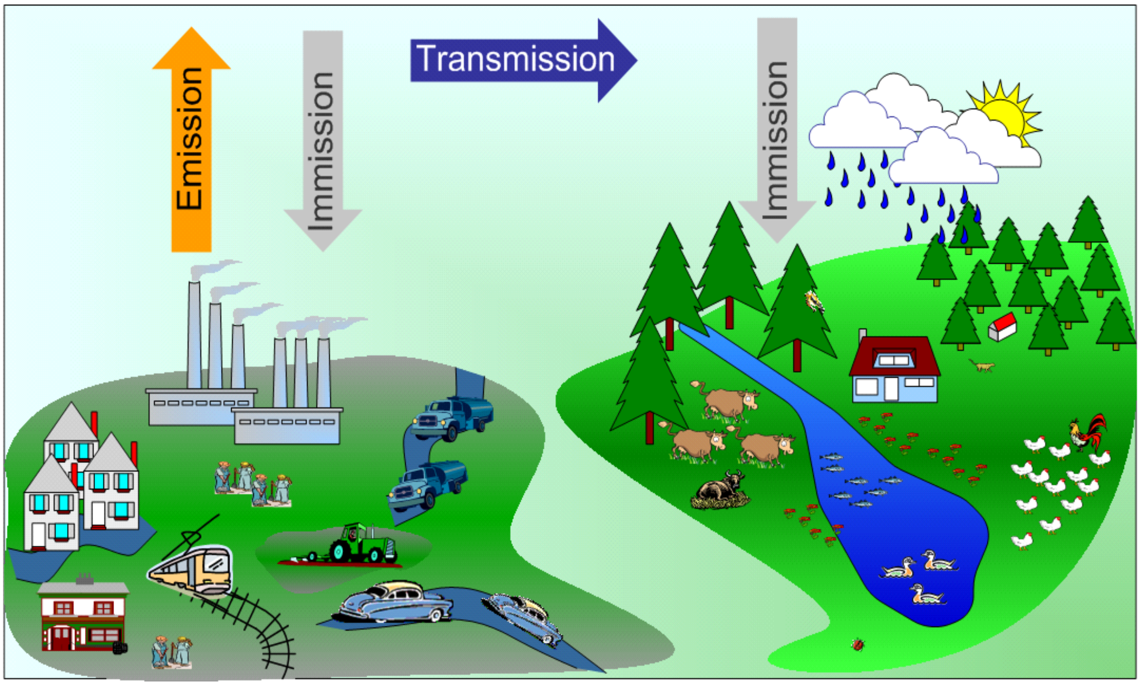

Figure 8: Interrelation of emission, transmission and immission.

Particulate matter (PM) emissions remained quite stable over the period 1990 to 2009: TSP emission decreased by 4%, PM10 emission were about 12% below the level of 1990, and PM2.5 emissions decreased by about 18%, whereas the decrease is mainly due to the crisis in 2009 (see Table 28). 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 28: National total emissions and emission trends for particulate matter (PM) 1990–2009.

Year	**Emissions [Mg]**		
	TSP	**PM10**	**PM2.5**
1990	62 453.33	39 691.31	24 103.39
:	NR	NR	NR
1995	63 043.39	39 079.97	23 322.97
:	NR	NR	NR
2000	63 362.09	38 659.22	22 613.47
2001	63 227.97	38 758.23	22 921.35
2002	62 296.53	37 766.98	22 204.16
2003	62 680.55	38 019.00	22 400.66
2004	63 384.55	38 148.35	22 168.86
2005	63 885.31	38 607.59	22 704.15
2006	61 942.06	36 882.80	21 371.98
2007	61 580.48	36 415.35	20 952.85
2008	62 520.54	36 747.76	20 749.59
2009	59 977.31	35 141.01	19 778.52
Trend 1990–2009	**-4%**	**-11%**	**-18%**

PM10 emissions and emission trends in Austria

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.

National total PM10 emissions amounted to 40 Gg in 1990 and have decreased steadily so that by the year 2009 emissions were reduced by 11% (to 35 Gg) – see Table 29.

As shown in Table 29, the main sources for PM10 emissions in Austria are combustion processes in the NFR Category 1 A *Fuel Combustion Activities* (61% in national total emissions in 2009) as well as handling of bulk materials like mineral products and the activities in the field of civil engineering of Category 2 *Industrial Processes*.

PM2.5 emissions and emission trends in Austria

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.

National total PM2.5 emissions amounted to 24 Gg in 1990 and have decreased steadily so that by the year 2009 emissions were reduced by 18% (to 20 Gg) – see Table 30.

As shown in Table 30, PM2.5 emissions in Austria mainly arose from combustion processes in the energy sector with a share of 84% in the total emissions in 2009. 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 and the agricultural sector both had a share of 7% 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.

Total suspended particulate matter (TSP) emissions and emission trends in Austria

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.

National total TSP emissions amounted to 62.4 Gg in 1990 and remained stable over the period 1990 to 2008 and amounted to 60 Gg in 2009, (Table 31). TSP emissions in Austria derive from industrial processes, road transport, agriculture and small heating installations.

Table 29: PM10 emissions per NFR Category 1990 and 2009, their trend 1990–2009 and their share in total emissions.

NFR Category		PM10 Emission in [Mg]		Trend		Share in National Total	
		1990	2009	1990–2009	2008-2009	1990	2009
1	ENERGY	22 970.92	21 450.49	-7%	-4%	58%	61%
1 A	FUEL COMBUSTION ACTIVITIES	22 666.21	21 265.21	-6%	-4%	57%	61%
1 A 1	Energy Industries	976.72	1 281.80	31%	2%	2%	4%
1 A 2	Manufacturing Industries and Construction	2 442.01	3 401.24	39%	-3%	6%	10%
1 A 2 a	Iron and Steel	51.42	134.28	161%	78%	<1%	<1%
1 A 2 b	Non-ferrous Metals	11.28	10.67	-5%	-10%	<1%	<1%
1 A 2 c	Chemicals	292.13	312.82	7%	-12%	1%	1%
1 A 2 d	Pulp, Paper and Print	950.40	206.01	-78%	6%	2%	1%
1 A 2 e	Food Processing, Beverages and Tobacco	108.41	42.77	-61%	-20%	<1%	<1%
1 A 2 f	Other	1 028.38	2 694.69	162%	-4%	3%	8%
1 A 3	Transport	6 356.00	7 464.13	17%	-7%	16%	21%
1 A 3 a	Civil Aviation	35.06	99.95	185%	-8%	<1%	<1%
1 A 3 b	Road Transportation	5 277.21	6 484.01	23%	-8%	13%	18%
1 A 3 c	Railways	937.78	769.64	-18%	-5%	2%	2%
1 A 3 d	Navigation	104.13	107.06	3%	-1%	<1%	<1%
1 A 3 e	Pipeline compressors	1.82	3.47	90%	-26%	<1%	<1%
1 A 4	Other Sectors	12 875.21	9 101.38	-29%	-3%	32%	26%
1 A 4 a	Commercial/Institutional	745.98	353.41	-53%	-16%	2%	1%
1 A 4 b	Residential	9 453.68	6 766.73	-28%	-1%	24%	19%
1 A 4 c	Agriculture/Forestry/Fisheries	2 675.55	1 981.24	-26%	-7%	7%	6%
1 A 5	Other	16.27	16.66	2%	<1%	<1%	<1%
1 B	FUGITIVE EMISSIONS FROM FUELS	304.71	185.29	-39%	-23%	1%	1%
2	INDUSTRIAL PROCESSES	10 435.13	7 683.58	-26%	-7%	26%	22%
2 A	MINERAL PRODUCTS	4 941.19	6 388.41	29%	-7%	12%	18%
2 A 1	Cement Production	156.37	71.11	-55%	-11%	<1%	<1%
2 A 2	Lime Production	56.61	76.75	36%	-18%	<1%	<1%
2 A 3	Limestone and Dolomite Use	NA	NA	NA	NA	NA	NA
2 A 4	Soda Ash Production and use	NA	NA	NA	NA	NA	NA
2 A 5	Asphalt Roofing	NA	NA	NA	NA	NA	NA
2 A 6	Road Paving with Asphalt	NA	NA	NA	NA	NA	NA
2 A 7	Other including Non Fuel Mining & Constr.	4 728.21	6 240.54	32%	-7%	12%	18%
2 B	CHEMICAL INDUSTRY	565.22	220.42	-61%	-17%	1%	1%
2 C	METAL PRODUCTION	4 560.81	638.15	-86%	-9%	11%	2%
2 D	OTHER PRODUCTION	367.91	436.61	19%	-1%	1%	1%
3	SOLVENT AND OTHER PRODUCT USE	406.93	443.24	9%	<1%	1%	1%
4	AGRICULTURE	5 808.70	5 479.11	-6%	<1%	15%	16%
4 B	MANURE MANAGEMENT	IE	IE	IE	IE	IE	IE
4 D	AGRICULTURAL SOILS	5 126.36	4 906.11	-4%	<1%	13%	14%
4 F	FIELD BURNING OF AGRICUL. RESIDUES	137.94	101.94	-26%	-5%	<1%	<1%
4 G	Agriculture OTHER	544.40	471.05	-13%	2%	1%	1%
6	WASTE	69.63	84.59	21%	--	<1%	<1%
	Total without sinks	**39 691.31**	**35 141.01**	**-11%**	**-4%**		

Table 30: PM2.5 emissions per NFR Category 1990 and 2009, their trend 1990–2009 and their share in total emissions.

NFR Category		**PM2.5 Emission in [Mg]**		**Trend**		**Share in National Total**	
		1990	**2009**	**1990–2009**	**2008–2009**	**1990**	**2009**
1	ENERGY	19 051.82	16 638.12	-13%	-5%	79%	84%
1 A	FUEL COMBUSTION ACTIVITIES	18 956.86	16 579.62	-13%	-5%	79%	84%
1 A 1	Energy Industries	833.03	1 089.60	31%	2%	3%	6%
1 A 2	Manufacturing Industries and Construction	2 037.73	2 474.81	21%	-4%	8%	13%
1 A 2 a	Iron and Steel	57.40	130.02	127%	51%	<1%	1%
1 A 2 b	Non-ferrous Metals	9.40	8.90	-5%	-10%	<1%	<1%
1 A 2 c	Chemicals	243.44	260.68	7%	-12%	1%	1%
1 A 2 d	Pulp, Paper and Print	781.44	169.39	-78%	6%	3%	1%
1 A 2 e	Food Processing, Beverages and Tobacco	90.34	35.65	-61%	-20%	<1%	<1%
1 A 2 f	Other	855.71	1 870.16	119%	-6%	4%	9%
1 A 3	Transport	4 395.46	4 781.98	9%	-9%	18%	24%
1 A 3 a	Civil Aviation	35.06	99.95	185%	-8%	<1%	1%
1 A 3 b	Road Transportation	3 679.92	4 165.39	13%	-10%	15%	21%
1 A 3 c	Railways	574.83	406.69	-29%	-9%	2%	2%
1 A 3 d	Navigation	104.13	107.06	3%	-1%	<1%	1%
1 A 3 e	Pipeline compressors	1.52	2.89	90%	-26%	<1%	<1%
1 A 4	Other Sectors	11 674.81	8 217.01	-30%	-3%	48%	42%
1 A 4 a	Commercial/Institutional	676.23	332.58	-51%	-16%	3%	2%
1 A 4 b	Residential	8 502.63	6 103.68	-28%	-1%	35%	31%
1 A 4 c	Agriculture/Forestry/Fisheries	2 495.95	1 780.75	-29%	-6%	10%	9%
1 A 5	Other	15.82	16.22	3%	<1%	<1%	<1%
1 B	FUGITIVE EMISSIONS FROM FUELS	94.96	58.50	-38%	-23%	<1%	<1%
2	INDUSTRIAL PROCESSES	3 225.92	1 373.37	-57%	-8%	13%	7%
2 A	MINERAL PRODUCTS	710.83	800.35	13%	-8%	3%	4%
2 A 1	Cement Production	139.00	63.21	-55%	-11%	1%	<1%
2 A 2	Lime Production	40.88	55.43	36%	-18%	<1%	<1%
2 A 3	Limestone and Dolomite Use	NA	NA	NA	NA	NA	NA
2 A 4	Soda Ash Production and use	NA	NA	NA	NA	NA	NA
2 A 5	Asphalt Roofing	NA	NA	NA	NA	NA	NA
2 A 6	Road Paving with Asphalt	NA	NA	NA	NA	NA	NA
2 A 7	Other including Non Fuel Mining & Constr.	530.95	681.70	28%	-7%	2%	3%
2 B	CHEMICAL INDUSTRY	301.97	116.29	-61%	-17%	1%	1%
2 C	METAL PRODUCTION	2 065.90	282.14	-86%	-9%	9%	1%
2 D	OTHER PRODUCTION	147.22	174.58	19%	-1%	1%	1%
3	SOLVENT AND OTHER PRODUCT USE	406.93	443.24	9%	<1%	2%	2%
4	AGRICULTURE	1 395.89	1 297.17	-7%	<1%	6%	7%
4 B	MANURE MANAGEMENT	IE	IE	IE	IE	IE	IE
4 D	AGRICULTURAL SOILS	1 140.71	1 092.92	-4%	<1%	5%	6%
4 F	FIELD BURNING OF AGRICULT. RES.	134.20	99.57	-26%	-5%	1%	1%
4 G	Agriculture OTHER	120.98	104.68	-13%	2%	1%	1%
6	WASTE	22.82	26.62	17%	--	<1%	<1%
	Total without sinks	**24 103.39**	**19 778.52**	**-18%**	**-5%**		

Table 31: TSP emissions per NFR Category 1990 and 2009, their trend 1990–2009 and their share in total emissions.

NFR Category		TSP Emission in [Mg]		Trend		Share in National Total	
		1990	2009	1990-2009	2008-2009	1990	2009
1	ENERGY	30 640.71	31 640.53	3%	-4%	49%	53%
1 A	FUEL COMBUSTION ACTIVITIES	29 993.67	31 248.81	4%	-4%	48%	52%
1 A 1	Energy Industries	1 030.72	1 394.89	35%	2%	2%	2%
1 A 2	Manufacturing Industries and Construction	2 828.66	4 626.88	64%	-2%	5%	8%
1 A 2 a	Iron and Steel	57.13	149.20	161%	78%	<1	<1
1 A 2 b	Non-ferrous Metals	12.53	11.86	-5%	-10%	<1	<1
1 A 2 c	Chemicals	324.59	347.57	7%	-12%	1%	1%
1 A 2 d	Pulp, Paper and Print	1 056.00	228.90	-78%	6%	2%	<1
1 A 2 e	Food Processing, Beverages and Tobacco	120.45	47.52	-61%	-20%	<1	<1
1 A 2 f	Other	1 257.96	3 841.83	205%	-3%	2%	6%
1 A 3	Transport	11 956.88	15 126.15	27%	-5%	19%	25%
1 A 3 a	Civil Aviation	35.06	99.95	185%	-8%	<1	<1
1 A 3 b	Road Transportation	9 840.88	13 108.64	33%	-6%	16%	22%
1 A 3 c	Railways	1 974.78	1 806.64	-9%	-2%	3%	3%
1 A 3 d	Navigation	104.13	107.06	3%	-1%	<1	<1
1 A 3 e	Pipeline compressors	2.03	3.85	90%	-26%	<1	<1
1 A 4	Other Sectors	14 160.38	10 083.52	-29%	-3%	23%	17%
1 A 4 a	Commercial/Institutional	810.43	374.24	-54%	-17%	1%	1%
1 A 4 b	Residential	10 404.72	7 429.79	-29%	-1%	17%	12%
1 A 4 c	Agriculture/Forestry/Fisheries	2 945.23	2 279.49	-23%	-8%	5%	4%
1 A 5	Other	17.02	17.38	2%	<1	<1	<1
1 B	FUGITIVE EMISSIONS FROM FUELS	647.03	391.71	-39%	-23%	1%	1%
2	INDUSTRIAL PROCESSES	18 522.43	15 666.69	-15%	-7%	30%	26%
2 A	MINERAL PRODUCTS	10 210.81	13 294.28	30%	-7%	16%	22%
2 A 1	Cement Production	173.75	79.01	-55%	-11%	<1	<1
2 A 2	Lime Production	62.90	85.28	36%	-18%	<1	<1
2 A 3	Limestone and Dolomite Use	NA	NA	NA	NA	NA	NA
2 A 4	Soda Ash Production and use	NA	NA	NA	NA	NA	NA
2 A 5	Asphalt Roofing	NA	NA	NA	NA	NA	NA
2 A 6	Road Paving with Asphalt	NA	NA	NA	NA	NA	NA
2 A 7	Other incl. Non Fuel Mining &Construction	9 974.16	13 129.99	32%	-7%	16%	22%
2 B	CHEMICAL INDUSTRY	957.60	375.86	-61%	-17%	2%	1%
2 C	METAL PRODUCTION	6 434.81	905.37	-86%	-9%	10%	2%
2 D	OTHER PRODUCTION	919.22	1 091.17	19%	-1%	1%	2%
3	SOLVENT AND OTHER PRODUCT USE	406.93	443.24	9%	<1	1%	1%
4	AGRICULTURE	12 737.85	12 048.06	-5%	<1	20%	20%
4 B	MANURE MANAGEMENT	IE	IE	IE	IE	IE	IE
4 D	AGRICULTURAL SOILS	11 390.12	10 899.33	-4%	<1	18%	18%
4 F	FIELD BURNING OF AGRICULTURAL RES.	137.94	101.94	-26%	-5%	<1	<1
4 G	Agriculture OTHER	1 209.79	1 046.78	-13%	2%	2%	2%
6	WASTE	145.41	178.80	23%	--	<1	<1
	Total without sinks	**62 453.33**	**59 977.31**	**-4%**	**-4%**		

2.3.1 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 29 to Table 31 for the period from 1990 to 2009:

- TSP emissions increased by about 4% to 31 Gg, which is a share of 52% in total TSP emissions in 2009.
- PM10 emissions decreased by about 6% to 21 Gg, which is a share of 61% in total PM10 emissions in 2009.
- PM2.5 emissions decreased by about 13% to 16.6 Gg, which is a share of 84% in total PM2.5 emissions in 2009.

In 2009 within this category NFR *1 A 3 Transport* and *1 A 4 Other Sectors* have together the highest contribution to TSP, PM10 and PM2.5 emissions: 42% of the national TSP emissions, 47% of the national PM10 emissions and 66% of the national PM2.5.

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 17% TSP, 26% 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 25% TSP, 21% PM10 and 24% 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 8% TSP, 10% of PM10 and 13% of PM2.5 emissions of the respective national totals.
- NFR 1 A 1 *Energy Industrie*s has a contribution of 2% TSP, 4% of PM10 and 6% of PM2.5 emissions of the respective national totals.

As presented in Table 30, the emissions of PM2.5 from 1 A *Fuel Combustion Activities* decreased by 13% and PM10 decreased by 6%. 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, etc.) in district-heating plants. These fuels belong even with modern technology more to the group of high-emission fuels regarding PM.

- *1 A 4 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, etc.) in district-heating plants. These fuels belong even with modern technology more to the group of high-emission fuels regarding PM.
- *1 A 3 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 39% between 1990 and 2009.

PM Emission Trend in NFR Category 2 Industrial Processes

The Sector *Industrial Processes* had, in 2009, a share of 22% in national total PM10 emissions, 7% in national total PM2.5 emissions and 26% 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 22% of the national total TSP and about 18% of national 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, whereas from 2008 to 2009 a decrease because of the crisis can be noted.
- *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.

  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 2% of national total TSP and PM10 emission, respectively, and 1% PM2.5 emissions of the respective national totals.

  In the NFR subcategory 2 C, a decreasing trend of about 86% of all PM fractions can be noted for the period 1990 to 2009 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 2% of TSP and for about 1% of of national total PM10 and PM2.5 emissions, respectively.

  In the NFR subcategory 2 D, an increasing trend of about 19 % of all PM fractions can be noted for the period 1990 to 2009 because of increasing production and handling 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 9% in national Total TSP, PM10 and PM2.5 emission, respectively, can be noted for the period 1990 to 2009. 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 16%, 7% and 20%, in 2009. 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 7% of the national total PM2.5, 5% of the national total TSP emissions and of about 6% of the national total PM10 over the period 1990 to 2009.

A comparatively small amount of the agricultural PM10 emissions results from animal husbandry (NFR 4 G), where a decreasing trend of 13% 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 21% and PM2.5 emissions increased by about 17 % in the period 1990 to 2009 due to underlying activity data.

2.4 Emission Trends for Heavy Metals

In general emissions of heavy metals decreased remarkably from 1985 to 2009. Emission trends for heavy metals from 1985 to 2009 are presented in Table 32. 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 32: National total emissions and emission trends for heavy metals 1985–2009.

Year	Emissions [Mg]		
	Cd	Hg	Pb
1985	3.092	3.742	326.662
1986	2.684	3.315	312.801
1987	2.195	2.841	306.717
1988	1.927	2.445	276.254
1989	1.734	2.234	242.799
1990	1.578	2.142	218.396
1991	1.527	2.038	179.458
1992	1.247	1.640	124.553
1993	1.162	1.391	87.216
1994	1.063	1.178	59.786
1995	0.975	1.200	16.049
1996	0.995	1.158	15.484
1997	0.970	1.133	14.467
1998	0.900	0.949	12.982
1999	0.947	0.933	12.417
2000	0.925	0.893	11.903
2001	0.951	0.954	12.038
2002	0.938	0.918	12.197
2003	0.978	0.961	12.518
2004	0.980	0.935	12.907
2005	1.077	0.999	13.677
2006	1.065	1.011	13.732
2007	1.101	1.011	14.378
2008	1.142	1.028	14.709
2009	1.055	0.914	12.681
Trend 1985–2009	**-66%**	**-76%**	**-96%**
Trend 1990–2009	**-33%**	**-57%**	**-94%**

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 population food is an important source of exposure because Cd is accumulated in the human and animal bodies due to its long half-life. Cd compounds and complexes are classified as an unambiguous carcinogenic working material.

Cadmium emissions and emission trends in Austria

National total Cd emissions amounted to 3.1 Mg in 1985, and amounted to 1.58 Mg in 1990; since then emissions have decreased steadily and by the year 2009 emissions were reduced by 66% (1.06 Mg) in the period 1985–2009; however the reduction of national total Cd emissions were reduced only by 33% in the period 1990–2009 (see Table 32).

The overall reduction from 1985 to 2009 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.

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 2009 Cd emissions decreased by 17% to 0.88 Mg, which is a share of 83% in national total Cd emission in 2009 (see Table 33). The main sources for Cd emissions in NFR 1 A are:

	Contribution in Total Cd emission
● NFR 1 A 1 Energy Industries	24%
● NFR 1 A 2 Manufacturing Industries and Construction	21%
● NFR 1 A 3 Transport *of which Road Transport*	9% *9%*
● NFR 1 A 4 Other Sectors (Comercial, Institutional and Residential heating, etc.)	29%

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 eight 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 in this period.

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 33 in the period from 1990 to 2009 the Cd emissions decreased by 62% to 0.17 Mg, which is a share of 16% 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.

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 0.1%.

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 2009, emissions only contribute about 0.1% (0.001 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 about 0.1% in national total Cd emission minor sources.

Table 33: Cd emissions per NFR Category 1990 and 2009, their trend 1990–2009 and their share in total emissions.

NFR Category		**Cd Emission in [Mg]**		**Trend**		**Share in National Total**	
		1990	**2009**	**1990–2009**	**2008-2009**	**1990**	**2009**
1	ENERGY	1.060	0.879	-17%	-3%	67%	83%
1 A	FUEL COMBUSTION ACTIVITIES	1.060	0.879	-17%	-3%	67%	83%
1 A 1	Energy Industries	0.194	0.257	32%	-3%	12%	24%
1 A 1 a	Public Electricity and Heat Production	0.104	0.115	11%	3%	7%	11%
1 A 1 b	Petroleum refining	0.091	0.142	57%	-7%	6%	13%
1 A 1 c	Manufacture of Solid fuels & Other Energy Ind.	NA	NA	NA	NA	NA	NA
1 A 2	Manufacturing Industries and Construction	0.386	0.223	-42%	-4%	24%	21%
1 A 2 a	Iron and Steel	0.006	0.004	-38%	-23%	<1%	<1%
1 A 2 b	Non-ferrous Metals	0.084	0.016	-81%	<1%	5%	2%
1 A 2 c	Chemicals	0.028	0.013	-55%	-15%	2%	1%
1 A 2 d	Pulp, Paper and Print	0.144	0.092	-36%	<1%	9%	9%
1 A 2 e	Food Processing, Beverages and Tobacco	0.002	0.001	-71%	-30%	<1%	<1%
1 A 2 f	Other	0.122	0.098	-19%	-5%	8%	9%
1 A 3	Transport	0.061	0.093	53%	-3%	4%	9%
1 A 3 a	Civil Aviation	<0.001	<0.001	175%	-8%	<1%	<1%
1 A 3 b	Road Transportation	0.060	0.093	54%	-3%	4%	9%
1 A 3 c	Railways	<0.001	<0.001	-84%	-9%	<1%	<1%
1 A 3 d	Navigation	<0.001	<0.001	26%	<1%	<1%	<1%
1 A 3 e	Pipeline compressors	NA	NA	NA	NA	NA	NA
1 A 4	Other Sectors	0.419	0.306	-27%	-2%	27%	29%
1 A 4 a	Commercial/Institutional	0.075	0.025	-66%	-22%	5%	2%
1 A 4 b	Residential	0.312	0.226	-28%	<1%	20%	21%
1 A 4 c	Agriculture/Forestry/Fisheries	0.032	0.054	67%	<1%	2%	5%
1 A 5	Other	<0.001	<0.001	30%	1%	<1%	<1%
1 B	FUGITIVE EMISSIONS FROM FUELS	NA	NA	NA	NA	NA	NA
2	INDUSTRIAL PROCESSES	0.457	0.173	-62%	-26%	29%	16%
2 A	MINERAL PRODUCTS	NA	NA	NA	NA	NA	NA
2 B	CHEMICAL INDUSTRY	0.001	0.001	-43%	-17%	<1%	<1%
2 C	METAL PRODUCTION	0.456	0.173	-62%	-26%	29%	16%
2 D	OTHER PRODUCTION	NA	NA	NA	NA	NA	NA
3	SOLVENT AND OTHER PRODUCT USE	<0.001	<0.001	--	--	<1%	<1%
4	AGRICULTURE	0.002	0.001	-25%	-4%	<1%	<1%
4 B	MANURE MANAGEMENT	NA	NA	NA	NA	NA	NA
4 D	AGRICULTURAL SOILS	NA	NA	NA	NA	NA	NA
4 F	FIELD BURNING OF AGRICULTURAL RES.	0.002	0.001	-25%	-4%	<1%	<1%
4 G	AGRICULTURE OTHER	NA	NA	NA	NA	NA	NA
6	WASTE	0.059	0.001	-98%	-4%	4%	<1%
6 A	SOLID WASTE DISPOSAL ON LAND	0.001	0.001	-56%	-7%	<1%	<1%
6 B	WASTEWATER HANDLING	NA	NA	NA	NA	NA	NA
6 C	WASTE INCINERATION	0.058	0.001	-99%	--	4%	<1%
6 D	OTHER WASTE	NA	NA	NA	NA	NA	NA
	Total without sinks	**1.578**	**1.055**	**-33%**	**-8%**		

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 2009 emissions were reduced by 76%; however the reduction of national total Hg emissions were reduced by 52% in the period 1990–2009 (see Table 32).

The overall reduction of about 76% for the period 1985 to 2009 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.

Hg Emission Trends in NFR Category 1 A Fuel Combustion Activities

Hg emissions mainly arise from NFR category 1 A by combustion processes with a share of 71% of the total emissions in 2009 (see Table 34). In 2009, Hg emissions amounted to 0.6 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. 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. The main sources for Hg emissions in NFR 1 A are:

	Contribution in Total Hg emission
● NFR 1 A 1 Energy Industries	18%
● NFR 1 A 2 Manufacturing Industries and Construction	32%
● NFR 1 A 3 Transport	<1%
● NFR 1 A 4 Other Sectors (Comercial, Institutional and Residential heating, etc.)	20%

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 27% of national total Hg emissions in 2009. As shown in Table 34, in the period from 1990 to 2009, the Hg emissions decreased by 54% to 0.24 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 is the main source and decreased by about 5 % due implemented extensive abatement measures which were compensated by increased activities.

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 3 Solvent Use and Other Product Use

No Hg emissions occur from NFR 3 Solvent Use and Other Product Use.

Hg Emission trend in NFR Category 4 Agriculture

Field Burning of Agricultural Waste (NFR 4 F) is the only emission source for Hg emissions of the Sector *Agriculture*. In 2009, emissions only contributed less than 1% (0.2 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*. The overall emission reduction of NFR 6 *Waste* was about 62%.

Table 34: Hg emissions per NFR Category 1990 and 2009, their trend 1990–2009 and their share in total emissions.

NFR Category		Hg Emission in [Mg]		Trend		Share in National Total	
		1990	2009	1990–2009	2008-2009	1990	2009
1	ENERGY	1.561	0.649	-58%	-5%	73%	71%
1 A	FUEL COMBUSTION ACTIVITIES	1.561	0.649	-58%	-5%	73%	71%
1 A 1	Energy Industries	0.334	0.167	-50%	-11%	16%	18%
1 A 1 a	Public Electricity and Heat Production	0.327	0.155	-53%	-14%	15%	17%
1 A 1 b	Petroleum refining	0.007	0.012	72%	42%	<1%	1%
1 A 1 c	Manufacture of Solid fuels & Other Energy Ind.	NA	NA	NA	NA	NA	NA
1 A 2	Manufacturing Industries and Construction	0.797	0.297	-63%	-3%	37%	32%
1 A 2 a	Iron and Steel	<0.001	<0.001	33%	27%	<1%	<1%
1 A 2 b	Non-ferrous Metals	0.007	0.008	12%	<1%	<1%	1%
1 A 2 c	Chemicals	0.012	0.008	-32%	-14%	1%	1%
1 A 2 d	Pulp, Paper and Print	0.066	0.069	4%	-1%	3%	8%
1 A 2 e	Food Processing, Beverages and Tobacco	0.001	<0.001	-54%	-14%	<1%	<1%
1 A 2 f	Other	0.711	0.212	-70%	-3%	33%	23%
1 A 3	Transport	0.002	0.002	2%	-4%	<1%	<1%
1 A 3 a	Civil Aviation	<0.001	<0.001	175%	-8%	<1%	<1%
1 A 3 b	Road Transportation	0.001	0.002	57%	-3%	<1%	<1%
1 A 3 c	Railways	0.001	<0.001	-91%	-13%	<1%	<1%
1 A 3 d	Navigation	<0.001	<0.001	26%	<1%	<1%	<1%
1 A 3 e	Pipeline compressors	NA	NA	NA	NA	NA	NA
1 A 4	Other Sectors	0.427	0.183	-57%	-1%	20%	20%
1 A 4 a	Commercial/Institutional	0.027	0.009	-66%	-17%	1%	1%
1 A 4 b	Residential	0.387	0.159	-59%	<1%	18%	17%
1 A 4 c	Agriculture/Forestry/Fisheries	0.014	0.015	12%	<1%	1%	2%
1 A 5	Other	<0.001	<0.001	30%	1%	<1%	<1%
1 B	FUGITIVE EMISSIONS FROM FUELS	NA	NA	NA	NA	NA	NA
2	INDUSTRIAL PROCESSES	0.528	0.244	-54%	-25%	25%	27%
2 A	MINERAL PRODUCTS	NA	NA	NA	NA	NA	NA
2 B	CHEMICAL INDUSTRY	0.270	<0.001	-100%	-17%	13%	<1%
2 C	METAL PRODUCTION	0.257	0.244	-5%	-25%	12%	27%
2 D	OTHER PRODUCTION	NA	NA	NA	NA	NA	NA
3	SOLVENT AND OTHER PRODUCT USE	NA	NA	NA	NA	NA	NA
4	AGRICULTURE	<0.001	<0.001	-27%	-5%	<1%	<1%
4 B	MANURE MANAGEMENT	NA	NA	NA	NA	NA	NA
4 D	AGRICULTURAL SOILS	NA	NA	NA	NA	NA	NA
4 F	FIELD BURNING OF AGRI. RESIDUES	0.001	<0.001	-27%	-5%	<1%	<1%
4 G	Agriculture OTHER	NA	NA	NA	NA	NA	NA
6	WASTE	0.054	0.021	-62%	<1%	3%	2%
6 A	SOLID WASTE DISPOSAL ON LAND	<0.001	<0.001	-56%	-7%	<1%	<1%
6 B	WASTEWATER HANDLING	NA	NA	NA	NA	NA	NA
6 C	WASTE INCINERATION	0.054	0.021	-62%	--	3%	2%
6 D	OTHER WASTE	NA	NA	NA	NA	NA	NA
	Total without sinks	**2.142**	**0.914**	**-57%**	**-11%**		

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 219 Mg in 1990; emissions have decreased steadily since 1990 and by the year 2009 emissions were reduced by 94% (13 Mg). The overall reduction trend was 96% for the period 1985-2009. As it is shown in Table 35 today's Pb emissions mainly arise from the NFR 1 A *FUEL COMBUSTION ACTIVITIES* with a share of about 59% of the Austrian Pb emissions. In 1985 the main emission source for Pb emissions with a share of about 90% was the sub-sector NFR 1A 3 b *road transport*. From 1990 to 1995 Pb emissions from this sub-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.

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 2009, Pb emissions decreased by 96% to 7.5 Mg, which is a share of 59% in national total Pb emission in 2009 (see Table 35). The main sources for Pb emissions in NFR 1 A are:

	Contribution in Total Pb emission
• NFR 1 A 1 Energy Industries	15%
• NFR 1 A 2 Manufacturing Industries and Construction	26%
• NFR 1 A 3 Transport	<1%
• NFR 1 A 4 Other Sectors (Comercial, Institutional and Residential heating, etc.)	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 Pb-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 35 in the period from 1990 to 2009, the Pb emissions decreased by 84% to 5 Mg, which is a share of 41% 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 3 Solvent Use and Other Product Use

NFR Cateogy 3 is a minor source of Pb emission. The share of this category in national total Pb emission is less than 0.1% (0.02 Mg).

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 2009, 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 about 0.1% (0.01 Mg) in national total Pb emissions.

Table 35: Pb emissions per NFR Category 1990 and 2009, their trend 1990–2009 and their share in total emissions.

NFR Category		Pb Emission in [Mg]		Trend		Share in National Total	
		1990	**2009**	**1990–2009**	**2008-2009**	**1990**	**2009**
1	ENERGY	185.256	7.486	-96%	-3%	85%	59%
1 A	FUEL COMBUSTION ACTIVITIES	185.256	7.486	-96%	-3%	85%	59%
1 A 1	Energy Industries	1.082	1.874	73%	1%	<1%	15%
1 A 1 a	Public Electricity and Heat Production	0.905	1.561	73%	-5%	<1%	12%
1 A 1 b	Petroleum refining	0.177	0.313	77%	43%	<1%	2%
1 A 1 c	Manufacture of Solid fuels & Other Energy Ind.	NA	NA	NA	NA	NA	NA
1 A 2	Manufacturing Industries and Construction	9.570	3.326	-65%	-5%	4%	26%
1 A 2 a	Iron and Steel	0.265	0.131	-51%	-37%	<1%	1%
1 A 2 b	Non-ferrous Metals	4.082	1.053	-74%	<1%	2%	8%
1 A 2 c	Chemicals	0.206	0.293	42%	-15%	<1%	2%
1 A 2 d	Pulp, Paper and Print	0.618	0.787	27%	<1%	<1%	6%
1 A 2 e	Food Processing, Beverages and Tobacco	0.005	0.004	-24%	-29%	<1%	<1%
1 A 2 f	Other	4.393	1.058	-76%	-3%	2%	8%
1 A 3	Transport	167.023	0.012	-100%	-2%	76%	<1%
1 A 3 a	Civil Aviation	1.726	0.000	-100%	-6%	1%	<1%
1 A 3 b	Road Transportation	165.011	0.012	-100%	-2%	76%	<1%
1 A 3 c	Railways	0.006	0.000	-92%	-14%	<1%	<1%
1 A 3 d	Navigation	0.280	0.000	-100%	-1%	<1%	<1%
1 A 3 e	Pipeline compressors	NA	NA	NA	NA	NA	NA
1 A 4	Other Sectors	7.581	2.274	-70%	-2%	3%	18%
1 A 4 a	Commercial/Institutional	0.454	0.181	-60%	-21%	<1%	1%
1 A 4 b	Residential	6.070	1.912	-69%	<1%	3%	15%
1 A 4 c	Agriculture/Forestry/Fisheries	1.058	0.182	-83%	<1%	<1%	1%
1 A 5	Other	0.000	0.000	30%	1%	<1%	<1%
1 B	FUGITIVE EMISSIONS FROM FUELS	NA	NA	NA	NA	NA	NA
2	INDUSTRIAL PROCESSES	32.093	5.157	-84%	-26%	15%	41%
2 A	MINERAL PRODUCTS	NA	NA	NA	NA	NA	NA
2 B	CHEMICAL INDUSTRY	0.001	0.001	-43%	-17%	<1%	<1%
2 C	METAL PRODUCTION	32.092	5.157	-84%	-26%	15%	41%
2 D	OTHER PRODUCTION	NA	NA	NA	NA	NA	NA
3	SOLVENT AND OTHER PRODUCT USE	0.020	0.020	--	--	<1%	<1%
4	AGRICULTURE	0.011	0.009	-24%	-4%	<1%	<1%
4 B	MANURE MANAGEMENT	NA	NA	NA	NA	NA	NA
4 D	AGRICULTURAL SOILS	NA	NA	NA	NA	NA	NA
4 F	FIELD BURNING OF AGRI. RESIDUES	0.011	0.009	-24%	-4%	<1%	<1%
4 G	Agriculture OTHER	NA	NA	NA	NA	NA	NA
6	WASTE	1.016	0.009	-99%	-1%	<1%	<1%
6 A	SOLID WASTE DISPOSAL ON LAND	0.001	0.001	-56%	-7%	<1%	<1%
6 B	WASTEWATER HANDLING	NA	NA	NA	NA	NA	NA
6 C	WASTE INCINERATION	1.014	0.008	-99%	--	<1%	<1%
6 D	OTHER WASTE	NA	NA	NA	NA	NA	NA
	Total without sinks	**218.396**	**12.681**	**-94%**	**-14%**		

2.5 Emission Trends for POPs

Emissions of Persistent Organic Pollutants (POPs) decreased remarkably from 1985 to 2009. As can be seen in Table 27, 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 (PCDD/F) stopped in 1993 and emissions of HCB stopped in 2001.

Table 36: Emissions and emission trends for POPs 1985–2009.

Year	**Emission**		
	PAH [Mg]	**PCDD/F [g]**	**HCB [kg]**
1985	27.055	187.127	106.315
1986	26.326	186.036	103.764
1987	26.246	188.038	106.575
1988	24.683	173.361	98.073
1989	24.293	164.425	94.840
1990	17.364	160.649	91.937
1991	17.946	135.342	84.616
1992	13.388	76.776	69.684
1993	10.162	66.976	64.001
1994	9.316	56.206	51.931
1995	9.652	58.429	53.081
1996	10.746	59.744	55.787
1997	9.317	59.372	51.917
1998	8.972	56.259	49.159
1999	8.807	53.614	47.564
2000	8.218	52.035	44.248
2001	8.685	53.279	46.056
2002	8.313	40.481	42.506
2003	8.420	40.396	41.727
2004	8.454	40.437	40.983
2005	8.996	43.303	45.583
2006	8.029	39.864	41.812
2007	7.878	38.532	40.662
2008	7.845	38.535	40.889
2009	7.501	35.995	38.258
Trend 1985–2009	**-72%**	**-80%**	**-64%**
Trend 1990–2009	**-57%**	**-78%**	**-58%**

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 of 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 2009 emissions were reduced by about 72% (to 7.5 Mg in 2009) in the period 1985 to 2009. The overall emission trend was about -57% for the period 1990 – 2009.

In 1985 the main emission sources for PAH emissions were the NFR 1 A *Fuel Combustion Activities* (44%), Industrial processes (29%) and Agriculture (26%). In 1990 the main source regarding PAH emissions is NFR 1 A *Fuel Combustion Activities* with a share in the national total of 55%, Industrial processes (43%), Agriculture (1%) and Waste (1%). From 1990 to 2009 PAH emissions from Agriculture decreased remarkably by 27% due to prohibition of open field burning, PAH emissions from the sector Industrial processes decreased by 98% due to the shut down of primary aluminium production in Austria, which was a main source for PAH emissions.

PAH Emission Trends in NFR Category 1 A Fuel Combustion Activities

The NFR 1 A *Fuel Combustion Activities* 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 37 in the period from 1990 to 2009 PAH emissions decreased by only about 25% to 7.1 Mg, which is a share of 95% in national total PAH emission in 2009.

In 2009 within the NFR category *1 A 4 Other Sectors* has the highest contribution (71%) 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 21% 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 37 in the period 1990 to 2009 the PAH emissions decreased by 98% to 0.18 Mg, which is a share of about 2% to the total PAH emissions. 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 3 Solvent Use and Other Product Use

No PAH emissions occur from NFR 3 Solvent Use and Other Product Use.

PAH Emission trend in NFR Category 4 Agriculture

As shown in Table 37 in 2009 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 27% 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% (<0.01 Mg) in total PAH emissions.

Table 37: PAH emissions per NFR Category 1990 and 2009, their trend 1990–2009 and their share in total emissions.

NFR Category		PAH Emission in [Mg]		Trend		Share in National Total	
		1990	2009	1990–2009	2008-2009	1990	2009
1	ENERGY	9.53	7.14	-25%	-4%	55%	95%
1 A	FUEL COMBUSTION ACTIVITIES	9.53	7.14	-25%	-4%	55%	95%
1 A 1	Energy Industries	0.01	0.02	255%	8%	<1%	<1%
1 A 2	Manufacturing Industries and Construction	0.06	0.22	240%	-4%	<1%	3%
1 A 2 a	Iron and Steel	<0.01	<0.01	73%	33%	<1%	<1%
1 A 2 b	Non-ferrous Metals	<0.01	<0.01	-23%	7%	<1%	<1%
1 A 2 c	Chemicals	0.02	0.02	8%	-15%	<1%	<1%
1 A 2 d	Pulp, Paper and Print	<0.01	<0.01	33%	-1%	<1%	<1%
1 A 2 e	Food Processing, Beverages and Tobacco	<0.01	<0.01	-32%	-18%	<1%	<1%
1 A 2 f	Other	0.04	0.19	368%	-2%	<1%	3%
1 A 3	Transport	0.93	1.60	72%	-2%	5%	21%
1 A 3 a	Civil Aviation	NE	NE	NE	NE	NE	NE
1 A 3 b	Road Transportation	0.90	1.57	74%	-2%	5%	21%
1 A 3 c	Railways	0.02	0.01	-31%	-2%	<1%	<1%
1 A 3 d	Navigation	<0.01	0.01	154%	13%	<1%	<1%
1 A 3 e	Pipeline compressors	NA	NA	NA	NA	NA	NA
1 A 4	Other Sectors	8.53	5.30	-38%	-5%	49%	71%
1 A 4 a	Commercial/Institutional	0.16	0.09	-46%	-23%	1%	1%
1 A 4 b	Residential	7.95	4.63	-42%	-4%	46%	62%
1 A 4 c	Agriculture/Forestry/Fisheries	0.42	0.58	39%	-3%	2%	8%
1 A 5	Other	<0.01	<0.01	-4%	<1%	<1%	<1%
1 B	FUGITIVE EMISSIONS FROM FUELS	NA	NA	NA	NA	NA	NA
1 B 1	Solid fuels	NA	NA	NA	NA	NA	NA
1 B 2	Oil and natural gas	IE	IE	IE	IE	IE	IE
2	INDUSTRIAL PROCESSES	7.44	0.18	-98%	-21%	43%	2%
2 A	MINERAL PRODUCTS	NA	NA	NA	NA	NA	NA
2 B	CHEMICAL INDUSTRY	0.45	NA	NA	NA	3%	NA
2 C	METAL PRODUCTION	6.44	0.14	-98%	-25%	37%	2%
2 C 1	Iron and Steel Production	0.35	0.14	-59%	-25%	2%	2%
2 C 2	Ferroalloys Production	NE	NE	NE	NE	NE	NE
2 C 3	Aluminium production	6.09	NO	NO	NO	35%	NO
2 C 5	Other metal production	IE	IE	IE	IE	IE	IE
2 D	OTHER PRODUCTION	0.55	0.04	-93%	--	3%	<1%
3	SOLVENT AND OTHER PRODUCT USE	0.15	NE	NE	NE	1%	NE
4	AGRICULTURE	0.25	0.18	-27%	1%	1%	2%
4 B	MANURE MANAGEMENT	NA	NA	NA	NA	NA	NA
4 D	AGRICULTURAL SOILS	NA	NA	NA	NA	NA	NA
4 F	FIELD BURNING OF AGRICULTURAL RESIDUES	0.25	0.18	-27%	1%	1%	2%
4 G	Agriculture OTHER	NA	NA	NA	NA	NA	NA
6	WASTE	<0.01	<0.01	-89%	--	<1%	<1%
	Total without sinks	**17.36**	**7.50**	**-57%**	**-4%**		

2.5.2 Dioxins and Furan (PCDD/F)

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 (PCDD/F) emissions and emission trends in Austria

In 1985 national total dioxin/furan (PCDD/F) emissions amounted to about 187 g and amounted to about 161 g in 1990; emissions have decreased steadily and by the year 2009 emissions were reduced by about 80% (to 36 g in 2009). The overall emission trend in the period 1990 to 2009 was -78%.

In 1985 the main sources for dioxin/furan (PCDD/F) emissions were NFR 1 A *Fuel Combustion Activities* (59%) and *Industrial Processes* (especially iron and steel production) (27%). In 1990 the main sources for dioxin/furan (PCDD/F) emissions were NFR 1 A *Fuel Combustion Activities* (64%) and *Industrial Processes* (especially iron and steel production) (24%). In 2009 the main sector regarding dioxin/furan (PCDD/F) emissions is NFR 1 A *Fuel Combustion Activities* with a share in National Total of 92%.

From 1985 to 2009 dioxin/furan (PCDD/F) emissions from the sectors *Waste* and *Solvents and Other Product Use* decreased by almost 100% due to stringent legislation and modern technology. The dioxin/furan (PCDD/F) 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.

Dioxin/Furan (PCDD/F) Emission Trends in NFR Category 1 A Fuel Combustion Activities

The NFR 1 A *Fuel Combustion Activities* 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 38 in the period from 1990 to 2009 dioxin/furan (PCDD/F) emissions decreased by about 68% to 33 g, which is a share of 92% in national total dioxin/furan (PCDD/F) emissions in 2009.

Within this source NFR *1 A 4 Other Sectors* has the highest contribution (70%) to dioxin/furan (PCDD/F) emissions due to biomass heatings. Emissions of NFR *1 A 2 Manufacturing Industries and Constrution* amount to 17% of national dioxin/furan (PCDD/F) emissions.

Dioxin/Furan (PCDD/F) Emission Trends in NFR Category 2 Industrial Processes

The dioxin/furan (PCDD/F) emissions are rated as key sources in NFR Category *2 Industrial Processes*. As shown in Table 38 in the period 1990 to 2009 the dioxin/furan (PCDD/F) emissions decreased by 93% to 2.7 g, which is a share of 8% to the total PCDD/F emissions. The main source for POP emissions of NFR Category 2 *Industrial Processes* was the sub sectors NFR *2 C Metal Production.* Dioxin/furan (PCDD/F) emissions decreased significantly due to extensive abatement measures.

Small source for persistent organic pollutant dioxin/furan (PCDD/F) 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 (PCDD/F) Emission Trend in NFR Category 3 Solvent Use and Other Product Use

No Dioxin/Furan (PCDD/F) emissions occur from NFR 3 Solvent Use and Other Product Use in 2009.

Dioxin/Furan (PCDD/F) Emission trend in NFR Category 4 Agriculture

As shown in Table 38 in the period from 1990 to 2009 dioxin/furan (PCDD/F) emissions decreased by 26% to 0.14 g, which is a share of less than 1% in total PCDD/F 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 (PCDD/F) Emission trend in NFR Category 6 Waste

Emissions of dioxin/furan (PCDD/F) from Sector NFR *6 Waste* are not rated as key sources of the Austrian Inventory. As shown in Table 38 in the period from 1990 to 2009 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 (PCDD/F) 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.

Table 38: Dioxin/Furan (PCDD/F) emissions per NFR Category 1990 and 2009, their trend 1990–2009 and their share in total emissions.

NFR Category		Dioxin Emission in [g]		Trend		Share in National Total	
		1990	2009	1990–2009	2008-2009	1990	2009
1	ENERGY	102.21	32.96	-68%	-5%	64%	92%
1 A	FUEL COMBUSTION ACTIVITIES	102.21	32.96	-68%	-5%	64%	92%
1 A 1	Energy Industries	0.82	0.95	16%	2%	1%	3%
1 A 2	Manufacturing Industries and Construction	52.02	5.97	-89%	-4%	32%	17%
1 A 2 a	Iron and Steel	0.03	0.03	-24%	-19%	<1%	<1%
1 A 2 b	Non-ferrous Metals	50.34	2.22	-96%	<1%	31%	6%
1 A 2 c	Chemicals	0.44	0.48	10%	-15%	<1%	1%
1 A 2 d	Pulp, Paper and Print	0.49	0.65	33%	-1%	<1%	2%
1 A 2 e	Food Processing, Beverages and Tobacco	0.03	0.03	-3%	-16%	<1%	<1%
1 A 2 f	Other	0.69	2.57	270%	-5%	<1%	7%
1 A 3	Transport	3.91	0.98	-75%	-6%	2%	3%
1 A 3 a	Civil Aviation	NE	NE	NE	NE	NE	NE
1 A 3 b	Road Transportation	3.86	0.95	-75%	-6%	2%	3%
1 A 3 c	Railways	0.04	0.01	-65%	-4%	<1%	<1%
1 A 3 d	Navigation	0.01	0.01	55%	8%	<1%	<1%
1 A 3 e	Pipeline compressors	<0.01	<0.01	90%	-26%	<1%	<1%
1 A 4	Other Sectors	45.46	25.06	-45%	-5%	28%	70%
1 A 4 a	Commercial/Institutional	1.92	1.35	-30%	-24%	1%	4%
1 A 4 b	Residential	41.79	21.33	-49%	-4%	26%	59%
1 A 4 c	Agriculture/Forestry/Fisheries	1.76	2.38	35%	-3%	1%	7%
1 A 5	Other	<0.01	<0.01	-4%	<1%	<1%	<1%
1 B	FUGITIVE EMISSIONS FROM FUELS	NA	NA	NA	NA	NA	NA
2	INDUSTRIAL PROCESSES	39.00	2.73	-93%	-23%	24%	8%
2 A	MINERAL PRODUCTS	NA	NA	NA	NA	NA	NA
2 B	CHEMICAL INDUSTRY	NA	NA	NA	NA	NA	NA
2 C	METAL PRODUCTION	37.21	2.60	-93%	-24%	23%	7%
2 C 1	Iron and Steel Production	37.21	2.60	-93%	-24%	23%	7%
2 C 2	Ferroalloys Production	NE	NE	NE	NE	NE	NE
2 C 3	Aluminium production	<0.01	NO	NO	NO	<1%	NO
2 C 5	Other metal production	IE	IE	IE	IE	IE	IE
2 D	OTHER PRODUCTION	1.79	0.13	-93%	--	1%	<1%
3	SOLVENT AND OTHER PRODUCT USE	1.06	NE	NE	NE	1%	NE
4	AGRICULTURE	0.18	0.14	-26%	1%	<1%	<1%
4 B	MANURE MANAGEMENT	NA	NA	NA	NA	NA	NA
4 D	AGRICULTURAL SOILS	NA	NA	NA	NA	NA	NA
4 F	FIELD BURNING OF AGRICULTURAL RESIDUES	0.18	0.14	-26%	1%	<1%	<1%
4 G	Agriculture OTHER	NA	NA	NA	NA	NA	NA
6	WASTE	18.19	0.17	-99%	--	11%	<1%
	Total without sinks	**160.65**	**35.99**	**-78%**	**-7%**		

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 (PCDD/F) 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 kg and amounted to about 92 kg in 1990; emissions have decreased steadily and by the year 2009 emissions were reduced by about 59% (to 38 kg in 2009) in the period from 1985 to 2009. National total emissions decreased by 58% in the period from 1990 to 2009.

In 1985 the two main sources for HCB emissions were the NFR 1 A *Fuel Combustion Activities* (78%) and *Industrial processes* (12%) in National Total HCB emission. In 1990 the two main sources for HCB emissions were the NFR 1 A *Fuel Combustion Activities* (79%) and *Industrial processes* (11%) in National Total HCB emission. In 2009 the main sources of HCB emissions was NFR 1 A *Fuel Combustion Activities* (92%) in National Total HCB emission.

From 1985 to 2009 HCB emissions from the sectors NFR 6 *Waste* as well as NFR 3 *Solvents and Other Products Use* decreased remarkably by 91% and 100%, respectively, more due to stringent legislation and modern technology. HCB emissions of the sectors *Industrial processes* and *Combustion Activities* decreased by 70% and 52%, respectively, due to improved dust abatement technologies.

HCB Emission Trends in NFR Category 1 A Fuel Combustion Activities

The NFR Category 1 A Fuel Combustion Activities is an important source for HCB emissions in Austria. As shown in Table 39 in the period from 1990 to 2009 HCB emissions decreased by about 52% to 35 kg, which is a share of 92% in national total HCB emissions in 2009.

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 39 in the period 1990 to 2009 the HCB emissions decreased by 69% to 2.96 kg, which is a share of 8% 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 3 Solvent Use and Other Product Use

No HCB emissions occur from NFR 3 Solvent Use and Other Product Use in 2009.

HCB Emission Trend in NFR Category 4 Agriculture

As shown in Table 39 in the period from 1990 to 2009 HCB emissions decreased by 26% 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 39 in the period from 1990 to 2009 HCB emissions decreased by about 91% to 0.03 kg, which is a share of about <1% in total HCB emissions.

Table 39: Hexachlorbenzene (HCB) emissions per NFR Category 1990 and 2009, their trend 1990–2009 and their share in total emissions.

NFR Category		HCB Emission in [kg]		Trend		Share in National Total	
		1990	2009	1990–2009	2008-2009	1990	2009
1	ENERGY	72.74	35.23	-52%	-4%	79%	92%
1 A	FUEL COMBUSTION ACTIVITIES	72.74	35.23	-52%	-4%	79%	92%
1 A 1	Energy Industries	0.21	0.38	84%	6%	<1%	1%
1 A 2	Manufacturing Industries and Construction	17.44	1.62	-91%	-2%	19%	4%
1 A 2 a	Iron and Steel	0.01	<0.01	-33%	-25%	<1%	<1%
1 A 2 b	Non-ferrous Metals	17.15	1.00	-94%	<1%	19%	3%
1 A 2 c	Chemicals	0.07	0.07	11%	-15%	<1%	<1%
1 A 2 d	Pulp, Paper and Print	0.10	0.13	33%	-1%	<1%	<1%
1 A 2 e	Food Processing, Beverages and Tobacco	<0.01	<0.01	-2%	-19%	<1%	<1%
1 A 2 f	Other	0.12	0.41	249%	-5%	<1%	1%
1 A 3	Transport	0.78	0.20	-75%	-6%	1%	1%
1 A 3 a	Civil Aviation	NE	NE	NE	NE	NE	NE
1 A 3 b	Road Transportation	0.77	0.19	-75%	-6%	1%	<1%
1 A 3 c	Railways	0.01	<0.01	-65%	-4%	<1%	<1%
1 A 3 d	Navigation	<0.01	<0.01	55%	8%	<1%	<1%
1 A 3 e	Pipeline compressors	<0.01	<0.01	90%	-26%	<1%	<1%
1 A 4	Other Sectors	54.31	33.04	-39%	-5%	59%	86%
1 A 4 a	Commercial/Institutional	1.45	0.83	-43%	-22%	2%	2%
1 A 4 b	Residential	50.30	28.44	-43%	-4%	55%	74%
1 A 4 c	Agriculture/Forestry/Fisheries	2.56	3.77	47%	-2%	3%	10%
1 A 5	Other	<0.01	<0.01	-4%	<1%	<1%	<1%
1 B	FUGITIVE EMISSIONS FROM FUELS	NA	NA	NA	NA	NA	NA
2	INDUSTRIAL PROCESSES	9.71	2.96	-69%	-25%	11%	8%
2 A	MINERAL PRODUCTS	NA	NA	NA	NA	NA	NA
2 B	CHEMICAL INDUSTRY	1.26	NA	NA	NA	1%	NA
2 C	METAL PRODUCTION	8.09	2.94	-64%	-25%	9%	8%
2 C 1	Iron and Steel Production	8.09	2.94	-64%	-25%	9%	8%
2 C 2	Ferroalloys Production	NE	NE	NE	NE	NE	NE
2 C 3	Aluminium production	--	NO	NO	NO	--	NO
2 C 5	Other metal production	IE	IE	IE	IE	IE	IE
2 D	OTHER PRODUCTION	0.36	0.03	-93%	--	<1%	<1%
3	SOLVENT AND OTHER PRODUCT USE	9.05	NE	NE	NE	10%	NE
4	AGRICULTURE	0.04	0.03	-26%	1%	<1%	<1%
4 B	MANURE MANAGEMENT	NA	NA	NA	NA	NA	NA
4 D	AGRICULTURAL SOILS	NA	NA	NA	NA	NA	NA
4 F	FIELD BURNING OF AGRICULTURAL RESIDUES	0.04	0.03	-26%	1%	<1%	<1%
4 G	Agriculture OTHER	NA	NA	NA	NA	NA	NA
6	WASTE	0.39	0.03	-91%	--	<1%	<1%
	Total without sinks	**91.94**	**38.26**	**-58%**	**-6%**		

3 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.

3.1 NFR 1 A Stationary Fuel Combustion Activities

No changes regarding methodology and emission factor were made since submission 2009.

3.1.1 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 2010 (UMWELTBUNDESAMT 2010) which is part of the submission under the UNFCCC.

- Additionally to information provided in this document, Annex 2 of (UMWELTBUNDESAMT 2010) 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 2010).

Completeness

Table 40 provides information on the status of emission estimates of all sub categories. A "✓" indicates that emissions from this sub category have been estimated.

Table 40: 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 (PCDD/F) 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 41 shows the correspondence of NFR and SNAP categories.

Table 41: 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

3.1.2 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 42: 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 2010). 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.

3.1.3 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 43 gives an overview of methodologies and data sources of sub category *1 A 1 Energy Industries*.

Table 43: 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). 2005–2008: 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 2005–2008: 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) 2005–2008: ETS data	Reported by plant operator: SO_2, NO_x, CO, NMVOC (yearly)	NH_3: national study
1 A 1 c	Energy balance 2005–2008: ETS data		All pollutants: national studies

For 2005–2008 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 to 2006. Since 2007 the reporting has been changed to an online system. To reach consistency with the GHG inventory all ETS plants and additionally 4 waste incineration plants are considered as large point sources. 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 2009). 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 44 shows measured and calculated emission data of category 1 A 1 a for the year 2008.

Table 44: NFR 1 A 1 a measured and calculated emission data for the year 2008.

	Fuel consumption [TJ]	NO_x [Gg]	CO [Gg]	SO_2 [Gg]	TSP [Gg]
≥ 50 MW_{th} Measured	134 775	5.51	0.61	1.49	0.26
< 50 MW_{th} Calculated	58 658	5.30	3.03	0.82	0.78
Total 1 A 1 a	**193 433**	**10.81**	**3.64**	**2.31**	**1.04**

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 ≥ 50 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 45 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 45: 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 46 shows main pollutant emission factors used for calculation of emissions from boilers < 50 MW_{th} for the year 2008. Inceasing biomass consumption of smaller plants is a main source of NO_x emissions from this category in 2008.

Table 46: NFR 1 A 1 a < 50 MW_{th} main pollutant emission factors and fuel consumption for the year 2008.

Fuel	Activity [TJ]	NO_x [kg/TJ]	CO [kg/TJ]	NMVOC [kg/TJ]	SO_2 [kg/TJ]	NH_3 [kg/TJ]
Light Fuel Oil	66	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	2 094	317.4	3/15[(1)]	8.0	398	2.7
Gasoil	115	65	10	4.8	45	2.7
Diesel oil	6	700	15	0.8	18.8	2.7
Liquified Petroleum Gas	5	150	5	0.5	6	1
Natural Gas/power and CHP	7 624	30	4	0.5	NA	1
Natural Gas/district heating	1 948	41	5	0.5	NA	1
Solid Biomass	35 777	94	72	5.0	11	5
Biogas, Sewage Sludge Gas, Landfill Gas	9 590	150	4	0.5	NA	1
Municipal Solid $Waste_{wet}$	1 785	30	200	38.0	130	0.02
Industrial Waste	1	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 47. The split follows closely (STANZEL et al. 1995).

Table 47: 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). Since 2007 the plant is equipped with a SNO_X facility which reduces SO_2 by about 65% and NO_X emissions by about 55%.

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 48 summarizes the selected emission factors for main pollutants and activity data for the year 2008. It is assumed that emissions are uncontrolled.

Table 48: NFR 1 A 1 c main pollutant emission factors and fuel consumption for the year 2008.

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)	9 526	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 49). It is assumed that imported oil products have a similar metal content.

Table 49: 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 50: Cd emission factors for Sector 1 A 1 Energy Industries.

Cadmium EF [mg/GJ]	1985	1990	1995	2008
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 51: Cd emission factors for waste for Sector 1 A 1 Energy Industries.

Cadmium EF [mg/t Waste]	1985	1990	1995	2008
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 52: Hg emission factors for Sector 1 A 1 Energy Industries.

Mercury EF [mg/GJ]	1985	1990	1995	2008
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 53: Hg emission factors for waste for Sector 1 A 1 Energy Industries.

Mercury EF [mg/t Waste]	1985	1990	1995	2008
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 54: Pb emission factors for Sector 1 A 1 Energy Industries.

Lead EF [mg/GJ]	1985	1990	1995	2008
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 55: Pb emission factors for waste for Sector 1 A 1 Energy Industries.

Lead EF [mg/t Waste]	1985	1990	1995	2008
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 (PCDD/F) 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 (PCDD/F) 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 56: POP emission factors for Sector 1 A 1 Energy Industries.

EF	PCDD/F [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 57: POP emission factors for Sector 1 A 1 Energy Industries.

EF	PCDD/F [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 58.

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

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

Table 58: PM implied emission factors (IEF) for LPS in NFR 1 A1 Energy Industries.

	TSP IEF [g/GJ]				%PM10	%PM2.5
	1990	1995	2000	2008	[%]	[%]
Public Power (0101)[(1)]	5.51	3.34	2.73	1.76	95	80
District Heating (0102) [(1)]	3.89	1.41	0.75	3.74	95	80
Petroleum Refining (010301)[(2)]	3,9	2,4	3.2	2.4	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. [104]

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 59: 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

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

3.1.4 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)[105]
  - other-stationary in industry (NFR 1 A 2 f 2).

General Methodology

Table 60 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 2008 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 60: 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 2005–2008: ETS data.		All pollutants: National studies
1 A 2 b	Non Ferrous Metals	Energy balance 2005–2008: ETS data.		All pollutants: National studies
1 A 2 c	Chemicals	Energy balance 2005–2008: ETS data.		All pollutants: National studies
1 A 2 d	Pulp, Paper and Print	Energy balance 2005–2008: 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 2005–2008: ETS data.		All pollutants: National studies
1 A 2 f	Cement Clinker Production	National Studies 2005–2008: 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 2005–2008: 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 2005–2008: ETS data.		All pollutants: National studies
1 A 2 f	Bricks and Tiles Production	Association of Bricks and Tiles Industry 2005–2008: ETS data.		All pollutants: National studies
1 A 2 f	Other	Energy balance 2005–2008: ETS data.		All pollutants: National studies

[105] 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 61: 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 62 summarizes the selected emission factors for the main pollutants and activity data for the year 2008. It is assumed that emissions are uncontrolled.

Table 62: NFR 1 A 2 a main pollutant emission factors and fuel consumption for the year 2008.

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)]	39	250.0	150.0	15.0	600.0	0.01
Coke oven coke	(BMWA 1990) [(1)]	87	220.0	150.0	8.0	500.0	0.01
Residual fuel oil < 1% S	(BMWA 1996) [(1)]	0	118.0	10.0	0.8	92.0	2.70
Residual fuel oil ≥ 1% S	(BMWA 1996) [(1)]	1 169	235.0	15.0	8.0	398.0	2.70
Heating oil	(BMWA 1996) [(2)]	0	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)]	5 389	41.0	5.0	0.5	NA	1.00
LPG	(BMWA 1996) [(4)]	13	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 63 shows fuel consumption and main pollutant emission factors of category *1 A 2 b* for the year 2008.

Table 63: NFR 1 A 2 b main pollutant emission factors and fuel consumption for the year 2008.

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)]	138	220.0	150.0	8.0	500.0	0.01
Residual fuel oil < 1% S	(BMWA 1996) [(1)]	137	118.0	10.0	0.8	92.0	2.70
Residual fuel oil ≥ 1% S	(BMWA 1996) [(1)]	73	235.0	15.0	8.0	398.0	2.70
Heating oil	(BMWA 1996) [(2)]	22	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)]	4 730	41.0	5.0	0.5	NA	1.00
LPG	(BMWA 1996) [(4)]	87	41.0	5.0	0.5	6.0[(5)]	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) *From (LEUTGÖB et al. 2003)*

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 64 sumarizes activity data and emission factors for 2008. Underlined values indicate non default emission factors.

Table 64: NFR 1 A 2 c main pollutant emission factors and fuel consumption for the year 2008.

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)	753	80.3(5)	150.0	15.0	60.0(9)	0.01
Coke oven coke	(BMWA 1990) (1)	0	220.0	150.0	8.0	500.0	0.01
Residual fuel oil < 1% S	(BMWA 1996) (1)	386	118.0	10.0	0.8	92.0	2.70
Residual fuel oil ≥ 1% S	(BMWA 1996) (1)	87	235.0	15.0	8.0	398.0	2.70
Heating oil	(BMWA 1996) (2)	62	65.0	15.0	4.8	45.0	2.70
Natural Gas	(BMWA 1996) (1)	18 588	41.0	5.0	0.5	NA	1.00
LPG	(BMWA 1996) (3)	36	41.0	5.0	0.5	6.0(4)	1.00
Industrial waste	(BMWA 1990) (1)	2 495	47.0(6)	200.0	38.00	65.00(6)	0.02
Solid biomass	(BMWA 1996) (1)	1 940	100.0(7)	72.00	5.0	30.0	5.00
Biogas	(BMWA 1990) (8)	280	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 2008 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 2002–2009). TSP emissions are taken from (UMWELTBUNDESAMT 2005). Other main pollutant emission factors used for emission calculation are industrial boilers default values.

Table 65 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 65: NFR 1 A 2 d main pollutant emission factors and fuel consumption for the year 2008.

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)	3 678	120.0(9)	150.0	15.0	112.0	0.01
Brown coal	(BMWA 1990) (1)	NO	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)	130	118.0	10.0	0.8	16.1	2.70
Residual fuel oil ≥ 1% S	(BMWA 1996) (1)	897	235.0	15.0	8.0	69.7	2.70
Heating oil	(BMWA 1996) (2)	41	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)	22	41.0	5.0	0.5	6.0(4)	1.00
Natural Gas	(BMWA 1996) (1)	30 980	41.0	5.0	0.5	NA	1.00
Industrial waste	(BMWA 1990) (1)	130	100.0	200.0	38.00	22.8	0.02
Black liquor	(BMWA 1990) (1)	27 807	77.0(7)	20.0	4.0	22.8	0.02
Fuel wood	(BMWA 1996) (8)	14	110.0	370.0	5.00	10.5	5.00
Solid biomass	(BMWA 1996) (1)	6 558	120.0(9)	72.00	5.0	10.5	5.00
Biogas	(BMWA 1990) (5)	212	150.0	5.0	0.5	NA	1.00
Sewage sludge gas	(BMWA 1990) (5)	61	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 66 sumarizes activity data and emission factors for 2008.

Table 66: NFR 1 A 2 e main pollutant emission factors and fuel consumption for the year 2008.

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)	17	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)	101	220.0	150.0	8.0	500.0	0.01
Residual fuel oil < 1% S	(BMWA 1996) (1)	879	118.0	10.0	0.8	92.0	2.70
Residual fuel oil ≥ 1% S	(BMWA 1996) (1)	467	235.0	15.0	8.0	398.0	2.70
Heating oil	(BMWA 1996) (2)	897	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)	152	41.0	5.0	0.5	6.0(4)	1.00
Natural Gas	(BMWA 1996) (1)	12 414	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)	42	110.0	370.0	5.00	11.0	5.00
Solid biomass	(BMWA 1996) (1)	195	134.0	72.00	5.0	60.0	5.00
Biogas	(BMWA 1990) (5)	218	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 67 presents the parameters used for 2008 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 67: Industry offroad machinery parameters for the year 2008.

Machinery	Stock	Avg. operating hours/year
Large construction equipment	14 511	1 259
Small construction equipment	91 213	550
Large industry equipment	1 130	421
Small industry equipment	1 650	501
Total	**108 504**	

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 68 shows total fuel consumption and emissions of main pollutants for sub categories of *1 A 2 f* for the year 2008.

Table 68: NFR 1 A 2 f ii Other Manufacturing Industries. Fuel consumption and emissions of main pollutants by sub category for the year 2008.

Category	Fuel Consumption [TJ]	NO_x [Gg]	CO [Gg]	NMVOC [Gg]	SO_2 [Gg]	NH_3 [Gg]
SNAP 0301 Other boilers	54 185	4.71	2.74	0.27	2.59	0.13
SNAP 030311 Cement Clinker Production	14 852	4.00	13.36	0.29	0.23	0.18
SNAP 030312 Lime Production	3 059	0.86	0.09	0.00	0.15	0.00
SNAP 030317 Glass Production	3 082	0.91	0.02	0.00	0.12	0.00
SNAP 030319 Bricks and Tiles Production	3 874	0.99	0.10	0.01	0.20	0.01
SNAP 030323 Magnesia Production	3 698	1.04	0.10	0.01	0.05	0.00
Total	**82 751**	**12.50**	**16.41**	**0.58**	**3.33**	**0.32**

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 72.

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 2008 and emissions of 25 pollutants of all plants are estimated in periodic surveys (HACKL & MAUSCHITZ 1995, 1997, 2001, 2003, 2007), (MAUSCHITZ 2004) and (ZEMENTINDUSTRIE 2009). Table 69 shows detailled fuel consumption data for 2008.

Table 69: Cement clinker manufacturing industry. Fuel consumption for the year 2008.

Fuel	Activity [TJ]
Hard coal	4 240
Brown coal	1 756
Petrol coke	548
Residual fuel oil < 1% S	17

Fuel	Activity [TJ]
Residual fuel oil 0.5% S	NO
Residual fuel oil ≥ 1% S	580
Natural Gas	183
Industrial waste	6 577
Pure biogenic residues	941
Total	**14 852**

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 70. Heavy metals emission factors are presented in the following subchapter. Fuel consumption and main pollutant emission factors are shown in Table 72.

Table 70: Lime production 1990 to 2008.

Year	Lime [kt]
1990	513
1995	523
2000	654
2005	760
2006	781
2007	782
2008	848

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 2008 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 72. Table 71 shows the sum of flat and packaging glass production data 1990 to 2008. The share of flat glass in total glass production is about 5%.

Table 71: Glass production 1990 to 2008.

Year	Glass [kt]
1990	399
1995	435
2000	375
2001	441
2002	389
2003	477
2004	357
2005	418
2006	448
2007	497
2008	504

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 2008 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 72 presents fuel consumption and main pollutant emission factors.

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

Table 72 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 72: NFR 1 A 2 f main pollutant emission factors and fuel consumption for the year 2008 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)	417	220.0	150.0	8.0	500.0	0.01
Brown coal	(BMWA 1990)(1)	NO	170.0	150.0	23.0	630.0	0.02
Residual fuel oil < 1% S	(BMWA 1996)(1)	1 930	118.0	10.0	0.8	92.0	2.70
Residual fuel oil ≥ 1% S	(BMWA 1996)(1)	1 757	235.0	15.0	8.0	398.0	2.70
Heating oil, Diesel oil	(BMWA 1996)(2)	2 228	65.0	15.0	4.8	45.0	2.70
Kerosene	(BMWA 1996)(6)	6	118.0	15.0	4.8	92.0	2.70
LPG	(BMWA 1996)(3)	2 099	41.0	5.0	0.5	6.0(4)	1.00

Fuel	Source of NO_x, CO, NMVOC, SO_2 emission factors	Activity [TJ]	NO_x [kg/TJ]	CO [kg/TJ]	NMVOC [kg/TJ]	SO_2 [kg/TJ]	NH_3 [kg/TJ]
Natural gas	(BMWA 1996)[(1)]	25 323	41.0	5.0	0.5	NA	1.00
Industrial waste	(BMWA 1990)[(1)]	3 661	100.0	200.0	38.00	130.0	0.02
Fuel wood	(BMWA 1996)[(7)]	1 761	110.0	370.0	5.00	11.0	5.00
Solid biomass	(BMWA 1996)[(1)]	15 001	143.0	72.00	5.0	60.0	5.00
Sewage sludge	(BMWA 1996)[(1)]	NO	100.0	200.0	38.00	NA	0.02
Biogas	(BMWA 1990)[(5)]	3	150.0	4.0	0.5	NA	1.00
SNAP 030312 Lime manufacturing							
Solid Biomass	(BMWA 1996) [(1)]	153	143.0	72.00	5.00	60.00	5.00
Residual fuel oil ≥ 1% S	(BMWA 1996) [(1)]	352	235.0	15.0	8.0	398.0	2.70
Natural Gas	(BMWA 1996) [(1)]	2 554	294.0[(8)]	30.0[(9)]	0.5	NA	1.00
SNAP 030317 Glass manufacturing							
Residual fuel oil	(BMWA 1996) [(1)]	80	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)]	3 002	299.1	5.0	0.5	34.1[(10)]	1.00
SNAP 030319 Bricks and tiles manufacturing							
Brown coal	(BMWA 1990) [(1)]	87	170.0	150.0	23.0	630.0	0.02
Coke oven coke	(BMWA 1990) [(1)]	47	220.0	150.0	8.0	500.0	0.01
Petrol coke	(BMWA 1990) [(1)]	39	220.0	150.0	8.0	81.0[(11)]	0.01
Residual fuel oil < 1% S	(BMWA 1996) [(1)]	80	118.0	10.0	0.8	92.0	2.70
Residual fuel oil ≥ 1% S	(BMWA 1996) [(1)]	NO	235.0	15.0	8.0	398.0	2.70
LPG	(BMWA 1996) [(3)]	NO	41.0	5.0	0.5	6.0[(4)]	1.00
Natural Gas	(BMWA 1996) [(1)]	3 002	294.0[(8)]	5.0	0.5	NA	1.00
Industrial waste	(BMWA 1990) [(1)]	14	100.0	200.0	38.0	130.0	0.02
Solid biomass	(BMWA 1996) [(1)]	724	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 73: Cd emission factors for NFR 1 A 2 Manufacturing Industries and Construction.

Cadmium EF [mg/GJ]	**1985**	**1990**	**1995**	**2008**
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	0.13
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	0.52
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	0.06
203C medium fuel oil	0.50 (all years)			
203C medium fuel oil 030311 IEF!	0.28	0.19	0.40	0.06
203D heavy fuel oil	1.00	0.75	0.50	0.50
203D heavy fuel oil 030311 IEF!	5.66	2.79	3.95	0.65
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	3.03

Table 74: Hg emission factors for NFR 1 A 2 Manufacturing Industries and Construction.

Mercury EF [mg/GJ]	1985	1990	1995	2008
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	9.84
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	25.47
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	0.23
203D heavy fuel oil	0.75 (all years)			
203D heavy fuel oil 030311 IEF!	3.61	2.85	0.54	0.43
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	7.24

Table 75: Pb emission factors for NFR 1 A 2 Manufacturing Industries and Construction.

LEAD EF [mg/GJ]	1985	1990	1995	2008
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	0.94
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	0.61
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	0.02
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	11.24

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 76: 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
2008	21 869	69 830	259 000	4000

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 77: 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
2007	87 012	3 992	5 203
2008	86 639	3 996	5 208

Table 78: Asphalt concrete production 1990 and 2008.

Year	Asphalt concrete [kt]
1990	403
2008	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 79: 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[106]	–	389 000–24 000[106]
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[106]	50–30[106]	12 000–200[106]
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 (PCDD/F) 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 ce-

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

ment clinker. HCB emission factors are taken from (HÜBNER 2001b). The PAK4 emission factor of 0.28 mg/GJ fuel input is derived on actual measurements communicated to the Umweltbundesamt.

The dioxin (PCDD/F) 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 81.

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 80: 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[107].

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.

[107] 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 81: POP emission factors (average EF per fuel category) for 1 A 2 Manufacturing Industries and Construction.

EF	PCDD/F [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/Nm³ flue gas.

Secondary copper is mainly produced by one company which uses scrap as raw material. In a first step black copper is produced in a toploader kiln which is a relevant source of dioxin emissions. Black copper is further converted into blister copper which is further processed in a natural gas fired anode kiln and finally refined by electrolysis. In the 1980s secondary copper production was a main emitter of dioxin and furan emissions in Austria. Since then emission control could be achieved by changing raw materials, process optimization and a flue gas afterburner.

The dioxin emission factor from secondary copper production for the years after 1991 was taken from (WURST & HÜBNER 1997), in the years before no emission control (thermo reactor) was operating, furthermore input materials with more impurities were used. Thus emissions for these years were estimated to be about 200 times higher.

HCB emissions for secondary copper production were estimated on the basis of dioxin emissions and a factor of 330 which was calculated from different measurements at an Austrian facility (HÜBNER et al. 2000).

Secondary aluminium is mainly produced by two companies which uses scrap as raw materials. The raw material is mainly processed in rotary kilns and in some cases in hearth type furnaces. The main driver for dioxin and furan emissions is the composition of processed raw material (Chlorine content). While in the early 1990s emissions were widely uncontrolled the facilities have been recently equipped with particle filters and flue gas afterburners.

The dioxin emission factors for secondary aluminium production for the years 1985–1989 was taken from the Belgian emission inventory, as in these years in Austrian facilities 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 82: 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[108]	200 000–1 300[108]	–
030310 Secondary aluminium	130/40–7[108]	65 000–3 500[108]	–
030313 Asphalt concrete plants	0.01	2.8	0.15
030324 Nickel production	13	2 600–2.25[108]	–

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 2002–2009).

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 83: PM emission factors for NFR 1 A 2.

	TSP Emission Factors [g/GJ]				PM10	PM2.5
	1990	1995	2000	2008	[%]	[%]
Gas						
301A and 303A	0.5				90	75
301A, Pulp & Paper (IEF)	0.20	0.10	0.11	0.06	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	2.53	95	80
Oil						
203B and 204A	3.0				90	75
203B and 204A, Pulp & Paper (IEF)	20.04	9.98	11.22	6.32	90	75
203C	35				90	75
203D	65				90	75
203D, Pulp & Paper (IEF)	20.19	10.02	9.94	6.32	90	75
303A, Pulp & Paper (IEF)	20.04	9.98	9.37	6.32	90	74
206A	3.0				95	80

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

	TSP Emission Factors [g/GJ]				PM10	PM2.5
	1990	1995	2000	2008	[%]	[%]
Other Fuels						
111A, 115A and 116A	55				90	75
111A, 115A and 116A, Pulp & Paper (IEF)	13.78	4.99	5.61	3.16	90	75
215 D	55				90	75
215, Pulp & Paper (IEF)	41.33	14.98	11.22	6.32	90	75
309A, 310A and 309A	0.5				90	75
309A, 310A and 309A, Pulp & Paper (IEF)	2.00	1.00	1.12	0.63	90	74

3.1.5 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 84 shows activity data and main pollutant emission factors. The NO_x emission factor of 150 kg/TJ is an expert guess by Umweltbundesamt.

Table 84: 1 A 3 e main pollutant emission factors and fuel consumption for the year 2008.

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)]	10 368	150.0	5.0	0.5	NA	1.00

[(1)] *Default emission factors for industry.*

3.1.6 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 85 presents new PM emission sources which have been estimated since the inventory 2007.

Table 85: PM emission sources in 2008.

Source	NFR	PM2.5 [Mg]
Bonfire	1 A 4 a i	150
Open fire pits	1 A 4 a i	16
Barbecue	1 A 4 b i	763
Agriculture (off-site)	1 A 4 c ii	32
Forestry	1 A 4 c ii	30
Total		991

Figure 9 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) [105] (see page 140)	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 [105] (see page 140)	Fuels combusted in traction vehicles and other mobile machinery on farm land and in forests.
1 A 4 c iii National Fishing[105] (see page 140)	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 9: 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, 2004, 2006 and 2008. 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 from 2004 on 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 2009) 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, 2004, 2006 and 2008 (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.

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 2008 it is assumed that 22 % of oil central heatings and 10 % 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. The inceasing pellet consumption 2005 (300 kt) to 2008 (500 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. Since 2001 fuel wood boiler sales are used for consumption estimates (about 13 000 new boilers yearly). 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 average annual exchange rate of 4 200 boilers assuming an average annual consumption of 80 GJ/boiler (1.9 t heating oil equivalent) from 1991 on.

Table 86: 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	47.5	47.2	5.3	100	83.8	6.1	10.1	61.0	9.2	29.8
2002	47.9	46.7	5.4	100	83.3	6.8	9.8	62.3	9.7	27.9
2003	48.3	46.2	5.6	100	82.9	7.5	9.6	63.6	10.3	26.1
2004	48.7	45.6	5.7	100	82.5	8.2	9.3	64.9	10.8	24.3
2005	50.5	44.5	5.0	100	86.6	6.3	7.1	68.3	10.0	21.7
2007	52.4	43.4	4.3	100	90.7	4.4	4.9	71.6	9.2	19.2
2007	54.0	42.0	4.1	100	92.3	3.6	4.1	74.1	7.6	18.3
2008	55.6	40.6	3.9	100	93.8	2.9	3.3	76.5	6.0	17.5

Table 87: 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	16.7	31.6	35.9	10.3	53.8	72.9	8.3	18.8
2002	56.1	14.8	29.2	45.6	10.5	44.0	70.2	9.2	20.6
2003	60.5	12.8	26.7	55.2	10.6	34.1	67.6	10.0	22.4
2004	64.9	10.8	24.3	64.9	10.8	24.3	64.9	10.8	24.3
2005	68.3	10.0	21.7	68.3	10.0	21.7	68.3	10.0	21.7
2006	71.6	9.2	19.2	71.6	9.2	19.2	71.6	9.2	19.2
2007	74.1	7.6	18.3	74.1	7.6	18.3	74.1	7.6	18.3
2008	76.5	6.0	17.5	76.5	6.0	17.5	76.5	6.0	17.5

Table 88: 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	66.8	7.5	25.7	86.9	3.3	9.8

Year	Fuel Wood (log wood)			Wood chips, pellets and other biomass		
2002	66.0	7.0	27.0	84.4	3.4	12.3
2003	65.1	6.5	28.4	81.9	3.4	14.8
2004	64.3	5.9	29.8	79.3	3.4	17.2
2005	70.3	5.5	24.2	81.9	3.8	14.3
2006	76.3	5.2	18.6	84.4	4.2	11.4
2007	76.0	5.2	18.8	86.6	3.6	9.8
2008	75.7	5.2	19.1	88.8	3.0	8.2

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 89. The split follows closely (STANZEL et al. 1995).

Table 89: 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 90: NFR 1 A 4 NO_x emission factors by type of heating for the year 2008.

	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 91: NFR 1 A 4 NMVOC emission factors by type of heating for the year 2008.

	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 92: NFR 1 A 4 CO emission factors by type of heating for the year 2008.

	Central heating [kg/TJ]	Apartement heating [kg/TJ]	Stove [kg/TJ]
Coal	4 206.0	4 206.0	3 705.0
Residual fuel oil < 1% S	45.0		
Residual fuel oil ≥ 1% S	15.0		
Heating oil	67.0	67.0	150.0
Kerosene	15.0		

	Central heating [kg/TJ]	Apartement heating [kg/TJ]	Stove [kg/TJ]
LPG	37.0	37.0	
Natural gas	37.0	37.0	44.0
Solid biomass conventional	4 303.0	4 303.0	4 463.0 2 345.0(2)
Wood gasification	3 237.0(2)	3 107.0(2)	
Industrial waste	200.0(1)		

(1) *Default values for industrial boilers*

(2) *CO from new biomass heatings is calculated by means of ratio of NMVOC from new biomass heatings by NMVOC from conventional heatings*

Table 93: NFR 1 A 4 SO_2 emission factors by type of heating for the year 2008.

	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 94: NFR 1 A 4 NH_3 emission factors for the year 2008.

	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 4 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 95: 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.

HCB emission factors are taken from the national study (HÜBNER 2002) and based on field measurements from 15 solid fuel residential heatings with a capacity less than 50 kW using the standard methodology according to Ö-NORM EN-1948-1. The results show a high variation in flue gas concentrations without any correlation between type of heating (stove, boiler) or fuel (log wood, pellets, wood chips, coal).

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 96: POP emission factors for 1 A 4.

EF	PCDD/F [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 2008)	0.186	176	21.2
115A Industrial waste	0.3	250	26
116A Wood wastes (IEF 2008)	0.430	240	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 2008)	0.223	387	49.7
116A Wood wastes	0.38	600	85
1A4b Residential plants: central and apartment heating (SNAP 020202)			
Coal102A, 105A, 106A, 107A	0.38	600	85 12
203B Light fuel oil 204A Heating oil	0.0015	0.15	
224A Other Oil Products	0.0017	0.14	0.011
301A Natural gas 303A LPG	0.0025	0.25	0.04
111A Wood, 116A Wood wastes Central heating (IEF 2008) Apartment heating	 0.223 0.38	 387 600	 49.7 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 97: 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 98: 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**	**2008**
Central heating	55.00	55.00	52.06	55.50
Apartment heating	90.00	90.00	82.95	59.50
Stoves	148.00	148.00	134.14	88.01

Other PM sources

For the following sources it is assumed that particle sizes are equal or smaller than PM2.5.

Barbecue

For activity data 11 kt of char coal has been calculated from foreign trade statistics and producton data (Import 11 900 t, Export 1 900 t, Production 1 000 t). An emission factor of 2 237 g TSP/GJ char coal has been selected which is 69 347 g/t char coal assuming a calorific value of 31 GJ/t. This leads to 763 t PM/year for the whole time series.

Bonfire

It is assumed that one bonfire is sparked every year for each 5000 rural inhabitants. This leads to 1000 bonfires each year for all 5 Mio rural inhabitants. The average size of a fire is estimated to have 30 m³ of wood which is 10 m³ of solid wood. Assuming a heating value of 10 GJ/m³ wood and selecting an emission factor of 1500 g/GJ (similar to open fire places, expert guess from literature) this leads to 150 kg PM for each fire and 150 t PM for each year.

Open fire pits

It is assumed that one open fire pit exists for each 2 500 inhabitants. Assuming 20 fires per year and fire pit this leads to 66 400 fires each year. Assuming 0.025 m³ of solid wood per fire which is 0.3 GJ and selecting an emission factor of 800 g/GJ (open fireplace, EPA 1998, Klimont et al. 2002) this leads to 240 g PM/fire and 16 t PM for each year.

NFR 1 A 4 c ii Off-road Vehicles and Other Machinery – soil abrasion

PM emissions from abrasion of offroad machinery in agriculture and forestry are estimated by means of machinery stock, average operating hours and an PM emission factor of 30 [g TSP/machine operating hour]. The share in TSP emissions is 45% for PM10 and 12% for PM2.5. The following Table 99 presents the parameters used for 2008 emission calculation. Emission factors are taken from (WINIWARTER et al. 2007). Activity data is consistent with activity data used for calculation of exhaust emissions.

Table 99: Agriculture offroad machinery parameters for the year 2008.

Machinery	Stock	Avg. operating hours/year	Off-Site operating hours
Tractors	407 036	169	12%
Trucks	15 744	123	12%
Harvesters	11 147	110	12%
Mowers	101 250	27	12%

3.1.7 QA/QC

Comparison with EPER and E-PRTR data

Comparison of emissions with reported 2004/2005 EPER and 2007 E-PRTR 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 45 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.

3.1.8 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.

3.2 Source-specific recalculations of NFR 1 A (Stationary Fuel Combustion Activities) including changes made in response to the review process

The following improvements were made in response to the issues raised in the Stage 3 in-depth review of emission inventories submitted under the UNECE LRTAP Convention and EU National Emissions Ceilings Directive (CEIP/S3.RR/2010/AUSTRIA).

REVIEW FINDINGS	Fullfiled
Areas for improvements identified by Austria	
24.Improved emission factors for space heating.	Field measurement campaign is ongoing.
General recommendations on cross-cutting issues.	
Completeness:	
The ERT considers the inventory for the stationary energy sector to be quite complete and comprehensive, with good levels of detail in the methodology descriptions.	–
Only one case of incompleteness was identified. See sub-sector specific recommendations (Category issue 1).	–
Transparency:	
Austria has provided a detailed and generally transparent emissions inventory. Estimates are provided at the most detailed level for all energy sectors. Austria's methodology and emission factors in the IIR are considered by the ERT to be transparent and well described for the stationary energy sector. The ERT has one comment about the transparency in the IIR. See sub-sector specific recommendations (Category issue 2).	–
Emission trends are described in a thorough manner. The focus of the trend description is on 1990 and the base year. The ERT suggests that more information could be included for the entire time series.	This task is included in the inventory improvement plan.
To improve transparency, the ERT recommends that rationales for choice of emission factors, when significantly different from default Guidebook emission factors, should be stated.	The rationale is always that CS emissions factors are derived from national measurements and/or expert guess which considers the national facility structure.
Accuracy:	
The ERT encourages Austria to undertake a quantitative uncertainty analysis for the stationary energy sector in order to help identify potential areas for further improvements and to provide an indication of the reliability of the inventory data.	This task is included in the inventory improvement plan.

REVIEW FINDINGS	Fullfiled
Austria has detailed QA/QC checks by the sector experts themselves, and there is a second audit for every sector. The ERT commends Austria for these thorough OA/QC procedures. The ERT encourages Austria to specify source-specific QA/QC procedures.	
Comparability:	
The methods used are – as far as the ERT can understand – consistent with the methods proposed by the EMEP/EEA Guidebook.	–
No over- or underestimates have been discovered during the review process.	–
Consistency:	
The ERT finds that the time series in the Austrian inventory is consistent throughout, for the most part. One minor inconsistency has been identified. See sub-sector specific recommendations (Category issue 3).	–
Recalculations:	
The recalculations in the Austrian inventory are thoroughly explained in the IIR, including a description of how the recalculations affect the emissions. However, the IIR does not explain the rationale for all recalculations. The ERT encourages Austria to provide the rationale for all recalculations in its IIR.	Recalculations are due to improved census data reflected in the revision of the national energy balance.
Improvement:	
The ERT commends the Party for its clear improvement plan in the stationary energy sector. The ERT encourages Austria to perform a quantitative uncertainty analysis in order to identify other areas of the stationary energy sector where improvements of activity data or emission factors could be appropriate.	This task is included in the inventory improvement plan.
Category issue 2: 1 A 4 c i: All pollutants	
The ERT has noted that the emission factors used in sector 1 A 4 are somewhat unclear. The ERT recommends that Austria clarifies this chapter by a more detailed description of the emission factors used for each fuel type throughout the time series.	Emission factors for central heatings are provided in tables of chapter 3.1.6
Category issue 3: 1 A 4 c i: NMVOC and CO	
The ERT noted a jump in NMVOC emissions from 1 A 4 c i between 1996 and 1997. Austria provided information stating that this was due to a change in methodology, with new emission factors arising from this change. No interpolation method has been used to smooth the resulting jump in the emission time series. The ERT recognizes the challenges connected to finding good methods for merging separate time series, but recommends that Austria uses interpolation to splice the two time series more gradually.	It is foreseen to solve this issue after emissions factors from field measurement campaign are available.

3.3 NFR 1 A Mobile Fuel Combustion Activities

No changes regarding methodology and emission factor were made since submission 2009.

Improvements were made in response to the issues raised in the Stage 3 in-depth review of emission inventories submitted under the UNECE LRTAP Convention and EU National Emissions Ceilings Directive.´These improvements are described in Chapter 3.4.

3.3.1 General description

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 100: 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**		
35. 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**		
36. R.T., Passenger cars	NFR 1 A 3 b 1	0701	Passenger cars
37. R.T., Light duty vehicles	NFR 1 A 3 b 2	0702	Light duty vehicles < 3.5 t
38. R.T., Heavy duty vehicles	NFR 1 A 3 b 3	0703	Heavy duty vehicles > 3.5 t and buses
39. R.T., Mopeds & Motorcycles	NFR 1 A 3 b 4	0704	Mopeds and Motorcycles < 50 cm³ 0705 Motorcycles > 50 cm³
40. Gasoline evaporation from vehicles	NFR 1 A 3 b 5	0706	Gasoline evaporation from vehicles
41. 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

Activity	NFR Category	SNAP	
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			
42. Residential	1 A 4 b	0809	Other Mobile Sources and Machinery-Household and gardening
43. Agriculture/Forestry/Fisheries	1 A 4 c	0806	Other Mobile Sources and Machinery-Agriculture 0807Other Mobile Sources and Machinery-Forestry
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 101 provides information on the status of emission estimates of all sub categories. A "✓" indicates that emissions from this sub category have been estimated. Table 100 proviedes an overview about NFR categories and the corresponding SNAP codes.

Table 101: 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

NFR Category	NO_x	CO	NMVOC	SO_x	NH_3	TSP	PM10	PM2.5	Pb	Cd	Hg	DIOX	PAH	HCB
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 methodology of mobile fuel combustion activities.

3.3.2 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 Domestic airport traffic (national LTO - landing/take off) and domestic cruise Traffic. International airport traffic 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 102 emissions from NFR 1 A 3 a Civil Aviation increased over the period from 1990–2008 due to an increase of activity by about 119%.

Table 102: Emissions from 1 A 3 a Civil Aviation 1990–2008.

Year	NO_x		SO_2		NH_3		NMVOC	
	LTO	cruise	LTO	cruise	LTO	cruise	LTO	cruise
	[Mg]							
1990	36.13	40.53	4.20	4.51	0.10	0.03	20.63	18.25
1995	47.14	133.20	5.37	11.62	0.10	0.08	17.27	6.50
2000	68.93	190.52	6.97	13.18	0.11	0.09	45.19	16.36
2005	64.99	199.46	6.38	13.19	0.12	0.09	38.50	16.37
2006	75.98	208.12	7.41	13.70	0.13	0.09	45.88	17.00
2007	76.51	211.86	7.53	14.19	0.13	0.10	46.86	17.61
2008	83.44	185.98	8.14	12.48	0.14	0.08	52.07	15.48
Trend 1990–2008	*131%*	*359%*	*94%*	*177%*	*38%*	*175%*	*152%*	*-15%*

Methodological Issues

IFR – Instrument Flight Rules

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[109] (flight distance and destination per aircraft type) and aircraft/ engine performances data were used for the calculation.

For the years 2000–2008 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 – Visual Flight Rules

Fuel consumption for the years 2000–2008 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).

Activity Data

Fuel consumptions for 1 A 3 a Civil Aviation presented in Table 103.

Table 103: Fuel consumptions 1 A 3 a Civil Aviation 1990–2008.

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
2008	7 039	2 630	12 475
Trend 1990–2008	*122%*	*6%*	*177%*

Instrument Flight Rules (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.

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

For the years 2000–2008 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.

The number of flight movements per aircraft type and airport (national and international) was obtained from special analyses by Statistik Austria (STATISTIK AUSTRIA 2010a) and by Austro Control (AUSTRO CONTROL 2010). Moreover, for the calculation of passenger kilometres and ton kilometres input data was taken out of the statistics of civil aviation (STATISTIK AUSTRIA 2010b) The total amount of jet kerosene and gasoline was taken out of the energy balance (STATISTIK AUSTRIA 2010c).

Visual Flight Rules (VFR) flights

Fuel consumption for the years 2000–2008 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).

Emission factors

Emission factors for NO_x, CO

Instrument Flight Rules (IVR) 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 2000–2008 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.

Visual Flight Rules (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 1999–2008 emissions of VFR flights have been calculated with IEF´s from the year 2000 by the study mentioned above (KALIVODA et al. 2002).

Emission factors for NMVOC

Instrument Flight Rules (IVR) 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 EMEP/CORINAIR Emission Inventory Guidebook (Version 2007) 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.

For the years 2000–2008 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.

Visual Flight Rules (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 1999–2008 NMVOC emissions of VFR flights have been calculated with an IEF from the year 2000 by the study mentioned above (KALIVODA et al. 2002).

Emission factors for NH_3

Instrument Flight Rules (IVR) 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 1999–2008 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).

Visual Flight Rules (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 1999–2008 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).

In Table 104 the activities and IEF for domestic aviation (LTO + cruise) are presented.

Table 104: Emission factors and activities for Civil Aviation (LTO + cruise) 1990–2008.

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	0.21	66.77
2005	0.92	289.01	21.38	0.23	59.97
2006	0.99	288.26	21.41	0.23	63.80
2007	1.01	284.93	21.47	0.23	63.70
2008	0.96	281.08	21.51	0.23	70.48

Planned improvements

There is no further aviation study foreseen at the moment.

Additional investigations concerning the allocation of aircraft types to equivalent aircraft types according to the CORINAIR guidebook are planned.

3.3.3 International Bunkers – Aviation

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

Table 105: Emissions for International Airport Traffic (LTO-cycles) and International Cruise Traffic 1990–2008.

Year	NO_x		SO_2		NH_3		NMVOC	
	LTO	cruise	LTO	cruise	LTO	Cruise	LTO	cruise
	[Gg]	[Gg]	[Gg]	[Gg]	[Gg]	[Gg]	[Gg]	[Gg]
1990	0.372	2.399	0.029	0.253	0.000	0.002	0.137	0.163
1995	0.632	3.601	0.049	0.372	0.000	0.003	0.186	0.279
2000	0.794	6.254	0.067	0.471	0.000	0.003	0.293	0.400
2005	1.028	6.788	0.086	0.536	0.001	0.004	0.377	0.455
2006	0.995	7.330	0.085	0.565	0.001	0.004	0.373	0.479
2007	1.092	7.781	0.092	0.598	0.001	0.004	0.404	0.508
2008	1.107	7.711	0.093	0.599	0.001	0.004	0.410	0.508
Trend 1990–2008	*198%*	*221%*	*226%*	*137%*	*224%*	*135%*	*201%*	*212%*

Table 106: Activities for International Airport Traffic (LTO-cycles) and International Cruise Traffic 1990–2008.

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
2008	4.04	25.92
Trend 1990–2008	*224%*	*135%*

Table 107: Emission factors and activities for International Airport Traffic (LTO-cycles) and International Cruise Traffic 1990–2008.

Year	Activity	IEF NO_x	IEF SO_2	IEF NH_3	IEF NMVOC
	[PJ]	[t/PJ]	[t/PJ]	[t/PJ]	[t/PJ]
1990	12.26	225.97	22.94	0.16	24.40
1995	18.25	231.98	23.09	0.16	25.46
2000	23.29	302.64	23.09	0.16	29.76
2005	26.92	290.40	23.09	0.16	30.90
2006	28.14	295.85	23.09	0.16	30.30
2007	29.88	296.95	23.09	0.16	30.50
2008	29.97	294.27	23.09	0.16	30.65

Emissions from International Airport Traffic (LTO-cycles) and International Cruise Traffic have been calculated using the methodology and emission factors as described in Chapter 1 A 3 a Civil aviation.

3.3.4 International Bunkers – Navigation

Since 2010, greenhouse gas emissions from water-borne navigation (inland navigation on the river Danube) have been reported separately for the national and the international share of navigation from 1990 onwards. For this purpose diesel consumption in navigation is obtained from the energy balance (STATISTIK AUSTRIA 2010c). Data origins from the Austrian Federal Ministry of Economy, Family and Youth (BMWFJ) which – according to the national oil statistics directive – collects data from all Austrian companies who export or import oil products.

As the national fuel consumption in navigation is calculated bottom-up there could be marginal double counting with the international fuel share reported by BMWFJ, but this seems to be neglectable.

The volatility of activity data and following emissions can be explained by the facts that fuel consumption for inland navigation is in general very low in Austria and that the reported data within the reporting obligations of BMWFJ is probably not completely thorough.

Emissions and activities for international navigaton will be given in the next thorough update of the IIR.

3.3.5 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 2008 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 busse, mopeds and motorcycles as well as gasoline evaporation from vehicles and automobile tyre and brake wear.

National NH3, NMVOC and CO emissions show a constantly decreasing trend between 1985 and 1995 without any peaks. So, the dips can be ex-plained by the methodology which is used for calculating fuel export (= total fuel sold minus inland and off-road consumption). Therefore, the dips must be a model output caused by changes in the Energy Balance.

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; HAUSBERGER 2010).

Road transport model GLOBEMI

The program calculates vehicle mileages, passenger-km, ton-km, fuel consumption, exhaust gas emissions, evaporative emissions and suspended PM10 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) vehicle stock of each category split into layers according to the propulsion system (SI.CI...). cylinder capacity classes or vehicle mass
2) emission factors of the vehicles according to the year of first registration and the layers from 1)
3) 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 (Fuel consumption (fc), CO, HC, NOx, particulate matter (PM), CO_2, SO_2 and several unregulated pollutants among them CH_4 and N_2O).

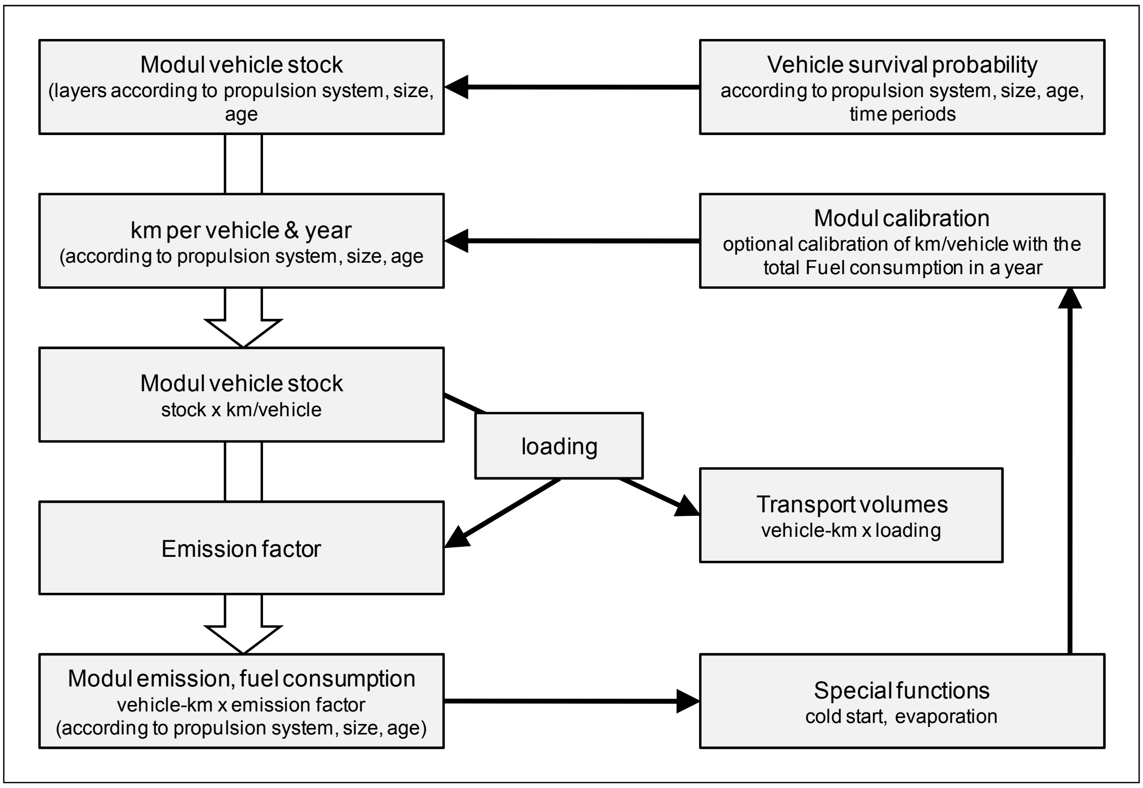

Figure 10: Schematic picture of the model GLOBEMI.

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. 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.

$$stock_{Jg_i,year\,i} = stock_{Jg_i,year\,i-1} \times survival\,probability_{Jg_i}$$

(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, <1 500ccm, EURO 3)

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

(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

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

(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 taken from the "Handbook of Emission Factors" (HBEFA) Version 2.1 (HAUSBERGER & KELLER et al. 1998) and on ARTEMIS measurements (basically for passenger cars, light duty vehicles and motorcycles) which are taken into account in HBEFA.

Activity data

Bottom up Methodology - 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).

The annual road performance (millage driven per year) in Austria is taken from the national traffic model (VMOe (Verkehrs-Mengenmodell-Oesterreich – Austrian National Transport Model, Ministry of Transport, BMVIT, not published).

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. VMOe 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 2010c) 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 108: Implied emission factors for NEC gases and CO and activities for 1 A 3 b Road Transport 1990–2008.

Year	Activity	IEF NO_x	IEF SO_2	IEF NH_3	IEF NMVOC	IEF CO
	[PJ]	[t/PJ]				
1990	176.70	576.44	27.35	16.13	284.84	3.68
1995	204.87	494.05	27.80	32.02	226.77	2.83
2000	243.66	516.52	9.47	18.16	120.37	1.51
2005	328.97	466.57	0.49	8.86	64.14	0.84
2006	320.74	431.05	0.43	7.63	57.74	0.76
2007	325.94	411.53	0.40	6.45	51.83	0.67
2008	310.83	392.13	0.40	5.46	47.61	0.60

Table 109: Implied emission factors for PM and activities for 1 A 3 b Road Transport 1990–2008.

Year	Activity	IEF PM	IEF TSP Non Exhaust	IEF PM10 Non Exhaust	IEF PM2.5P Non Exhaust
	[PJ]	[t/PJ]			
1990	176.70	16.90	38.74	12.91	3.87
1995	204.87	20.06	39.54	13.18	3.95
2000	243.66	18.95	36.98	12.33	3.70
2005	328.97	15.20	30.28	10.09	3.03
2006	320.74	13.89	31.69	10.56	3.17
2007	325.94	12.69	32.38	10.79	3.24
2008	310.83	11.56	33.95	11.32	3.40

Table 110: Implied emission factors for heavy metals and POPs and activities for 1 A 3 b Road Transport 1990–2008.

Year	Activity	IEF Cd	IEF Hg	IEF Pb	IEF PAH	IEF Dioxin	IEF HCB
	[PJ]	[t/PJ]					
1990	176.70	0.00002	0.00001	0.93449	0.00511	<0.00001	<0.00001
1995	204.87	0.00002	0.00001	0.00006	0.00444	<0.00001	<0.00001
2000	243.66	0.00002	0.00001	0.00005	0.00483	<0.00001	<0.00001
2005	328.97	0.00002	0.00001	0.00004	0.00508	<0.00001	<0.00001
2006	320.74	0.00002	0.00001	0.00004	0.00506	<0.00001	<0.00001
2007	325.94	0.00002	0.00001	0.00004	0.00511	<0.00001	<0.00001
2008	310.83	0.00002	0.00001	0.00004	0.00518	<0.00001	<0.00001

Emission factors

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

Recalculations

- A methodical update of the quantity structure of road transport resulted in a reduction of fuel consumption of inland road transport. This reduction can be explained by the ex post consideration of real-world road performance data for 2007, 2008 and 2009, which especially shows the downturn of road freight transport caused by the economic slowdown.
- As the revised national energy balance shows a nearly identically overall fuel consumption for 2008 compared with the value in the national emission inventory 2009, the shifting of reduced inland fuel consumption to the amount of fuel export has no effect on overall GHG emissions. What can be clearly seen is the shift of reduced inland GHG emissions towards the share of fuel export.

Improvements of methodology

In 2009, following methodical changes have been implemented in the transport emission calculation models GLOBEMI and GEORG which result in revised emission data for the whole time-series (HAUSBERGER 2010):

- Revised road freight performance data has been implemented in the GLOBEMI calculation model for the years 2007, 2008 and 2009. These data has been generated from automatic vehicle counting checkpoints on highways. Thus, statements about real-world road freight performance in Austria over the past three years are possible instead of estimations based on out-dated traffic performance projections.
- The revised road freight performance data leads to a heavily decreased fuel consumption of inland road freight transport amounting to -5% (caused by the weak economic situation). As the revised national energy balance shows a nearly identical overall fuel consumption for 2008 compared with the value in the national emission inventory 2009, the decrease in inland fuel consumption has been counterbalanced by an increase in fuel export on road. As the economic downturn has the same slowing effect on road freight transport from abroad, the decrease in inland fuel consumption has especially been counterbalanced by an increase in fuel export from cars.

- Adaption of out-dated age pattern and failure rates of the Austrian vehicle fleet according to actual fleet structure data from national statistics. This leads to an adjustment of the Austrian inland fleet towards newer vehicles with a less specific overall fuel consumption.
- Adaptation of the specific CO_2 emission factors of passenger cars according to the national CO_2 monitoring data for the Austrian fleet.
- The "fuel export" fleet composition which is necessary to calculate the proportional driving and transport performance and the corresponding emissions has been updated towards the characteristics of the Austrian long-distance inland fleet.

Planned Improvements

- The update of emission factors from HBEFA 2.1 – which are currently used in GLOBEMI – to the new version of HBEFA 3.1 (INFRAS 2010) has not been realised yet, but is planned to be implemented in the next submission.

3.3.6 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 111 to Table 114. 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 111: 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 112: 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 113: 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 114: 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

- The fuel consumption of off-road mobile machinery (especially in industry) has been adjusted downwards for the year 2008 according to the revised national energy balance (STATISTIK AUSTRIA 2010c), which leads to reduced GHG emissions.

Planned Improvements

It is obvious that the above listed implied emission factors expressed in t/TJ or kg/TJ could be updated. As soon as the Umweltbundesamt budget allows a new study about off-road fuel consumption and pollutant emissions, input-data for the off-road traffic will be updated and recalculated with the model GEORG.

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

Emissions from this category are presented in the following table.

Table 115: Emissions from off-road – Industry 1990–2008

Year	NO_x	SO_2	NH_3	NMVOC	PM
			[Gg]		
1990	3.03	0.20	0.001	0.53	0.52
1995	4.53	0.09	0.001	0.68	0.64
2000	7.66	0.12	0.002	0.94	0.78
2005	7.66	0.03	0.002	0.89	0.60
2006	8.69	0.03	0.003	0.99	0.60
2007	8.53	0.01	0.003	1.00	0.57
2008	8.63	0.01	0.003	1.05	0.55
Trend 1990–2008	*185%*	*-96%*	*162%*	*99%*	*6%*

Activity data and emission factors

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 116: Implied emission factors and activities for off-road transport in industry (NFR 1 A 2 f Manufacturing Industries and Construction – mobile) 1990–2008.

Year	Activity	IEF NO_x	IEF SO_2	IEF NH_3	IEF NMVOC	IEF PM
	[PJ]			[t/PJ]		
1990	3.45	877.76	5933	0.31	153.13	151.49
1995	4.82	941.01	18.54	0.30	141.67	131.89
2000	7.47	1.026.44	16.19	0.27	125.58	104.40
2005	11.17	685.68	2.33	0.21	79.28	53.54
2006	14.02	619.68	2.32	0.19	70.50	42.89
2007	15.19	561.16	0.46	0.18	66.02	37.47
2008	16.79	513.99	0.46	0.17	62.65	32.96

Recalculations

- Update of statistical energy data.

Planned Improvements

No additional investigations are planned.

3.3.6.2 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 117: Emissions from railways 1990–2008.

Year	NO_x	SO_2	NH_3	NMVOC	PM exhaust	PM non-exhaust
				[Gg]		
1990	1.82	0.26	0.00	0.37	0.20	0.52
1995	1.56	0.21	0.00	0.30	0.15	0.52
2000	1.50	0.09	0.00	0.26	0.11	0.52
2005	1.84	0.06	0.00	0.29	0.06	0.52
2006	1.92	0.06	0.00	0.29	0.06	0.52
2007	1.82	0.06	0.00	0.28	0.06	0.52
2008	1.90	0.07	0.00	0.29	0.06	0.52
Trend 1990–2008	*4%*	*-75%*	*-25%*	*-21%*	*-72%*	*0%*

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

Table 118: Activities railways 1990–2008.

Year	Activity [PJ]
1990	2.38
1995	2.00
2000	1.83
2005	2.23
2006	2.35
2007	2.26
2008	2.40

Table 119: Emission factors for railways 1990–2008.

Year	IEF NO_x	IEF SO_2	IEF NH_3	IEF NMVOC	IEF PM Total
			[t/PJ]		
1990	762.62	110.54	0.30	153.12	300.35
1995	781.58	103.84	0.30	150.00	332.74
2000	819.66	48.44	0.26	142.85	343.87
2005	826.99	27.40	0.23	128.07	261.31
2006	815.12	27.56	0.23	125.04	245.99
2007	803.40	27.50	0.23	122.58	254.15
2008	791.44	27.34	0.22	120.06	239.75

Emission factors for heavy metals, POPs and PM are presented in the following chapter 1.4.6.

Recalculations

- Activity data was revised according to an updated study by the Federal Ministry for Transport, Innovation and Technology about rail performance in Austria. It has been implemented in the GEORG calculation model which leads to a reduction in diesel consumption (mainly used for rail shunting) and following to reduced GHG emissions for the rail sector in 2008.

Planned Improvements

No additional investigations are planned.

3.3.6.3 NFR 1 A 3 d Navigation

Emissions and activities for national navigaton will be given in the next thorough update of the IIR. For submission 20010 the new methodology was introduced to report emissions from national and international navigation separately which is described in chapter International Bunkers – Navigation (Chapter 3.3.4).

Recalculations

- Activity data and emissions in domestic navigation have been corrected by the proportion of international navigation on the Danube. The values reported under "domestic navigation" in former annual inventory reports also included the amount of international navigation.
- Activity data was updated and updated emission factors have been used.

Planned Improvements

As the split between national and international fuel sold in the navigation sector on the river Danube in Austria has been examined in Chapter International Bunkers, no further improvements are planned at the moment.

3.3.6.4 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 2008, especially SO_2 emissions decreased to a greater extend due to decreasing emission factors.

Table 120: Emissions from off-road – household and gardening 1990–2008.

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
2008	0.67	0.00	0.00	2.28	0.04
Trend 1990–2008	*-17%*	*-98%*	*-29%*	*-52%*	*-70%*

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

Table 121: Emission factors and activities for off-road – household and gardening 1990–2008.

Year	Activity [PJ]
1990	1.93
1995	1.96
2000	1.92
2005	1.89
2006	1.90
2007	1.88
2008	1.87

Table 122: Emission factors and activities for off-road – household and gardening 1990–2008.

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	68.20
1995	472.98	10.89	0.14	2 344	53.53
2000	502.39	9.77	0.14	1 990	46.30
2005	413.88	2.34	0.12	1 685	27.40
2006	403.92	2.32	0.12	1 526	25.12
2007	371.91	0.46	0.11	1 376	23.24
2008	358.07	0.46	0.11	1 218	21.33

Planned Improvements

No additional investigations are planned.

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

Emissions from this category decreased over the period from 1990 to 2008, especially SO_2 emissions decreased by about 99% due to decreasing emission factors.

Table 123: Emissions from off-road – agriculture 1990–2008.

Year	NO_x	SO_2	NH_3	NMVOC	PM
			[Gg]		
1990	8.47	0.54	0.00	1.98	1.85
1995	8.39	0.17	0.00	1.87	1.70
2000	8.89	0.15	0.00	1.77	1.59
2005	8.96	0.02	0.00	1.66	1.38
2006	8.77	0.02	0.00	1.60	1.30
2007	8.49	0.00	0.00	1.54	1.22
2008	8.34	0.00	0.00	1.50	1.17
Trend 1990–2008	*-1%*	*-99%*	*-13%*	*-24%*	*-37%*

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

Table 124: Activities for off-road – agriculture 1990–2008.

Year	Activity [PJ]
1990	9.06
1995	9.05
2000	9.52
2005	10.27
2006	10.57
2007	10.55
2008	10.78

Table 125: Emission factors for off-road – agriculture 1990–2008.

Year	IEF NO_x	IEF SO_2	IEF NH_3	IEF NMVOC	IEF PM
			[t/PJ]		
1990	934.40	60.10	0.46	218.46	203.85
1995	926.89	18.46	0.45	206.26	187.63
2000	934.06	16.18	0.42	185.66	167.04
2005	871.73	2.35	0.38	161.14	134.09
2006	830.00	2.30	0.36	151.47	123.45
2007	804.91	0.46	0.35	145.93	115.90
2008	774.02	0.46	0.34	139.49	108.49

Table 126: Emissions from off-road – forestry 1990–2008.

Year	NO_x	SO_2	NH_3	NMVOC	PM
			[Gg]		
1990	0.87	0.06	0.00	2.36	0.24
1995	0.87	0.02	0.00	2.05	0.22
2000	0.91	0.02	0.00	1.82	0.21
2005	0.92	0.00	0.00	1.96	0.20
2006	0.91	0.00	0.00	2.22	0.20
2007	0.98	0.00	0.00	2.42	0.22
2008	0.96	0.00	0.00	2.45	0.21
Trend 1990–2008	*10%*	*-99%*	*-5%*	*4%*	*-12%*

Table 127: Activities for off-road – forestry 1990–2008.

Year	Activity [PJ]
1990	1.11
1995	1.08
2000	1.11
2005	1.23
2006	1.30
2007	1.44
2008	1.48

Table 128: Emission factors for off-road – forestry 1990–2008.

Year	IEF NO_x	IEF SO_2	IEF NH_3	IEF NMVOC	IEF PM
			[t/PJ]		
1990	785.14	50.37	0.39	2 119	219.17
1995	799.48	16.32	0.39	1 893	203.40
2000	815.62	14.56	0.37	1 637	187.14
2005	748.55	2.35	0.33	1 602	163.66
2006	700.90	2.31	0.31	1 709	157.24
2007	678.86	0.46	0.30	1 681	150.98
2008	651.52	0.46	0.28	1 653	144.73

Planned Improvements

No additional investigations are planned.

3.3.7 NFR 1 A 5 Other Military

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

3.3.7.1 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 129: Emissions from military off road transport [Gg] 1990–2008.

Year	NO_x	SO_2	NH_3	NMVOC	PM
			[Gg]		
1990	0.02389	0.00172	0.00001	0.00428	0.00428
1995	0.02506	0.00053	0.00001	0.00376	0.00376
2000	0.02819	0.00045	0.00001	0.00267	0.00267
2005	0.02404	0.00006	0.00001	0.00182	0.00182
2006	0.02191	0.00006	0.00001	0.00156	0.00156
2007	0.01986	0.00001	0.00000	0.00133	0.00133
2008	0.01763	0.00001	0.00000	0.00114	0.00114
Trend 1990–2008	*-26%*	*-99%*	*-100%*	*-73%*	*-73%*

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

Table 130: Activities for military off road transport 1990–2008.

Year	Activity [PJ]
1990	0.03
1995	0.03
2000	0.03
2005	0.03
2006	0.03
2007	0.03
2008	0.03

Table 131: Emission factors for military off road transport 1990–2008.

Year	IEF NO_x	IEF SO_2	IEF NH_3	IEF NMVOC	IEF PM
			[t/PJ]		
1990	0.03	832.87	59.96	0.35	149.21
1995	0.03	884.64	18.71	0.35	132.73
2000	0.03	1025.55	16.37	0.36	97.13
2005	0.03	882.14	2.20	0.37	66.78
2006	0.03	798.47	2.19	0.36	56.85
2007	0.03	721.83	0.36	-	48.34
2008	0.03	638.45	0.36	-	41.28

Planned Improvements

No additional investigations are planned.

3.3.7.2 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 1999–2008 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 132: Emissions and activities military aviation 1990–2008.

Year	NO_x	SO_2	NMVOC	NH_3	Activity
	[Mg]				[PJ]
1990	50.66	10.49	10.16	0.07	0.46
1995	46.93	9.72	9.41	0.07	0.42
2000	59.73	12.37	11.98	0.08	0.53
2005	64.06	13.26	12.85	0.09	0.57
2006	64.92	13.44	13.02	0.09	0.58
2007	65.79	13.62	13.20	0.09	0.59
2008	66.65	13.80	13.37	0.09	0.59

Planned Improvements

No additional investigations are planned.

3.3.8 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 49. 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 production and import of leaded gasoline has been prohibited since 1993. In Austria and that earlier emission estimates are based on a lead content of 0.56 g Pb/litre for aviation gasoline. From 1996 on a lead content of 0,1 mg/GJ has been estimated for gasoline due to the assumed use of lead additives for old non-catalyst vehicles and that a lead content of 0.02 mg/GJ has been assumed for diesel oil.

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 133: 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 134: 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.[110]

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.

[110] 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 135: POP emission factors for Sector 1 A 3 Transport and SNAP 08 Off-Road Machinery.

	PCDD/F 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.

PM emissions from tyre and brake wear are included in road abrasion and it is not possible to develop separate emission factors (by road and vehicle type) from field emission measurements which consider total vehicle emissions.

3.4 Source-specific recalculations of NFR 1 A (Mobile Fuel Combustion Activities) including changes made in response to the review process

The following improvements were made in response to the issues raised in the Stage 3 in-depth review of emission inventories submitted under the UNECE LRTAP Convention and EU National Emissions Ceilings Directive (CEIP/S3.RR/2010/AUSTRIA).

AREAS FOR IMPROVEMENTS IDENTIFIED BY AUSTRIA	Fullfiled
25. Introduction of an updated version of the "Handbook on Emission Factors" for transport.	The update of emission factors from HBEFA 2.1 – which are currently used in GLOBEMI – to the new version of HBEFA 3.1 has not been realised yet, but is planned to be implemented in the next submission. Information included in Chapter 3.3.5
General recommendations on cross-cutting issues.	
Completeness:	
50. The ERT considers the Transport sector to be complete and comprehensive for the pollutants reviewed.	–
Transparency & Comparability:	
51. The ERT commends the already good levels of detail in the methodology descriptions for the main sources within the transport sector (1A3a, b), encouraging the Party to further improve the transparency and comparability of its inventory by	Planned to be implemented in the next thorough update of the IIR.

AREAS FOR IMPROVEMENTS IDENTIFIED BY AUSTRIA	Fullfiled
providing even more details where necessary.	
52. On the other hand, the ERT notes that, compared to the main transport sub-categories, little information is provided on the "off-road" vehicles. Here, the Party provides information for all off-road vehicles together without further separation of sub-categories such as railways or navigation. The ERT therefore recommends that the Party includes much more detailed information and descriptions in its next submission for the sub-categories summed up under "off-road" at the moment.	As soon as the Umweltbundesamt budget allows a new study about off-road fuel consumption and pollutant emissions, input-data for the off-road traffic will be updated and recalculated with the model GEORG. Information included in Chapter 3.3.6
Accuracy:	
53. The ERT commends the Party for the QA/QC procedures implemented and the description of these procedures in the IIR.	–
54. The ERT encourages Austria to undertake specific uncertainty analysis for the Transport Sector in order to help inform the improvement process and to provide an indication of the reliability of the inventory data.	Planned to be implemented in submission 2012.
Recalculations:	
55. Austria has recalculated its inventory for almost all sectors in the year 2010, providing not only good information on the reasons within the IIR but also detailed data on the recalculated emissions on a very detailed level. The ERT commends the Party's efforts, encouraging Austria to try and provide such data on a level as disaggregated as possible.	Planned to be implemented in following submissions.
Improvements:	
56. The ERT commends the Party for its improvements carried out and still planned within the transport sector, encouraging the Party to further improve its inventory by attaching more attention to off-road mobile sources.	As soon as the Umweltbundesamt budget allows a new study about off-road fuel consumption and pollutant emissions, input-data for the off-road traffic will be updated and recalculated with the model GEORG. Information included in Chapter 3.3.6
Sub-sector Specific Recommendations.	
Category issue 1: 1.A.3a ii – Air Transport: Pb	
57. During the review the Party stated that production and import of leaded gasoline has been prohibited since 1993. In Austria and that earlier emission estimates are based on a lead content of 0.56 g Pb/litre for aviation gasoline. The Party also provided further explanatory information on the issue of emission factors used for lead emissions from avgas. The ERT thanks Austria for the information provided, and recommends that the Party provides additional explanatory information within the relevant IIR chapters in its next submission.	Information included in Chapter 3.3.8
Category issue 2: 1.A.3.bi & ii Road transport – Pb	
58. During the review the ERT asked the Party to provide additional information on the development of Pb emissions reported for these categories. Besides the information given above for avgas, Austria stated that from 1996 on a lead content of 0,1 mg/GJ has been estimated for gasoline due to the assumed use of lead additives for old non-catalyst vehicles and that a lead content of 0.02 mg/GJ has been assumed for diesel oil. The ERT thanks the Party for its detailed answer, asking the Party to include these assumptions in its IIR.	Information included in Chapter 3.3.8

AREAS FOR IMPROVEMENTS IDENTIFIED BY AUSTRIA	Fullfiled
Category issue 3: 1.A.3.b i: NMVOC, CO, NH_3	
59. The ERT noted some dips in the trends reported for 1990 emissions of NH_3, NMVOC and CO, asking the Party to provide some explanation on these issues. The ERT recommends that the Party include explanations in its IIR.	National NH_3, NMVOC and CO emissions show a constantly decreasing trend between 1985 and 1995 without any peaks. So, the dips can be explained by the methodology which is used for calculating fuel export (= total fuel sold minus inland and off-road consumption). Therefore, the dips must be a model output caused by changes in the Energy Balance. Information included in Chapter 3.3.5
Category issue 4: 1.A.3.b vi & vii: PM, TSP	
60. The ERT notes that particle emissions from tyre and brake wear (1A3bvi) are reported as 'IE', asking the Party to provide some information as to whether these emissions are part of 1A3bvii and why no separate reporting is possible. Austria states that PM emissions from tyre and brake wear are included in road abrasion and that it is not possible to develop separate emission factors (by road and vehicle type) from field emission measurements which consider total vehicle emissions. The ERT accepts this answer but wants to encourage the Party to further develop its models and to provide separate estimates for both sub-categories in future submissions.	Information included in Chapter 3.3.8 A separately reporting is not yet planned.
Category issue 5: 1.A.3.b vi & vii: Other HM	
61. The ERT notes that Austria reports emissions of all HM (besides Cd, Hg and Pb) as not reported (NR). The Party states that no such estimations have been carried out up to now. The ERT accepts this answer but anyhow wants to encourage Austria to provide estimates for 'Other HMs' in its next submission.	The reporting of 'Other HM' is not yet planned but this task is included in the inventory improvement plan.
Category issue 6: 1.A.4.a ii – All pollutants	
62. The ERT notes that Austria reports all emissions from 1A4aii as 'IE', giving no information, where these emissions are included. In contrast, under activity data only 'NO' occurs. The Party stated that emissions from mobile machinery are included in category 1A4bii and that it is not possible to split the data into commercial and non-commercial use. The ERT thanks Austria for the answer provided, and encourages the Party to provide more information on the notation keys used in its inventory in both IIR and NFR in its next submission. The ERT also encourages Austria to investigate whether it will be possible to gather new data to allow these two sources to be reported separately in the future.	Wie lautet hier die Antwort für IE und AD NO A separately reporting is not yet planned.

3.5 NFR 1 B Fugitive Emissions

Fugitive Emissions arise 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.

No changes regarding methodology and emission factor were made since submission 2009.

3.5.1 Completeness

Table 136 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 136: 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	PCDD/F	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*

3.5.2 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 137 together with the national emission factors (WINIWARTER et al. 2001).

Table 137: Emission factors and activity data for fugitive TSP, PM10 and PM2.5 emissions from NFR category 1B 1.

PM	Bituminous coal/Anthracite	Lignite/Brown coal	Coke oven coke
	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	2 041.80	1 629.94	2 319.99
2002	1 942.23	1 558.73	2 589.07
2003	2 410.56	1 649.99	2 514.93
2004	2 426.01	1 212.22	2 525.59
2005	2 152.34	1 272.92	2 750.68
2006	2 349.43	755.18	2 792.98
2007	2 291.18	94.25	2 762.01
2008	1 973.67	87.40	2 716.10

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 138.

Table 138: 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	8 743
2006	221	233	270	1 992	60	8 472
2007	228	233	270	1 966	60	8 496
2008	183	246	270	1 835	58	8 710

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 the country-specific share of 1.2% NMVOC in natural gas. This share is based on the natural gas composition in Austrian. Emissions are directly linked with CH_4 emissions that are calculated applying a Tier 3 method based on the specific distribution pipeline lengths separated by material and material specific EFs.

Table 139: 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/1000m^3] NMVOC	IEF [g/1000 m^3] SO_2	Natural gas extracted [1000 m^3]	IEF [g/km]	Distribution mains [km]
1990	849	1553	1 288 000	2 172	11 672
1991	824	980	1 326 000	1 941	12 700
1992	761	1392	1 437 000	1 829	13 893
1993	723	1411	1 488 000	1 635	15 178
1994	764	945	1 355 000	1 438	16 589
1995	676	1032	1 482 000	1 323	17 778
1996	659	804	1 492 000	1 217	18 995
1997	689	47	1 428 000	1 106	20 219
1998	614	27	1 568 000	1 038	21 339

Year	Gas extraction/first treatment			Gas distribution	
	IEF [g/1000m³] NMVOC	IEF [g/1000 m³] SO_2	Natural gas extracted [1000 m³]	IEF [g/km]	Distribution mains [km]
1999	547	82	1 741 000	969	22 701
2000	525	80	1 805 000	903	24 099
2001	485	81	1 954 000	866	25 042
2002	468	69	2 014 000	870	24 216
2003	465	74	2 030 000	831	25 699
2004	472	73	1 963 000	775	26 158
2005	557	81	1 637 000	753	26 958
2006	501	92	1 819 000	732	27 413
2007	284	99	1 848 000	712	27 945
2008	289	106	1 532 000	696	28 348

3.5.3 Recalculations

Activity data for 1 B 1 for the years 2001-2007 were updated due to updated energy statistics. EF NMVOC of natural gas distribution – previously based on the CH_4 default value – is now based on the country specific CH_4 EF.

3.6 Source-specific recalculations of NFR 1 B including changes made in response to the review process

The following improvements were made in response to the issues raised in the Stage 3 in-depth review of emission inventories submitted under the UNECE LRTAP Convention and EU National Emissions Ceilings Directive Directive (CEIP/S3.RR/2010/AUSTRIA).

AREAS FOR IMPROVEMENTS IDENTIFIED BY AUSTRIA	Fullfiled
27. Looking into the possible omission of NMVOC emissions from coal mining, storage and handling.	Planned to be implemented in following submissions.
Sub-sector Specific Recommendations	**Fullfiled**
Category issue 1: 1 B 1 a: NMVOC	
47. The ERT notes that Austria does not estimate emissions of NMVOCs from coal mining and handling. Emission factors for NMVOC from this sector are provided in the EMEP/EEA Guidebook. Austria notes that there has been no coal mining in Austria after 2007. The ERT encourages Austria to apply the default emission factors from the Guidebook and to estimate NMVOC emissions from coal mining and handling for the years prior to 2007. Austria will consider including this in its improvement plan.	Planned to be implemented in following submissions.

4 INDUSTRIAL PROCESSES (NFR SECTOR 2)

4.1 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 2009 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.

Only small changes regarding methodology and emission factor of Limestone and Dolomite use were made since submission 2009. For all other subcategories no changes regarding methodology and emission factor were made since submission 2009.

4.2 General description

4.2.1 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.

4.2.2 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 140. 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 140: 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.

4.2.3 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 subchapters of this chapter.

Update of emission factors

2 A 7a Quarrying and Mining of Minerals other than coal:

New emission factors for limestone, dolomite, and basalt use were used.

4.2.4 Completeness

Table 141 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 141: 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*

4.3 NFR 2 A Mineral Products

4.3.1 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 production 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 to VDI[111] 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)[112].

In 2011, a new confidential study was published by the Association for Building Materials and Ceramic Industries, which contained a new EF for PM 10 for limestone (AMANN&DÄMON, 2011). The calculation was based on the evaluation of 20 studies, comparing different quarries, also for dolomite and basaltic rocks. It showed that the EF can be used for all three kinds of material. For the calculation of emission factors for PM2.5 and TSP, the relation TSP 100%, PM10 46.51%, PM2.5 4.65% was used (WINIWARTER et al. 2007). For data befor 20000, EFs were calculated based on the same theory, but based on the EF for dolomite based on the study by HÖFINGER&TRENKER (2001).

Emission factors are presented in Table 142. Activity data are mainly taken from national statistics and presented in Table 143.

Table 142: 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 (3)	141.90	66.00	6.60
Limestone (3)	141.90	66.00	6.60
Basaltic rocks (3)	141.90	66.00	6.60
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

[111] Association of German Engineers – VDI Verein Deutscher Ingenieure
[112] http://www.air.sk/tno/cepmeip/em_factors_results.php?

Bulk material	EF TSP [g/t]	EF PM10 [g/t]	EF PM2.5 [g/t]
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/m²]**	**EF PM10 [g/m²]**	**EF PM2.5 [g/m²]**
Construction and demolition (1)	173.40	86.70	8.67

(1) *Source: WINIWARTER et al. 2008*

(2) *decreasing EF; values given for 2006 (1990)*

(3) *Source: AMANN&DÄMON 2011*

Table 143: Activity data for diffuse PM emissions from bulk material handling.

Activity data [t]	1990	1995	2000	2005	2008	2009
Magnesite	1 179 162	783 497	725 832	693 754	837 476	544 716
Sand	2 517 296	3 033 907	3 692 910	3 660 228	1 979 073	1 894 395
Gravel	14 264 676	17 192 140	20 978 974	25 361 797	30 373 832	28 385 404
Silicates	1 484 527	810 520	1 991 018	2 580 295	3 714 309	3 103 432
Dolomite	1 879 837	8 789 688	7 152 245	6 291 413	4 613 972	4 161 298
Limestone	15 371 451	19 079 581	23 823 529	22 643 754	23 795 020	22 085 833
Basaltic rocks	3 673 535	4 202 244	4 933 202	3 166 281	4 074 790	3 711 457
Iron ore	2 310 710	2 116 099	1 859 449	2 047 950	2 032 671	2 002 131
Tungsten ore	191 306	411 417	416 456	472 964	434 296	344 851
Gypsum, Anhydride	751 645	958 430	946 044	911 162	1 087 259	910 945
Lime, quick, slacked	512 610	522 934	654 437	760 464	847 847	695 019
Cement	3 693 539	2 929 973	3 052 974	3 221 167	3 996 243	3 428 140
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	62 387	91 733	89 120
Wheat flour	259 123	287 461	291 482	324 160	456 927	456 665
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	100 185	122 860	124 549
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	1 018 649	941 441	1 072 321
Constructed floor space [m²]	**1990**	**1995**	**2000**	**2005**	**2008**	**2009**
Construction and demolition	10 142 004	11 060 799	11 788 151	12 635 694	16 884 748	16 268 429

4.3.2 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 2008 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 144: Activity data for CO emissions from asphalt roofing.

	1990	1995	2000	2005	2007	2008	2009
Asphalt roofing [m^2]	27 945 000	31 229 000	26 020 734	27 952 613	27 952 613	27 952 613	27 952 613

4.3.3 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".

4.3.4 Recalculations

Because of the high uncertainty associated with the emission factors for diffuse PM emissions from limestone and dolomite, these emissions were excluded from the inventory. It is planned to revise these emissions as soon as substantiated data are available.

4.4 NFR 2 B Chemical Products

4.4.1 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 (IEF) was calculated (see Table 145 and Table 146). The implied emission factor (IEF) 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 in 2009 decreased significantly, this is due to a change of combustion temperature in the plant which results in a decrease of emissions.

NO_x emissions from 1990 to 1992 are reported in category *2 B 5 Other processes in organic chemical industries*.

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.

Table 145: 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
2007	177	401	24.0	54.4	84	190
2008	224	458	12.1	24.8	46	94
2009	129	287	13	28.3	43	95

Table 146: 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

Year	NO_x emission [Mg]	NO_x IEF [g/Mg]	NH_3 emission [Mg]	NH_3 IEF [g/Mg]
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
2007	135	270	1.60	3.20
2008	113	201	1.20	2.14
2009	97	195	1.30	2.62

4.4.2 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 147: TSP, PM10, PM2.5 emissions and emissions and implied emission factors for and NH_3 from Ammonia nitrate.

Year	NH_3 emission [Mg]	NH_3 IEF [g/Mg]	TSP emission [Mg]	PM10 emission [Mg]	PM2.5 emission [Mg]
1990	0.71	72	12.80	11.52	10.24
1991	1.05	72	NE	NE	NE
1992	0.78	72	NE	NE	NE
1993	0.84	72	NE	NE	NE
1994	0.30	24	12.80	11.52	10.24
1995	0.90	72	14.90	13.41	11.92
1996	0.40	28	9.80	8.82	7.84
1997	0.30	22	0.40	0.38	0.36
1998	0.30	21	0.30	0.28	0.27
1999	0.30	21	0.40	0.38	0.36
2000	0.20	13	0.20	0.19	0.18
2001	0.30	20	0.30	0.28	0.27
2002	0.48	29	0.20	0.19	0.18
2003	0.43	24	0.30	0.29	0.27
2004	0.40	21	0.20	0.19	0.18
2005	0.33	17	0.26	0.24	0.23
2006	0.43	22	0.30	0.28	0.27
2007	0.53	26	0.30	0.29	0.27
2008	0.34	22	0.20	0.19	0.18
2009	0.30	23	0.40	0.38	0.36

Table 148: 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

Year	NH_3 emission [Mg]	NH_3 IEF [g/Mg]	CO emission [Mg]	CO IEF [g/Mg]
2005	30	72	4	9
2006	25	59	4	9
2007	32	83	3	9
2008	29	70	4	9
2009	40	100	4	9

Fertilizer production

For fertilizer production activity data from 1990 to 1994 were taken from national production statistics[113] (STATISTIK AUSTRIA); NO_x and NH_3 emissions and activity data from 1995 onwards were reported by the main producer in Austria. For the years 1990 to 1993 NH_3 emissions were estimated with information on emissions of the main producer and extrapolation to total production. The emission estimate for 1994 was obtained by applying the average emission factor of 1995–1999. NO_x emissions from 1990 to 1992 are included in *Other processes in organic chemical industries*.

Cd, Hg and Pb emissions were calculated by multiplying the above mentioned activity data with national emission factors (HÜBNER 2001a), that derive from analysis of particular matter fractions as described in (MA LINZ 1995). Particular matter emissions (fugitive and non-fugitive) were estimated for the whole fertilizer production in Austria (WINIWARTER et al. 2007) for the years 1990, 1995 and 1999. Implied emission factors were calculated from emission and activity data that were used to calculate emissions from 2000 to 2005. The shares of PM10 and PM2.5 are 58.6% and 30.9% for the whole time-series.

Table 149: 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

[113]This results in an inconsistency of the time series, as activity data taken from national statistics represent total production in Austria, whereas the data obtained from the largest Austrian producer covers only the production of this producer. It is planned to prepare a consistent time series.

Year	NO_x emission [Mg]	NH_3 emission [Mg]
2004	47	20
2005	89	25
2006	70	32
2007	26	17
2008	82	36
2009	70	32

Table 150: 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
2007	0.62	0.08	0.78	390	228	120
2008	0.62	0.08	0.78	455	267	140
2009	0.62	0.08	0.78	375	220	116

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 151.

Table 151: 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
2007	1 325	1 066 788	IE	766	11 064	908 640
2008	1 325	1 066 788	IE	766	11 064	908 640
2009	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 152: 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	NO	20 000	NO
2005	NO	NO	NO

4.4.3 Recalculations

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

4.5 NFR 2 C Metal Production

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.

4.5.1 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[114]), (HÜBNER 2001b[115]) for each of the processes (sinter, coke oven, blast furnace cowpers) separately and summing up emissions. For the years 2001–2008 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[116]). The sources for these emissions are environmental declarations from the companies. For the years 2002–2008 total particular matter emissions are reported directly by the operator.

Pig iron production figures were taken from national statistics. Activity data, POP, HM and PM emissions are presented in Table 153.

Table 153: 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
2007	5 887 710	134	321	3 484	189	2	3 622	772	540	232
2008	5 845 533	133	319	3 460	188	2	3 596	970	679	291
2009	4 376 368	100	239	2 590	141	1	2 692	888	621	266

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

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

[116] according to VOEST (2000)

Basic Oxygen Furnace Steel Plant

In this category POP and heavy metal emissions are considered. SO_2, NO_x, NMVOC and CO emissions are included in category 1 A 2 a. 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[117]), 1995–2000 (HÜBNER 2001a[114]), the latest were also used for 2001–2008, and multiplied with steel production to calculate HM emissions. POP emissions were calculated by multiplying steel production with national emission factors (HÜBNER 2001b[115]).

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

Table 154: 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									
2007	6 871 499									
2008	6 872 742									
2009	5 076 926									

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 155 together with electric steel production figures.

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

Table 155: Activity data and emission factors for emissions from Electric Steel Production 1990–2008.

	1990	1995	2000	2005	2007	2008	2009
Electric steel production [Mg]							
Activity	370 107	453 645	540 539	624 262	706 501	757 258	585 074
Emission factor [g/Mg Electric steel production]							
SO_2	590(1)	511(3)	119(3)	40(2)	40(2)	40(2)	40(2)
NO_x	330(1)	295(3)	119(3)	84(2)	84(2)	84(2)	84(2)
NMVOC	60(1)	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)	159(2)
Emission factor [mg/Mg Electric steel production]							
Cd	80.0(4)	13.0(5)	13.0(5)	0.4(2)	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)	1.0(5)
Pb	4 125.0(4)	470.0(5)	470.0(5)	19.3(2)	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)	4.6(6)
Emission factor [µg/Mg Electric steel production]							
DIOX	4.2(6)	1.4(6)	1.4(6)	0.1(2)	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)	20.0(2)
Emission factor [g/Mg Electric steel production]							
TSP	610.0(7)	610.0(7)	30.0(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)	28.5(8)
PM2.5	549.0(9)	549.0(9)	27.0(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[117])*

(5) *(HÜBNER 2001a[114])*

(6) *(HÜBNER 2001b[115])*

(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 156: Emission factors and activity data for cast iron 1990–2008.

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
2007	130	151	1 180	10 843	223 108
2008	130	151	1 180	10 843	222 152
2009	130	151	1 180	10 843	138 745

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 157: Activity data for cast steel 1990–2008.

Year	Activity [Mg]
1990	86 844
1995	107 486
2000	116 766
2004	118 410
2005	119 570
2006	126 352
2007	136 096
2008	135 513
2009	84 634

4.5.2 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[118]) 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 158: Emission factors and activity data for light metal cast 1990–2008.

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
2007	10	170	1 289	660	118 215
2008	10	170	1 289	660	120 194
2009	10	170	1 289	660	92 374

Table 159: Emission factors and activity data for heavy metal cast 1990–2008.

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

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

Year	Emission factors [g/Mg]				Activity [Mg]
	SO_2	NO_x	NMVOC	CO	Heavy metal cast
2007	80	80	1 180	2 770	15 690
2008	80	80	1 180	2 770	15 387
2009	80	80	1 180	2 770	12 394

4.5.3 Recalculations

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

4.6 NFR 2 D Other Production

4.6.1 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 160: Activity data for chipboard production 1990–2008.

Year	Activity [Mg]
1990	1 121 786
1995	1 194 262
2000	1 509 673
2004	1 248 028
2005	2 182 251
2006	2 560 241
2007	2 560 241
2008	2 147 527
2009	1 782 448

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 (STATISTIK AUSTRIA 2009) that was applied to the whole time-series.

Table 161: 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 162: 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	11 794	25.90	10.36	4.14
1995	12 601	27.67	11.07	4.43
2000	29 914	65.69	26.28	10.51
2001	31 877	70.00	28.00	11.20
2002	30 658	67.32	26.93	10.77
2003	35 971	78.99	31.60	12.64
2004	34 476	75.71	30.28	12.11
2005	54 775	120.28	48.11	19.25
2006	57 026	125.22	50.09	20.04
2007	72 948	160.19	64.07	25.63
2008	77 435	170.04	68.02	27.21
2009	76 050	167.00	66.80	26.72

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 double counted. 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

Update of activity data based on energy balance of 2010.

4.6.2 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 2008 no activity data was yet available, that's why the values of 2007 were also used for 2008.

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[119]) 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 163.

[119] according to MEISTERHOFER (1986)

Table 163: POP emissions and activity data from smokehouses 1990–2008.

Year	Activity [Mg]	Emissions		
	Smoked meat	PAH [kg]	Diox [g]	HCB [g]
1990	15 318	545	1.8	358
1995	19 533	107	0.4	72
2000	19 533	37	0.1	26
2004				
2005				
2006				
2007				
2008				
2009				

Recalculations

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

4.6.3 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 164: 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	1 670 903	43.38	17.35	6.94
2002	1 785 275	46.34	18.54	7.42
2003	1 136 820	29.51	11.80	4.72
2004	1 248 028	32.40	12.96	5.18
2005	2 182 251	56.65	22.66	9.06
2006	2 560 241	66.46	26.58	10.63
2007	2 560 241	66.46	26.58	10.63
2008	2 147 527	71.92	28.77	11.51
2009	1 782 448	60.34	24.13	9.65

Recalculations

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

4.7 Source-specific recalculations of NFR 2 including changes made in response to the review process

The following improvements were made in response to the issues raised in the Stage 3 in-depth review of emission inventories submitted under the UNECE LRTAP Convention and EU National Emissions Ceilings Directive (CEIP/S3.RR/2010/AUSTRIA).

AREAS FOR IMPROVEMENTS IDENTIFIED BY AUSTRIA	Fullfiled
26. Further investigation of the issue of possible double-counting in chipboard production	This task is included in the inventory improvement plan.
General recommendations on cross-cutting issues	
Completeness:	
63. The ERT considers the industrial processes sector to be almost complete. Only an emissions estimate for the Ferroalloys production is missing. TSP emissions are assumed to be negligible and would contribute 0.02% to the national total.	This task is included in the inventory improvement plan.
Transparency:	
64. The ERT notes that the Industrial Processes sector in the Austrian IIR is in general very well organised and includes almost all necessary information. This approach provides a high level of transparency. However, there are some categories which would benefit from improved transparency (see chapter Sector-specific Recommendations).	-

AREAS FOR IMPROVEMENTS IDENTIFIED BY AUSTRIA	Fullfiled
Accuracy:	
65. The ERT encourages Austria to undertake sector-specific quantitative uncertainty analysis for the industrial processes in order to help inform the improvement process and to provide an indication of the reliability of the inventory data.	This task is included in the inventory improvement plan.
66. Austria has implemented a quality management system (QMS) which is based on ISO/IEC 17020 *General criteria for the operation of various types of bodies performing inspections* and which incorporate many of the EMEP/EEA emission inventory guidebook 2009 requirements. ERT encourages Austria to provide more sector-specific information in the next submission.	Chapter 4.2.2.
Recalculations:	
67. Because of changes in methodologies and activity data, the ERT noted that Austria revised the emissions of the year 2007 for 2.D.2 Other Production – Food and Drink (Bread, Wine, Beer and Spirits). This recalculation had an insignificant influence on the total NMVOC emissions. Austria also revised emissions estimates of TSP, PM_{10} and $PM_{2.5}$ emissions from limestone and dolomite and excluded these emissions from the inventory. These recalculations had a very significant influence on the total TSP, PM_{10} and $PM_{2.5}$ emissions. The ERT appreciates Austria's plans to revise these emissions.	Chapter 4.3.1
Improvement:	
68. The Austrian IIR includes only very limited information about sector-specific improvements plans. The ERT encourages Austria to provide more sector-specific information about planned improvements in the next submission.	This task is included in the inventory improvement plan.
Sector-specific Recommendations	
Category issue 1: 2 A 1 Cement production	
69. The ERT noted that Austria reported SO_2 emissions from Cement production as NA. Austria has responded that the methodology does not allow combustion and process emissions to be split. The ERT encourages Austria to try and separate emissions from combustion and from processes and to report them under the relevant categories in future submissions. Where this is not possible the ERT encourages Austria to use the IE notation key and to provide comments in the IIR and NFR.	This task is included in the inventory improvement plan.
Category issue 2: 2 C 1 Iron and steel production	
70. The ERT notes that some data used for HM estimates are provided in table 162 of the IIR. However, the ERT suggests that Austria should present some activity data more clearly - in particular activity data for coke production, coke consumption in sinter plants and blast furnace gas production.	This task is included in the inventory improvement plan.
Category issue 3: 2 C 3 Aluminium production	
71. The ERT notes that the Austrian IIR does not use terminology used in NFR for chapter titles. This makes the IIR difficult to follow. The ERT recommends that Austria should increase the transparency of industrial processes reporting by ensuring that each category is described under individual and appropriately named chapters.	See relevant chapters.

5 SOLVENT AND OTHER PRODUCT USE (CRF SECTOR 3)

5.1 Sector Overview

This chapter describes the methodology used for calculating greenhouse gas emissions from solvent use in Austria. 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 (Fireworek 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

No changes regarding methodology and emission factor were made since submission 2009.

5.1.1 Emission Trends

In the year 2008, 58% of total NMVOC emissions in Austria (104 Gg) originated from *Solvent and Other Product Use*. Table 165 present the trend in NMVOC emissions by subcategories.

Table 165: Total NMVOC emissions and trend from 1990–2008 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	114.43	45.79	15.20	30.58	13.70	13.26	0.44	12.79	42.15	12.65	11.61	17.89
1991	96.93	37.87	12.84	25.04	11.26	10.88	0.38	10.44	37.35	10.76	11.16	15.43
1992	78.54	29.79	10.36	19.43	8.87	8.55	0.32	8.14	31.74	8.77	10.24	12.74
1993	79.91	29.21	10.51	18.70	8.79	8.45	0.34	7.95	33.97	8.97	11.77	13.22
1994	75.02	26.17	9.82	16.34	8.05	7.72	0.33	7.16	33.64	8.48	12.48	12.68
1995	81.27	26.72	10.60	16.12	8.55	8.18	0.37	7.42	38.58	9.26	15.27	14.05
1996	77.47	24.66	9.86	14.80	8.39	8.02	0.36	7.10	37.32	8.55	15.33	13.44
1997	83.48	25.70	10.36	15.34	9.29	8.88	0.40	7.68	40.82	8.90	17.38	14.54
1998	75.46	22.44	9.13	13.31	8.61	8.24	0.37	6.96	37.45	7.76	16.49	13.19
1999	69.41	19.91	8.17	11.73	8.11	7.77	0.35	6.43	34.96	6.87	15.91	12.18
2000	82.35	22.74	9.43	13.31	9.85	9.43	0.42	7.66	42.10	7.84	19.77	14.49
2001	86.90	24.08	10.00	14.08	10.69	10.25	0.44	7.94	44.18	8.05	20.74	15.39
2002	95.77	26.63	11.07	15.56	12.12	11.63	0.49	8.60	48.42	8.62	22.73	17.07
2003	97.69	27.25	11.34	15.91	12.71	12.21	0.51	8.61	49.11	8.54	23.06	17.52
2004	83.58	23.39	9.75	13.64	11.18	10.74	0.44	7.23	41.78	7.08	19.61	15.08
2005	88.39	24.81	10.36	14.45	12.14	11.68	0.47	7.50	43.93	7.26	20.62	16.05
2006	103.73	29.12	12.16	16.96	14.25	13.70	0.55	8.80	51.56	8.52	24.20	18.84
2007	95.06	26.68	11.14	15.54	13.06	12.56	0.50	8.07	47.25	7.81	22.18	17.26
2008	97.11	27.26	11.38	15.88	13.34	12.83	0.51	8.24	48.27	7.97	22.66	17.64
Trend												
1990–2008	-15.1%	-40.5%	-25.1%	-48.1%	-2.6%	-3.3%	17.5%	-35.6%	14.5%	-37.0%	95.2%	-1.4%
2007–2008	2.2%	2.2%	2.2%	2.2%	2.2%	2.2%	2.2%	2.2%	2.2%	2.2%	2.2%	2.2%
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%
2008	59,4%	16,7%	7,0%	9,7%	8,2%	7,9%	0,3%	5,0%	29,5%	4,9%	13,9%	10,8%

Greenhouse gas emissions in this sector decreased by 24% between 1990 and 2008, due to decreasing solvent and N_2O use 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[120]*, amendment of Federal Law Gazette 872/1995*[121]*; amendment of Federal Law Gazette 492/1991*[122] *(implementation of Council Directive 2004/42/CE)*

[120] 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

- 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[123]*, amendment of Federal Law Gazette 27/1990*[124]

- 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[125]

- 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[126]

- Convention on Long-range Transboundary Air Pollution (LRTAP)[127], extended by eight protocols from which the following have relevance
  - The 1988 Protocol concerning the Control of Nitrogen Oxides or their Transboundary Fluxes[128]
  - The 1991 Protocol concerning the Control of Emissions of Volatile Organic Compounds or their Transboundary Fluxes[129]
  - The 1998 Protocol on Persistent Organic Pollutants (POPs)[130]
  - The 1999 Protocol to Abate Acidification, Eutrophication and Ground-level Ozone; 21 Parties.[131]

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

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

123 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

124 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

125 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)

126 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

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

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

129 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

130 Entered into force on 23 October 2003; ratified by Austria 27 August 2002

131 Entered into force on 17 May 2005; signed by Austria 1 December 2000

- 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[132]*, amended by Federal Law Gazette*[133]
- Council Directive 1999/13/EC[134] 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[135] of the European Parliament and of the Council of 21 April 2004 on the limitation of emissions of volatile organic compounds due to the use of organic solvents in certain paints and varnishes and vehicle refinishing products and amending Directive 1999/13/EC
- Ordinance on the limitation of emission during the use of solvents containing lightly volatile halogenated hydrocarbons in industrial facilities and installations

  Federal Law Gazette II No. 411/2005[136]

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

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[132] 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

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

[134] 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

[135] 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

[136] 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

5.1.2 Completeness

Table 166 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 166: 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	PCDD/F	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	✓

5.2 NMVOC Emissions from Solvent and other product use (Category 3.A, 3.B, 3.C and 3.D.3)

5.2.1 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 11 to Figure 13 present an overview of the methodology.

The top down approach provided total quantities of solvents used in Austria. The share of the solvents used for the different applications and the solvent emission factors have been calculated on the basis of the bottom up approach. By linking the results of bottom up and top down approach, quantities of solvents annually used and solvent emissions for the different applications were obtained.

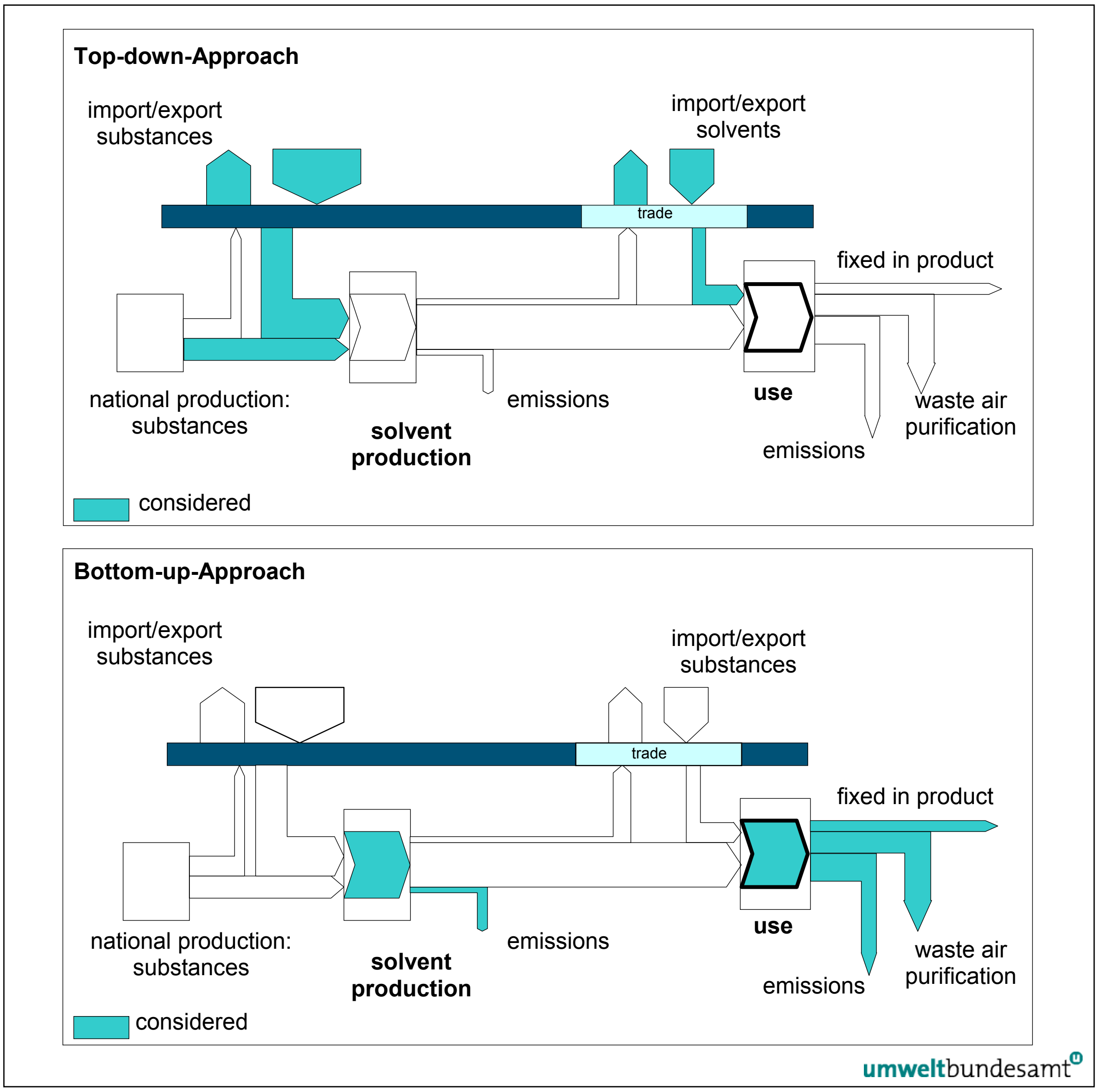

Figure 11: Top-down-Approach compared to Bottom-up-Approach.

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

CRF Sector 3A-3D	SNAP Level 3		Solvent Share CRF 3	Solvent Share CRF 3A-D	Solvent Share SNAP Lev 3	Solvent Emission Factor CRF 3	Solvent Emission Factor CRF 3A-D	Solvent Emission Factor SNAP Lev 3	Solvent Activity CRF 3	Solvent Activity CRF 3A-D	Solvent Activity SNAP Lev 3	Solvent Emissions CRF 3	Solvent Emissions CRF 3A-D	Solvent Emissions 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 vehicles			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 12: Combination of Top-down-Approach compared to Bottom-up-Approach for 2008.

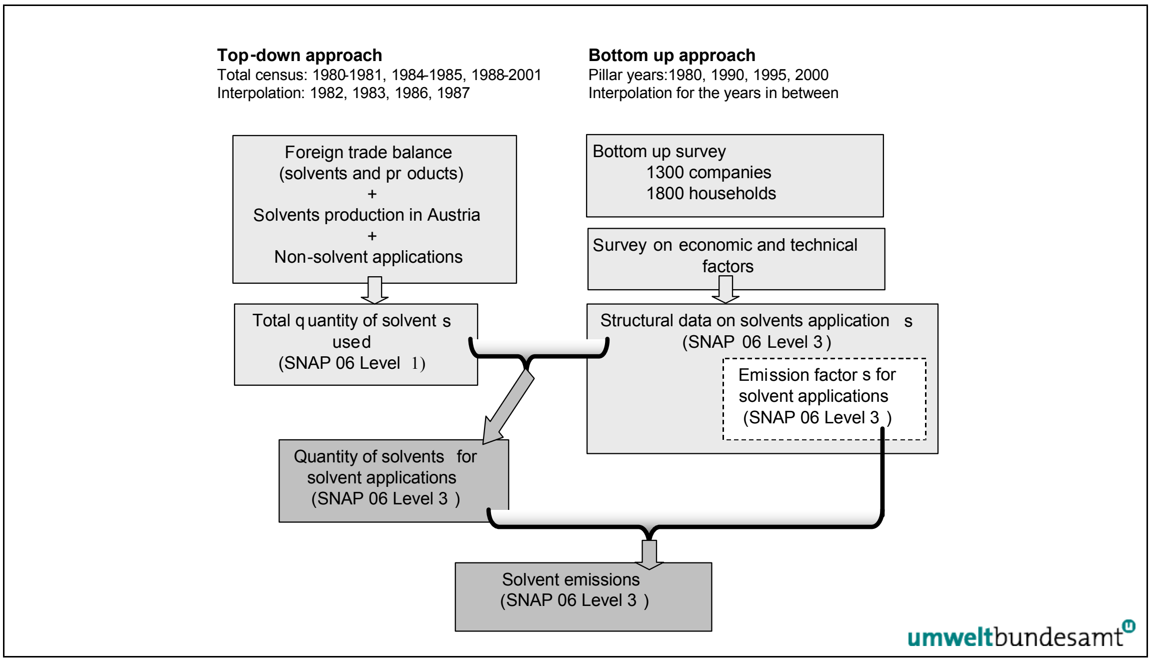

Figure 13: Overview of the methodology for solvent emissions.

A study (WINDSPERGER et al. 2002a) showed that emission estimates only based on the top down approach overestimate emissions because a large amount of solvent substances is used for "non-solvent-applications". "Non-solvent application" are applications where substances usually are used as feed stock in chemical, pharmaceutical or petrochemical industry (e.g. production of MTBE[137], ETBE[138], 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.

5.2.2 Top-down Approach

The top-down approach is based on

1. import-export statistics (foreign trade balance)
2. production statistics on solvents in Austria
3. a survey on non-solvent-applications in companies (WINDSPERGER et al. 2004a, WINDSPERGER et al. 2008)
4. 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.

[137] Methyl-tertiär-butylether

[138] Ethyl-*tert*-butylether

5.2.3 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 167).

Table 167: 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 relevant branches taken from national employment statistics (STATISTIK AUSTRIA 2000 & 1998) and using information from (KSV1870 INFORMATION, 2000).

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 168: 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 169: 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%

SNAP category	description	year	Distribution of used paints		Part of waste gas treatment	
			Solvent based paints	Water based paints	application	purification
060108	Other industrial paint application	2005	97%	3%	90%	46%
		2000				
		1995	99%	1%	87%	45%
		1990	100%	0%	26%	20%
		1980	100%	0%	0%	0%
060201	Metal degreasing	2005	92%	8%	75%	0%
		2000				
		1995	95%	5%	65%	0%
		1990	100%	0%	10%	0%
		1980	100%	0%	0%	0%
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 170: 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).

5.2.4 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 was carried out (see below Table 171). 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 has been increased up to 25%. Table 171 shows the range of the differences in the considered pillar years broken down to the 15 substance categories.

Table 171: 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. Table 172 presents activity data and implied emission factors.

Table 172: Activity data for solvent and other product use [Mg].

IPCC	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	50 391	1 755	938	4 183	1 911	4 976	4 794	31 834
2001	53 759	1 977	1 008	4 486	2 035	5 232	4 980	34 042
2002	59 892	2 318	1 130	5 023	2 264	5 744	5 400	38 013
2003	61 757	2 507	1 174	5 206	2 331	5 837	5 417	39 286
2004	53 410	2 268	1 022	4 524	2 013	4 974	4 556	34 053
2005	57 101	2 530	1 100	4 860	2 148	5 240	4 736	36 486
2006	67 010	2 969	1 291	5 704	2 521	6 150	5 557	42 818
2007	61 407	2 721	1 183	5 227	2 310	5 636	5 093	39 238
2008	62 733	2 780	1 208	5 340	2 360	5 757	5 203	40 085

IPCC	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	17 773	8 155	492	1 725	7 401
2001	19 308	8 696	524	1 768	8 321
2002	21 892	9 682	582	1 890	9 738
2003	22 962	9 978	600	1 867	10 517
2004	20 190	8 625	518	1 545	9 501
2005	21 934	9 216	553	1 579	10 586
2006	25 741	10 816	648	1 853	12 424
2007	23 588	9 911	594	1 698	11 385
2008	24 098	10 125	607	1 735	11 630

IPCC	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	14 948	619	8 816	1 200	273	949	708	5	59	2 319
2001	15 523	623	9 163	1 256	290	928	742	5	58	2 457
2002	16 827	653	9 944	1 372	321	942	812	6	60	2 718
2003	16 877	632	9 983	1 387	328	877	822	6	57	2 784
2004	14 191	511	8 404	1 176	282	678	698	5	45	2 392
2005	14 744	508	8 742	1 233	300	640	733	5	44	2 540
2006	17 303	597	10 258	1 446	352	751	860	6	51	2 981
2007	15 856	547	9 401	1 326	322	688	788	6	47	2 732
2008	16 198	558	9 604	1 354	329	703	805	6	48	2 790

IPCC	3.D.5								
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	56 657	11 929	281	607	615	184	23 483	6 040	13 519
2001	59 520	12 268	269	587	666	195	24 647	6 433	14 456
2002	65 295	13 164	265	587	752	216	27 013	7 155	16 142
2003	66 294	13 061	239	538	785	221	27 401	7 366	16 681
2004	56 452	10 858	178	408	688	190	23 311	6 361	14 459
2005	59 422	11 147	159	375	745	203	24 513	6 790	15 491
2006	69 734	13 082	187	440	874	238	28 767	7 968	18 179
2007	63 903	11 988	171	403	801	218	26 362	7 302	16 659
2008	65 283	12 247	175	412	818	223	26 931	7 459	17 019

Table 173: NMVOC emission of Category 3 Solvent and Other Product Use 1990–2008.

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	85.337	3.617	1.713	6.767	5.075	8.334	12.951	46.880
1991	76.246	3.476	1.547	6.176	3.970	7.045	11.951	42.081
1992	75.006	3.383	1.530	6.082	4.088	6.978	11.700	41.246
1993	73.779	3.291	1.513	5.988	4.205	6.910	11.452	40.421
1994	72.565	3.200	1.496	5.895	4.321	6.839	11.207	39.606
1995	71.200	3.103	1.476	5.790	4.426	6.752	10.941	38.712
1996	70.831	3.049	1.477	5.766	4.592	6.757	10.829	38.361
1997	70.454	2.995	1.477	5.742	4.761	6.759	10.715	38.005
1998	70.070	2.941	1.478	5.716	4.931	6.759	10.600	37.645
1999	60.702	2.514	1.288	4.957	4.446	5.886	9.134	32.478
2000	45.790	1.679	971	3.659	4.012	4.733	6.563	24.173
2001	37.875	1.335	866	3.341	3.149	3.996	5.480	19.709
2002	29.790	1.011	740	2.921	2.327	3.222	4.376	15.194
2003	29.206	956	796	3.211	2.112	3.254	4.386	14.490
2004	26.166	829	793	3.263	1.711	3.025	4.056	12.488
2005	26.720	825	916	3.834	1.521	3.235	4.327	12.062
2006	24.663	821	856	3.619	1.479	2.962	3.907	11.018
2007	25.702	921	905	3.859	1.625	3.062	3.975	11.355
2008	22.437	864	802	3.450	1.497	2.649	3.379	9.796

IPCC	3.B	3 B 1	3 B 2	3 B 1	3 B 1
SNAP	**Total**	**060201**	**060202**	**060203**	**060204**
Unit			**Mg**		
1990	28.405	21.803	515	3.753	2.334
1991	26.638	21.586	373	3.557	1.122
1992	25.967	20.779	391	3.452	1.346
1993	25.307	19.985	408	3.348	1.566
1994	24.658	19.205	425	3.246	1.782
1995	23.965	18.396	440	3.139	1.990
1996	23.612	17.850	461	3.076	2.224
1997	23.257	17.303	483	3.014	2.458
1998	22.901	16.753	504	2.951	2.694
1999	19.641	14.114	458	2.515	2.553
2000	13.699	8.655	436	1.704	2.903
2001	11.262	6.764	382	1.371	2.745
2002	8.869	5.019	321	1.050	2.479
2003	8.788	4.634	339	1.005	2.810
2004	8.055	3.905	331	882	2.937
2005	8.551	3.745	375	886	3.545
2006	8.387	3.560	365	818	3.644
2007	9.285	3.816	401	853	4.215
2008	8.610	3.422	369	745	4.073

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	28.405	11.170	2.750	543	1.044	20	3	292	11.182	1.593
1991	26.638	9.782	1.568	465	815	18	2	283	11.882	1.409
1992	25.967	9.278	1.780	468	839	18	2	276	11.349	1.402
1993	25.307	8.784	1.990	470	864	18	2	269	10.820	1.395
1994	24.658	8.298	2.198	472	888	18	2	262	10.295	1.389
1995	23.965	7.803	2.399	473	910	18	3	255	9.752	1.379
1996	23.612	7.422	2.633	481	945	18	3	251	9.345	1.388
1997	23.257	7.039	2.870	489	980	18	3	247	8.931	1.398
1998	22.901	6.655	3.111	496	1.016	19	3	243	8.510	1.407
1999	19.641	5.463	2.922	439	916	16	3	208	7.041	1.234
2000	13.699	3.826	3.170	359	829	13	3	139	3.488	963
2001	11.262	2.896	2.582	313	743	12	3	116	2.940	837
2002	8.869	2.071	1.998	262	639	10	2	92	2.369	697
2003	8.788	1.832	1.926	275	691	10	3	92	2.394	731
2004	8.055	1.466	1.695	268	692	10	3	85	2.230	709
2005	8.551	1.321	1.697	302	803	11	3	89	2.395	796
2006	8.387	1.425	1.525	282	791	10	3	78	2.265	718
2007	9.285	1.720	1.541	297	879	10	4	77	2.420	728
2008	8.610	1.726	1.298	263	819	8	4	62	2.167	616

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	64.222	24.881	169	1.811	1.173	196	12.113	5.932	17.947
1991	53.674	22.859	151	1.836	1.068	136	8.281	4.640	14.703
1992	53.916	22.383	150	1.772	1.057	145	8.865	4.778	14.764
1993	54.152	21.914	149	1.710	1.047	154	9.444	4.915	14.819
1994	54.381	21.451	149	1.647	1.036	163	10.018	5.051	14.867
1995	54.479	20.946	148	1.582	1.023	171	10.561	5.173	14.874
1996	55.333	20.736	149	1.538	1.025	182	11.253	5.368	15.083
1997	56.191	20.523	150	1.494	1.026	193	11.952	5.565	15.288
1998	57.053	20.309	151	1.449	1.027	204	12.661	5.764	15.489
1999	50.458	17.504	132	1.222	896	187	11.655	5.196	13.665
2000	42.154	12.654	102	719	671	185	11.607	4.689	11.527
2001	37.353	10.763	89	592	596	167	11.162	4.307	9.677
2002	31.741	8.765	74	466	507	145	10.239	3.791	7.754
2003	33.966	8.972	77	460	544	158	11.774	4.198	7.782
2004	33.636	8.481	74	419	540	160	12.480	4.299	7.183
2005	38.579	9.264	83	440	621	187	15.267	5.096	7.621
2006	37.323	8.546	74	409	589	172	15.332	4.953	7.247
2007	40.819	8.899	74	429	631	179	17.377	5.442	7.787
2008	37.446	7.760	62	377	567	156	16.494	5.014	7.017

Table 174: Implied NMVOC Emission factors for Category 3 Solvent and Other Product Use 1990–2008.

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	972.178	1.000.000	993.484	884.692	980.642	1.000.000	875.494
1991	968.986	997.633	989.745	884.692	966.706	993.730	866.186
1992	965.794	995.266	986.005	884.692	952.770	987.461	856.877
1993	962.602	992.899	982.266	884.692	938.834	981.191	847.568
1994	959.409	990.532	978.526	884.692	924.898	974.921	838.259
1995	956.217	988.165	974.787	884.692	910.962	968.651	828.951
1996	953.025	985.798	971.048	884.692	897.026	962.382	819.642
1997	949.833	983.431	967.308	884.692	883.090	956.112	810.333
1998	946.641	981.064	963.569	884.692	869.154	949.842	801.024
1999	943.448	978.697	959.829	884.692	855.218	943.572	791.716
2000	940.256	976.330	956.090	884.692	841.282	937.303	782.407
2001	881.087	973.302	943.066	885.292	789.602	892.671	700.783
2002	821.917	970.273	930.042	885.892	737.923	848.039	619.160
2003	762.747	967.245	917.018	886.492	686.243	803.408	537.536
2004	703.578	964.216	903.994	887.092	634.563	758.776	455.913
2005	644.408	961.188	890.970	887.692	582.884	714.144	374.290
2006	630.223	947.902	888.550	887.692	572.205	705.644	360.196
2007	616.038	934.617	886.130	887.692	561.525	697.144	346.102
2008	601.854	921.331	883.710	887.692	550.846	688.645	332.009

IPCC	3 B 1	3 B 2	3 B 1	3 B 1
SNAP	**060201**	**060202**	**060203**	**060204**
Unit		**[gNMVOC/t]**		
1990	1.000.000	990.000	847.084	756.137
1991	993.487	986.000	840.133	752.795
1992	986.975	982.000	833.183	749.452
1993	980.462	978.000	826.232	746.110
1994	973.949	974.000	819.281	742.767
1995	967.436	970.000	812.331	739.425
1996	960.924	966.000	805.380	736.082
1997	954.411	962.000	798.429	732.740
1998	947.898	958.000	791.478	729.397
1999	941.386	954.000	784.528	726.055
2000	934.873	950.000	777.577	722.712
2001	859.909	936.000	720.859	717.653
2002	784.944	922.000	664.140	712.594
2003	709.980	908.000	607.421	707.534
2004	635.015	894.000	550.703	702.475
2005	560.051	880.000	493.984	697.416
2006	537.371	874.000	482.891	693.820
2007	514.691	868.000	471.797	690.225
2008	492.011	862.000	460.703	686.629

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					[gMNVOC/t]				
1990	1.000.000	768.177	1.000.000	1.000.000	1.000.000	10.017	887.574	882.325	1.000.000
1991	998.559	737.606	1.000.000	1.000.000	1.000.000	10.017	890.310	882.325	1.000.000
1992	997.119	707.035	1.000.000	1.000.000	1.000.000	10.017	893.047	882.325	1.000.000
1993	995.678	676.464	1.000.000	1.000.000	1.000.000	10.017	895.784	882.325	1.000.000
1994	994.237	645.893	1.000.000	1.000.000	1.000.000	10.017	898.520	882.325	1.000.000
1995	992.797	615.322	1.000.000	1.000.000	1.000.000	10.017	901.257	882.325	1.000.000
1996	991.356	584.751	1.000.000	1.000.000	1.000.000	10.017	903.993	882.325	1.000.000
1997	989.915	554.180	1.000.000	1.000.000	1.000.000	10.017	906.730	882.325	1.000.000
1998	988.475	523.609	1.000.000	1.000.000	1.000.000	10.017	909.467	882.325	1.000.000
1999	987.034	493.038	1.000.000	1.000.000	1.000.000	10.017	912.203	882.325	1.000.000
2000	985.593	462.467	1.000.000	1.000.000	1.000.000	10.017	914.940	882.325	1.000.000
2001	981.271	420.541	1.000.000	1.000.000	1.000.000	10.017	915.713	882.325	1.000.000
2002	976.950	378.615	1.000.000	1.000.000	1.000.000	10.017	916.486	882.325	1.000.000
2003	972.628	336.689	1.000.000	1.000.000	1.000.000	10.017	917.260	882.325	1.000.000
2004	968.306	294.763	1.000.000	1.000.000	1.000.000	10.017	918.033	882.325	1.000.000
2005	963.984	252.837	1.000.000	1.000.000	1.000.000	10.017	918.806	882.325	1.000.000
2006	958.317	253.856	1.000.000	1.000.000	1.000.000	10.017	922.804	882.325	1.000.000
2007	952.651	254.876	1.000.000	1.000.000	1.000.000	10.017	926.802	882.325	1.000.000
2008	946.984	255.896	1.000.000	1.000.000	1.000.000	10.017	930.800	882.325	1.000.000

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	923.149	200.885	857.364	989.115	850.000	838.943	940.864	988.307
1991	916.741	200.885	857.624	989.251	850.000	838.903	940.864	978.477
1992	910.333	200.885	857.883	989.387	850.000	838.863	940.864	968.647
1993	903.924	200.885	858.143	989.523	850.000	838.822	940.864	958.817
1994	897.516	200.885	858.403	989.659	850.000	838.782	940.864	948.987
1995	891.108	200.885	858.663	989.795	850.000	838.742	940.864	939.158
1996	884.700	200.885	858.922	989.931	850.000	838.701	940.864	929.328
1997	878.292	200.885	859.182	990.067	850.000	838.661	940.864	919.498
1998	871.884	200.885	859.442	990.203	850.000	838.621	940.864	909.668
1999	865.476	200.885	859.701	990.339	850.000	838.581	940.864	899.838
2000	859.068	200.885	859.961	990.475	850.000	838.540	940.864	890.009
2001	824.765	200.885	826.067	990.536	850.000	838.915	940.864	833.022
2002	790.462	200.885	792.173	990.598	850.000	839.290	940.864	776.036
2003	756.159	200.885	758.279	990.660	850.000	839.665	940.864	719.049
2004	721.856	200.885	724.386	990.722	850.000	840.040	940.864	662.063
2005	687.553	200.885	690.492	990.784	850.000	840.415	940.864	605.076
2006	681.467	200.885	680.134	990.951	850.000	840.668	940.864	596.510
2007	675.380	200.885	669.776	991.117	850.000	840.921	940.864	587.943
2008	669.293	200.885	659.418	991.284	850.000	841.174	940.864	579.376

5.3 Recalculation for Emissions from Solvent and Other Product Use

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 updated from 2004 onwards.

The activity data from 2000 onwards concerning non-solvent use and the 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.:

Emission factors have been updated with information from surveys at companies and associations from 2004 onwards.

5.4 Emissions of Particulate Matter (PM) from Other product use (Category 3.D.3)

The category 3.D.3 covers emissions which originate from the use of fireworks and tobacco.

	3.D.3 Use of fireworks (SNAP 0604)	3.D.3 Use of tobacco (SNAP 0604)
key category	no	no
pollutant	TSP, PM10, PM2.5	
activity	Inhabitants	
method	A country specific methodology is applied.[139] $Emission_{(TSP, PM10, PM2,5)} = activity * emission\ factor_{(TSP, PM10, PM2,5)}$	
emission factor	35 g PM2,5 / inhabitants (TSP = PM10 = PM2,5)	18 g PM2,5 / inhabitants (TSP = PM10 = PM2,5)
recalculation	Update of activity data	

[139] Winiwarter, W.; Schmidt-Stejskal, H.& Windsperger, A.(2007): Aktualisierung und methodische Verbesserung der österreichischen Luftschadstoffinventur für Schwebstaub Endbericht. Dezember 2007. ARC—sys-0149.

5.5 Source-specific recalculations of NFR 2 including changes made in response to the review process

The following improvements were made in response to the issues raised in the Stage 3 in-depth review of emission inventories submitted under the UNECE LRTAP Convention and EU National Emissions Ceilings Directive (CEIP/S3.RR/2010/AUSTRIA).

General recommendations on cross-cutting issues	Fullfiled
63. The Austrian solvent emissions inventory is complete and accurate. The ERT appreciates the efforts of Austria to provide a very good quality report.	–
Completeness:	
64. The ERT considers the solvent sector to be complete and comprehensive.	–
Transparency:	
65. Estimation approaches, activity data, assumptions and relevant documentation are transparently presented in the IIR.	–
Accuracy:	
66. The IIR indicates that no quantitative uncertainty assessment for any of the pollutants or pollutant groups has been made. The qualitative assessment provides the typical error range of 10-30% for NMVOC emissions in solvent sector. The ERT encourages Austria to present quantitative uncertainty assessments for the categories in the solvent sector to support future submissions.	This task is included in the inventory improvement plan.
QA/QC procedures:	
67. According to information provided, QA/QC procedures are set up for the solvents sector. The procedures are both general and sector-specific, and are regarded as being sufficient.	–
Comparability:	
68. Austria applied a combination of bottom-up and top-down approaches to estimate emissions from solvent uses. The output format complies with the latest NFR categories, and allows comparison with other Parties.	–
Consistency:	
69. Austria used the 2000 data (e.g. solvent content in paints, waste gas purification efficiency) for the subsequent years to estimate solvent use data as no new survey has been conducted. The approach is conservative though it might significantly overestimate NMVOC emissions in the solvent sector as some solvent uses and regulations associated with mitigating emissions were amended after 2000. The ERT encourages Austria to consider improving the estimates of data for 2000 onwards, and recalculating emissions.	This task is included in the inventory improvement plan.
Recalculations:	
70. Recalculations which have been done in the sector are transparently explained in the IIR.	–
Improvement:	
71. No improvements are planned for the sector.	–
Sector-specific Recommendations	
Category Issue 1: 3.A. Paints and Coatings – NMVOC	
72. Austria uses the "Not Applicable" notation key for the NMVOC emissions from the 3A3 "Other coating application" category. However, the Party explained that the paint use, and hence associated emissions, under 3A3 are accounted for in 3A1. The ERT recommends that Austria should use the appropriate notation key IE ("Included Elsewhere") and provide an explanation in the IIR that all paint use emissions are included under 3A1.	More description will provided in the next submission

6 AGRICULTURE (NFR SECTOR 4)

In 2008 the Umweltbundesamt commissioned the University of Natural Resources and Applied Life Sciences with the revision of the national emission model of sector agriculture (AMON, B. & HÖRTENHUBER, S. 2009). The new input-data on AWMS was taken from the research project "Animal husbandry and manure management systems in Austria" (AMON et al. 2007). Within this project a comprehensive survey on the agricultural practice in Austria had been carried out. In 2009 a detailed emission model for NH_3, NMVOC und NO_x has been implemented into the national inventory (AMON, B. & HÖRTENHUBER, S. 2008).

The emission calculations within the revised agriculture amonnia inventory follow the methodologies defined in the EMEP/CORINAIR atmospheric emission inventory guidebook 2007.

No changes regarding methodology and emission factor were made since submission 2009.

6.1 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 2000-2009):

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)

6.2 NFR 4 B Manure Management

For the inventory 2009 the agriculture emission model was revised on the basis of a new study commissioned by the Umweltbundesamt (AMON & HÖRTENHUBER 2008). In the new model representative data on animal husbandry and manure management systems all over Austria were implemented. The new data are based on the research project "Animal husbandry and manure management systems in Austria" (AMON et al. 2007). The inventory revision led to a considerable improvement of the inventory quality.

6.2.1 Methodological Issues

NH_3 emissions from Sector 4 Agriculture are estimated according to the EMEP/CORINAIR atmospheric emission inventory guidebook (EEA 2007). The guidebook outlines a simple and a detailed methodology. Emissions from cattle and swine are estimated with the detailed methodology which requires detailed information on animal characteristics and the manner in which manure is managed. Due to a lack in data availability and as they contribute to a minor extent to total emissions, emission from sheep, goats, horses, laying hens, broilers or other poultry are estimated with the simple methodology.

For the first time NO_x emissions from manure management have been estimated using the default Tier 1 emission factors of the new EMEP/CORINAIR emission inventory guidebook 2009. (EEA 2009).

6.2.1.1 Animal numbers

The Austrian official statistics (STATISTIK AUSTRIA 2008) provides national data of annual livestock numbers on a very detailed level. These data are based on livestock counts held in December each year[140].

In Table 175 and Table 176 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.

[140] 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 175: Domestic livestock population and its trend 1990–2008 (I).

Year	Population size [heads] * Livestock category						
	Dairy	Non-Dairy	Suckling Cows	Young Cattle < 1 yr	Breeding Heifers 1–2 yr	Fattening Heifers, Bulls, Oxen 1–2 yr	Other Cattle > 2 yr
1990	904 617	1 679 297	47 020	925 162	255 464	305 339	146 312
1991	876 000	1 658 088	57 333	894 111	253 219	301 607	151 212
1992	841 716	1 559 009	60 481	831 612	239 569	281 509	145 838
1993	828 147	1 505 740	69 316	705 547	257 939	314 982	157 956
1994	809 977	1 518 541	89 999	706 579	263 591	309 586	148 786
1995	706 494	1 619 331	210 479	691 454	266 108	298 244	153 046
1996	697 521	1 574 428	212 700	670 423	259 747	277 635	153 923
1997	720 377	1 477 563	170 540	630 853	259 494	254 986	161 690
1998	728 718	1 442 963	154 276	635 113	254 251	241 908	157 415
1999	697 903	1 454 908	176 680	630 586	255 244	233 039	159 359
2000	621 002	1 534 445	252 792	655 368	246 382	220 102	159 801
2001	597 981	1 520 473	257 734	658 930	241 556	214 156	148 097
2002	588 971	1 477 971	244 954	640 060	236 706	213 226	143 025
2003	557 877	1 494 156	243 103	641 640	229 150	216 971	163 292
2004	537 953	1 513 038	261 528	646 946	230 943	210 454	163 167
2005	534 417	1 476 263	270 465	628 426	229 874	206 429	141 069
2006	527 421	1 475 498	271 314	631 529	222 104	212 887	137 664
2007	524 500	1 475 696	271 327	634 089	211 044	226 014	133 222
2008	530 230	1 466 979	266 452	636 469	200 787	230 457	132 814
Trend 1990–2008	*-41.4%*	*-12.6%*	*466.7%*	*-31.2%*	*-21.4%*	*-24.5%*	*-9.2%*

* *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 176: Domestic livestock population and its trend 1990–2008 (II).

Year	**Population size [heads] * Livestock category**					
	Swine	**Young & Fattening Pigs > 20 kg**	**Breeding Sows > 50 kg**	**Young Swine < 20 kg**	**Sheep**	**Goats**
1990	3 687 981	2 347 001	382 335	958 645	309 912	37 343
1991	3 637 980	2 315 181	377 152	945 648	326 100	40 923
1992	3 719 600	2 367 123	385 613	966 864	312 000	39 400
1993	3 819 798	2 425 852	396 001	997 945	333 835	47 276
1994	3 728 991	2 368 061	394 938	965 992	342 144	49 749
1995	3 706 185	2 356 988	401 490	947 707	365 250	54 228
1996	3 663 747	2 311 988	398 633	953 126	380 861	54 471
1997	3 679 876	2 330 334	397 742	951 800	383 655	58 340
1998	3 810 310	2 456 935	386 281	967 094	360 812	54 244
1999	3 433 029	2 226 307	343 812	862 910	352 277	57 993
2000	3 347 931	2 160 338	334 278	853 315	339 238	56 105
2001	3 440 405	2 220 765	350 197	869 443	320 467	59 452
2002	3 304 650	2 146 968	341 042	816 640	304 364	57 842
2003	3 244 866	2 125 371	334 329	785 166	325 495	54 607
2004	3 125 361	2 016 005	317 033	792 323	327 163	55 523
2005	3 169 541	2 091 225	315 731	762 585	325 728	55 100
2006	3 139 438	2 038 170	321 828	779 440	312 375	53 108
2007	3 286 292	2 171 519	318 349	796 424	351 329	60 487
2008	3 064 231	2 023 536	297 830	742 865	333 181	62 490
Trend 1990–2008	*-16.9%*	*-13.8%*	*-22.1%*	*-22.5%*	*7.5%*	*67.3%*

* *from 1990 to 1992 adjusted age class split for swine as recommended in the centralized review (October 2003)*

Table 177: Domestic livestock population and its trend 1990–2008 (III).

Year	**Population size [heads] * Livestock category**				
	Poultry	**Chicken**	**Other Poultry**	**Horses**	**Other**
1990	13 820 961	13 139 151	681 810	49 200	37 100
1991	14 397 143	13 478 820	918 323	57 803	37 100
1992	13 683 900	12 872 100	811 800	61 400	37 100
1993	14 508 473	13 588 850	919 623	64 924	37 100
1994	14 178 834	13 265 572	913 262	66 748	37 736
1995	13 959 316	13 157 078	802 238	72 491	40 323
1996	12 979 954	12 215 194	764 760	73 234	41 526
1997	14 760 355	13 949 648	810 707	74 170	56 244

Year	Population size [heads] * Livestock category				
	Poultry	Chicken	Other Poultry	Horses	Other
1998	14 306 846	13 539 693	767 153	75 347	50 365
1999	14 498 170	13 797 829	700 341	81 566	39 086
2000	11 786 670	11 077 343	709 327	81 566	38 475
2001	12 571 528	11 905 111	666 417	81 566	38 475
2002	12 571 528	11 905 111	666 417	81 566	38 475
2003	13 027 145	12 354 358	672 787	87 072	41 190
2004	13 027 145	12 354 358	672 787	87 072	41 190
2005	13 027 145	12 354 358	672 787	87 072	41 190
2006	13 027 145	12 354 358	672 787	87 072	41 190
2007	13 027 145	12 354 358	672 787	87 072	41 190
2008	13 027 145	12 354 358	672 787	87 072	41 190
Trend 1990–2008	*-5,7%*	*-6.0%*	*-1.3%*	*77.0%*	*11.0%*

* *adjusted age class split for swine as recommended in the centralized review (October 2003)*

6.2.1.2 Animal Waste Management System Distribution (AWMS)

In the previous submissions data on the distribution of Austria’s housing and storage systems for cattle and swine were taken from (KONRAD 1995). In this study data on existing Austrian conditions were derived from a research survey carried out on 720 randomly-chosen agricultural enterprises in the years 1989–1992. Data have not been updated until now and were assumed to have remained constant for the entire time series.

The distribution of housing and storage systems has undergone major changes, which should be reflected in the inventory. Austria therefore updated its information on animal waste management systems (AWMS) distribution. Hence, in 2008 the Umweltbundesamt commissioned the University of Natural Resources and Applied Life Sciences with the revision of the national emission model of sector agriculture (AMON & HÖRTENHUBER 2008).

The new input-data on AWMS (cattle and swine) was taken from the research project ‘Animal husbandry and manure management systems in Austria (TIHALO)’ (AMON et al. 2007). In this project a comprehensive survey on the agricultural practices in Austria has been carried out. Within this project, the Division of Agricultural Engineering (DAE) of the Department for Sustainable Agricultural Systems of the University of Natural Resources and Applied Life Sciences (BOKU) closely co-operated with the Swiss College of Agriculture, the Austrian Chamber of Agriculture, the Umweltbundesamt, the Agricultural Research and Education Centre Raumberg-Gumpenstein and the Statistics Austria. Firstly, a questionnaire was developed to assess animal housing, manure storage and manure application on typical Austrian farms. In November 2005, the questionnaire was sent to 5 000 Austrian farms. The statistical sampling plan was set up with the assistance of the Statistics Austria to guarantee the selection of a representative sample of Austrian farms. A questionnaire return of about 40% had to be achieved to receive representative data on animal husbandry and manure management systems in Austria. With the active assistance of the regional chambers of agriculture, a rate of questionnaire return of 39 % was achieved. The returned questionnaires were manually fed into a data template by the Statistics Austria. On the basis of this template, a data base was created that contained the questionnaire information. Anonymity of the farms that supplied data is guaranteed. The data base was checked for representativeness and plausibility.

As a result of (AMON et al. 2007), for 2005 new representative data on animal husbandry and manure management systems all over Austria is available. For the creation of a plausible time series in the inventory the AWMS distribution of 1990 (based on KONRAD 1995) partly had to be adopted. Changes to the year 1990 were derived from the new study results (AMON et al. 2007) and expert opinion carried out by DI Alfred Pöllinger (Agricultural Research and Education Centre Raumberg-Gumpenstein) in June 2008. The AWMS data 2005-2008 were derived by linear extrapolation. From 2008 onwards AWMS distribution is held constant in order to prevent implausible trends.

Cattle

The results of the new time series show that tied systems and systems with straw-litter decreased, but still account for the biggest part, whereas loose housing systems and slurry-based systems increased from 1990 to 2005. Small farms use predominantly tied systems, especially with solid manure, while large farms take more use of loose housing systems in general and tied systems with liquid slurry.

Table 178: Animal waste management systems for cattle in 1990 based on (Amon et al. 2007), Konrad (1995) and expert opinion (PÖLLINGER 2008).

Cattle category	Animal Waste Management Systems 1990					
	tied systems			loose housing systems		
	liquid slurry [%]	solid manure [%]	total share tied systems [%]	liquid slurry [%]	solid manure [%]	total share loose housing systems [%]
Dairy cows	26.65	57.0	83.65	3.9	12.45	16.35
Suckling cows	13.95	66.45	80.4	12.85	6.75	19.6
Cattle < 1 year	12.0	56.45	68.45	24.35	7.2	31.55
Breeding heifers 1-2 years	23.9	54.1	78.0	9.2	12.8	22.0
Fattening heifers, bulls & oxen, 1–2 years	30.8	37.8	68.6	13.0	18.4	31.4
(other) cattle > 2 years	25.35	55.2	80.55	8.1	11.35	19.45

Table 179: Animal waste management systems for cattle in 2005 according to (AMON et al. 2007).

Cattle category	Animal Waste Management Systems 2005					
	tied systems			loose housing systems		
	liquid slurry [%]	solid manure [%]	total share tied systems [%]	liquid slurry [%]	solid manure [%]	total share loose housing systems [%]
Dairy cows	14.2	53.1	67.3	24.9	7.8	32.7
Suckling cows	7.2	53.6	60.8	13.5	25.7	39.2
Cattle < 1 year	4.8	32.1	36.9	14.4	48.7	63.1
Breeding heifers 1–2 years	11.1	44.9	56.0	25.6	18.4	44.0

Cattle category	Animal Waste Management Systems 2005					
	tied systems			loose housing systems		
	liquid slurry [%]	solid manure [%]	total share tied systems [%]	liquid slurry [%]	solid manure [%]	total share loose housing systems [%]
Fattening heifers, bulls & oxen, 1–2 years	12.4	24.8	37.2	36.8	26.0	62.8
(other) cattle > 2 years	14.0	47.1	61.1	22.7	16.2	38.9

Yard

Table 180 shows the average percentage of time that Austrian cattle spent on yards in the years 1990 and 2005. The values for the year 1990 were estimated to be the half of the values from 2005 (Pöllinger 2008). Data from 2005 onwards were derived by linear extrapolation.

Table 180: Austrian average values for time cattle spent on yards based on (Amon et al. 2007) for 2005 and expert opinion for 1990 (Pöllinger 2008).

	percentage of time per year spent on yards	
Cattle category	1990 (%)	2005 (%)
Dairy cows	0.9	1.8
Suckling cows	1.05	2.1
Cattle < 1 year	0.8	1.6
Breeding heifers 1–2 years	0.75	1.5
Fattening heifers, bulls & oxen, 1–2 years	0.75	1.5
(other) Cattle > 2 years	0.95	1.9

Pasture

Table 181 describes the average percentage of time Austrian cattle spent on pasture for the years 1990 and 2005. While time spent on pastures increased for suckling cows from 1990 to 2005 (from 10.6% up to 13.7%), it decreased for other cattle categories (e.g. dairy cows from 10.6% to 4.2%).

Table 181: Austrian average values for time cattle spent on pasture in 2005 according to (Amon et al. 2007) and distribution in 1990 according to Konrad (1995) and expert opinion (Pöllinger 2008).

	Percentage of time spent on pasture per year	
	1990 (%)	2005 (%)
Dairy cows	10.65	4.2
Suckling cows	10.65	13.7
Cattle < 1 year	4.8	2.4
Breeding heifers 1–2 years	26.2*	9.2
Fattening heifers, bulls & oxen, 1–2 years	0.6	0.3
(other) Cattle > 2 years	17.8	8.9

Swine

Table 182 gives information on the distribution of housing systems for pigs. The distribution of housing system is based on the survey TIHALO (Amon et. al. 2007). Data for 1990 were taken from the survey carried out by Konrad (1995).

Table 182: Animal waste management systems for swine for 1990 according to KONRAD (1995) and for 2005 according to (AMON et. al. 2007).

Pig category	1990		2005	
	Solid manure (%)	Liquid slurry (%)	Solid manure (%)	Liquid slurry (%)
Litter (< 20 kg)	–	–	34.5	65.5
Young pigs (20–50 kg)	–	–	12.8	87.2
Fattening pigs (> 50 kg)	–	–	10.2	89.8
Empty and gestating sow	–	–	36.9	63.1
Lactating sow	–	–	44.4	55.6
Boars	–	–	74.5	25.5
Breeding sows plus litter	30 [1)]	70 [1)]	38.6	61.4
Fattening pigs	28.1 [2)]	71.9 [2)]	10.8	89.2

[1)] *one value for breeding sows plus litter– estimate of expert DI Alfred Pöllinger following KONRAD (1995)*

[2)] *one value for young and fattening pigs (KONRAD 1995)*

Houses with straw-litter for young and fattening pigs decreased in the period from 1990 to 2005, those with slatted floors increased. Houses with straw-litter for breeding sows plus litter seem to have increased during the period. The reason for this may be lie in the approximate and conservative estimate by expert Alfred Pöllinger (in November 2006) following Konrad's (1995) high values between 75 and nearly 100 percent sows on solid manure (with straw) for diverse houses of breeding sows plus litter. Small farms more frequently use systems with solid manure, large farms make more use of slurry systems.

Yard

Table 183 shows the average percentage of time that Austrian swine spent on yards in the years 1990 and 2005. The values for the year 1990 were estimated to be the half of the values from 2005 (Pöllinger 2008). Data from 2005 onwards were derived by linear extrapolation.

Table 183: Austrian average values for time swine spent on yards based on (AMON et al. 2007) for 2005 and expert opinion for 1990 (PÖLLINGER 2008).

	Percentage of time per year pigs spent in yards	
	1990 (%)	2005 (%)
Litter (< 20 kg)	0.3	0.6
Young pigs (20–50 kg)	0.55	1.1
Fattening pigs (> 50 kg)	0.55	1.1
Empty and gestating sow	1.55	3.1
Lactating sow	0.3	0.6
Boars	1.45	2.9
Breeding sows plus litter	1.15	2.3
Fattening pigs	0.55	1.1

Pasture

Calculations for pigs on pasture from data collected within (AMON et al. 2007) showed that hardly any pig had free access to a pasture. The highest values were found for empty and gestating sows: 0.3 % had access to pasture. 0.1 % of fattening pigs had access to pasture. Free range systems for pigs are uncommon in Austria and were therefore not estimated in the inventory revision.

6.2.1.3 Manure storage – cattle and swine

Table 184 describes the share of composted and not composted solid manure for the years 1990 and 2005. The values for 2005 are taken from the TIHALO survey (AMON et al. 2007). Those for 1990 were estimated by Alfred Pöllinger in June 2008 on the basis of TIHALO results.

Table 184: Share of composted and untreated solid manure for cattle and swine in Austria in 2005 according to (AMON et al. 2007) and distribution in 1990 according to expert opinion (PÖLLINGER 2008).

	1990		2005	
	Composted solid manure [%]	**Untreated solid manure [%]**	**Composted solid manure [%]**	**Untreated solid manure [%]**
Dairy cows	5.95	94.05	11.9	88.1
Suckling cows	5.85	94.15	11.7	88.3
Cattle < 1 year	5.9	94.1	11.8	88.2
Breeding heifers 1–2 years	5.9	94.1	11.8	88.2
Fattening heifers, bulls & oxen, 1–2 years	4.4	95.6	8.8	91.2
Cattle > 2 years	5.7	94.3	11.4	88.6
Breeding sows plus litter	6.35	93.65	12.7	87.3
Fattening pigs	4.2	95.8	8.4	91.6

Table 185: Slurry storage and treatment for cattle and swine in 2005 according to (AMON et al. 2007) and distribution in 1990 according to expert opinion (PÖLLINGER 2008).

	Dairy cows	Suckling cows [1]	Cattle < 1 year	Breeding heifers 1–2 years	Fattening heifers, bulls & oxen, 1–2 years	(Other) cattle > 2 years	Breeding Sows plus litter	(Young &) Fattening Pigs
1990								
Solid cover	70.5	73.9	74.8	72.8	77.4	74.1	82.6	73.6
Uncovered and not aerated	11.2	9.4	6.9	13.8	9.3	5.3	9.5	15.4
Uncovered and aerated	11.4	11.5	13.5	8.3	8.2	16.3	5.1	3.7
Straw cover	0	0	0	0.1	0	0.1	0.3	0.4
Plastic foil	0	0	0	0	0	0	0.1	0.4
Natural crust	6.9	5.2	4.8	5.0	5.1	4.2	2.4	6.5
2005								
Solid cover	70.5	73.9	74.8	72.8	77.4	74.1	82.6	73.6
Uncovered and not aerated	11.2	9.4	6.9	13.8	9.3	5.3	9.5	15.4
Uncovered and aerated	11.4	11.5	13.5	8.3	8.2	16.3	5.1	3.7
Straw cover	0	0	0	0.1	0	0.1	0.3	0.4
Plastic foil	0	0	0	0	0	0	0.1	0.4
Natural crust	6.9	5.2	4.8	5.0	5.1	4.2	2.4	6.5

[1] values from TIHALO for suckling cows had to be replaced by mean values of all other classes of cattle because of wrong values for aeration

6.2.1.4 Spreading technologies

Table 186 gives information on slurry application for the years 1990 and 2005. The values for 1990 had to be estimated, because they had never been assessed before. The values for the year 1990 are expected to be the half of the ones in 2005 (expert estimation by Alfred Pöllinger, June 2008).

Table 186: Cattle and pig slurry application in Austria in 2005 based on (AMON et al. 2007) and in 1990 based on expert judgement (PÖLLINGER 2008).

Animal category:	1990		2005	
	Broadcast application (%)	Band spreading (%)	Broadcast application (%)	Band spreading (%)
Dairy cows	96.2	3.8	92.4	7.6
Suckling cows	97.1	2.9	94.2	5.8
Cattle < 1 year	96.55	3.45	93.1	6.9
Breeding heifers 1-2 years	96.4	3.6	92.8	7.2
Fattening heifers, bulls & oxen, 1-2 years	98.35	1.65	96.7	3.3
Cattle > 2 years	94.7	5.3	89.4	10.6
Breeding sows plus litter	97.95	2.05	95.9	4.1
Fattening pigs	97.0	3.0	94.0	6.0

The findings of TIHALO (AMON et al. 2007) show that sleigh foot application and slurry injection apparently did not exist in Austria's agriculture in 2005. Only a small percentage of slurry is applied with band spreading technologies. Nearly all slurry is still broadcast in Austria.

6.2.1.5 N excretion

In the year 2005 Austrian N excretion values were reviewed and recalculated. The revision resulted in higher N excretion rates of dairy and suckling cows (see Table 187).

Table 187: Austria specific N excretion values of dairy cows for the period 1990–2008.

Year	Milk yield [kg yr^{-1}]	*Nitrogen excretion [kg/animal*yr]*	*Year*	Milk yield [kg yr^{-1}]	*Nitrogen excretion [kg/animal*yr]*
1990	3 791	76.62	2000	5 210	89.39
1991	3 862	77.26	2001	5 394	91.05
1992	3 934	77.90	2002	5 487	91.88
1993	4 005	78.54	2003	5 638	93.24
1994	4 076	79.18	2004	5 802	94.72
1995	4 619[1)]	84.07	2005	5 783	94.55
1996	4 670	84.53	2006	5 903	95.63
1997	4 787	85.58	2007	5 997	96.48
1998	4 924	86.82	2008	6 059	97.03
1999	5 062	88.06			

[1)] *From 1995 onwards data have been revised by Statistik Austria, which led to significant higher milk yield data of Austrian dairy cows.*

N excretion values as shown in Table 187 and Table 188 are based on the following literature: (GRUBER & PÖTSCH 2006, PÖTSCH et al. 2005, STEINWIDDER & GUGGENBERGER 2003, UNTERARBEITSGRUPPE N-ADHOC 2004 and ZAR 2004).

According to the requirements of the European nitrate directive, the Austrian N excretion data were recalculated following the guidelines of the European Commission. The revised nitrogen excretion coefficients were calculated based on following input parameters:

Cattle: Feed rations represent data of commercial 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.

On the basis of a new study (HÄUSLER 2009) for suckling cows an average milk yield of 3 500kg has been assumed for the years from 2004 onwards.

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.

Table 188: Austria specific N excretion values of other cattle and swine.

Livestock category	***Nitrogen excretion* [kg/animal*yr]**
suckling cows[1)] (1990)	69.5
suckling cows[2)] (2008)	74.0
cattle 1–2 years	53.6
cattle < 1 year	25.7
cattle > 2 years	68.4
breeding sows	29.1
fattening pigs	10.3

1) *Annual milk yield: 3 000 kg*

2) *Annual milk yield: 3 500 kg*

Nitrogen excretion coefficients of other livestock categories were calculated based on following input parameters:

Sheep and goats: life weight, daily gain of weight, degree of pregnancy or lactating, feeding rations.

Poultry: feeding ration, duration of keeping, nitrogen uptake, nitrogen efficiency.

Horses: feeding ration per horse category, weight of horses.

Table 189: Austria specific N excretion values of other livestock categories.

Livestock category	***Nitrogen excretion* [kg/animal*yr]**
sheep	13.1
goats	12.3
horses	47.9
chicken[1)]	0.52
other poultry[2)]	1.1
other livestock/deer[3)]	13.1

1) *Weighted average of hens and broilers*

2) *Weighted average of turkeys and other (ducks, gooses)*

3) *Value of sheep applied*

TAN content in excreta

The detailed methodology 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). Due to the improved data availability, the inventory revision estimates for the first time emissions from composted farmyard manure. The TAN content of composted farmyard manure was taken from BMLFUW (2006b).

Table 190: TAN content for Austrian cattle and pig manure after Schechtner (1991) and BMLFUW (2006b) in case of composted farmyard manure.

	TAN content [kg NH_4-N per kg Nex]
cattle – farmyard manure	0.15
cattle – liquid manure	0.50
swine – farmyard manure	0.15
swine – liquid manure	0.65
composted farmyard manure	(<) 0.01

6.2.1.6 Calculation of NH_3 emissions from cattle (4.B.1) and swine (4.B.8)

Key Sources: NH_3

Emissions of Ammonia (NH_3) occur during animal housing (1), the storage of manure (2) and the application of organic fertilizers on agricultural soils (3). Emissions of nitric oxide (NO_x) were calculated for manure management and field spreading of manure (4).

Total NH_3 emissions from Category *4.B.1* and *4.B.8* are calculated as follows:

$$NH_{3\ Total} = NH_{3\ (housing)} + NH_{3\ (storage)} + NH_{3\ (spreading)}$$

This inventory revision integrates new manure management options which had so far not been included in the emission estimates. For these, new emission factors were needed. Where no national emission factors were available, emission factors were taken from the Swiss ammonia inventory which is calculated with the computer based programme "DYNAMO" (MENZI et al. 2003, REIDY et al. 2007, REIDY & MENZI 2005). Due to similar management strategies and geographic structures, Swiss animal husbandry is closest to Austrian animal husbandry.

1. NH_3 emissions from housing (cattle and swine)

Table 191 gives NH_3 emission factors for emissions from animal housing. As far as possible, Swiss default values as given in the EMEP/CORINAIR atmospheric emission inventory guidebook have been chosen. Due to similar management strategies and geographic structures, 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 191: Emission factors for NH_3 emissions from animal housing.

Manure management system	**CORINAIR Emission factor [kg NH_3-N (kg N excreted)$^{-1}$]**
Pasture/range/paddock - cattle	0.050
Cattle, tied systems, liquid slurry system	0.040
Cattle, tied systems, solid storage system	0.039
Cattle, loose houses, liquid slurry system	0.118
Cattle, loose houses, solid storage system	0.118
Fattening pigs, liquid slurry system	0.150
Fattening pigs, solid storage system	15% of total N + 30% of the remaining TAN
Sows plus litter, liquid slurry system	0.167
Sows plus litter, solid storage system	0.167

For yards the swiss emission factor has been taken (KECK 1997, MISSELBROOK et al 2001) as used in DYNAMO (MENZI et al. 2003, REIDY et al. 2007, REIDY & MENZI 2005).

Table 192: NH_3 emission factors for yards.

Manure management system	DYNAMO Emission factor [kg NH_3-N (kg TAN)$^{-1}$]
Cattle, yard	0.8

N excretion by manure management system

Country-specific N excretion per animal waste management system for Austrian *cattle* and *swine* has been calculated using the following formula:

$$Nex_{(AWMS)} = \sum_{(T)} [N_{(T)} \times Nex_{(T)} \times AWMS_{(T)}]$$

$Nex_{(AWMS)}$	=	*N excretion per animal waste management system [kg yr^{-1}]*
$N_{(T)}$	=	*number of animals of type T in the country (see Table 175, Table 176 and Table 177)*
$Nex_{(T)}$	=	*N excretion of animals of type T in the country [kg N animal^{-1} yr^{-1}] (see Table 187, Table 188 and Table 189)*
$AWMS_{(T)}$	=	*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*
(T)	=	*type of animal category*

2. NH_3 emissions from manure storage (cattle and swine)

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 and the NH_3-N losses from housing (see above) are subtracted. The remaining N enters the store.

NH_3 emission factors

NH_3-N losses are estimated with CORINAIR default emission factors given in *Table 193*.

Table 193: 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

** 15% + 0.3 % of remaining TAN for deep litter (as used for fattening pigs in agriculture), otherwise 15% for daily removal of solid manure*

Correction factors

Table 194 shows correction factors (CF) to emission factors (EF) for a range of manure treatment options. Untreated variants systems, for example uncomposted solid manure, give the reference value '1'. EF for other treatment options, managements and systems get an associated CF, e.g. +20% for the composting of solid manure (CF = 1.2). The CF is multiplied with the

EF. Factors were taken from the Swiss ammonia inventory which is calculated with the computer based programme 'DYNAMO' (MENZI et al. 2003, REIDY et al. 2007, REIDY & MENZI 2005). Due to similar management strategies and geographic structures, Swiss animal husbandry is closest to Austrian animal husbandry.

DYNAMO is based on the N flow model and estimates ammonia emissions for each stage of the manure management continuum. Animal categories, manure management systems and a range of additional parameters are considered within DYNAMO. DYNAMO parameters were adapted to Austrian specific conditions. The DYNAMO model is peer reviewed by the EAGER[141] group and published in (REIDY et al. 2008, 2009).

Table 194: Correction factors (CF) for NH_3 emissions from manure storage.

Manure storage	[CF]
Uncomposted solid manure	1
Composted solid manure	1.2
Uncovered tank	1
Solid cover – liquid system	0.2
Aerated open tank – liquid system	1.1
Straw cover – liquid system	0.6
Plastic foil cover – liquid system	0.4
Natural crust – liquid system	0.6

3. NH_3 emissions from manure application (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, in the revised Austrian inventory the band spreading application of liquid manure has been taken into account.

NH_3 emissions from manure nitrogen applied to soils have been calculated using the following formula:

[141] European Agricultural Gaseous Emissions Inventory Researchers Network (EAGER)

$$NH_3\text{-}N_{spread} = N_{exLFS} * (Frac_{SS} * F_{TAN\ SS} * EF\text{-}NH_3\text{-}N_{spread\ SS} + Frac_{LS\text{-}bc} * F_{TAN\ LS} * EF\text{-}NH_3\text{-}N_{spread\ LS} + Frac_{LS\text{-}bs} * F_{TAN\ LS} * EF\text{-}NH_3\text{-}N_{spread\ LS} * CF_{bs})$$

$NH_3\text{-}N_{spread}$	=	*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*
$Frac_{LS\text{-}bc}$	=	*Fraction of nitrogen left for spreading produced as liquid slurry in a liquid waste management system (broadcast spreading)*
$Frac_{LS\text{-}bs}$	=	*Fraction of nitrogen left for spreading produced as liquid slurry in a liquid waste management system (band spreading)*
CF_{bs}	=	*Correction factor band spreading*
$F_{TAN\ SS}$	=	*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 (broadcast spreading)*
$EF\text{-}NH_3\text{-}N_{spread\ LS}$	=	*NH_3-N Emission factor of animal waste from a liquid slurry waste management system spread on agricultural soils (broadcast spreading)*

Nitrogen left for spreading

After housing and storage, manure is applied to agricultural soils. Manure application is connected with NH_3-N, NO_x-N and N_2O-N losses that depend on the amount of manure N. With regard to a comprehensive treatment of the nitrogen budged, Austria established a link between the ammonia and nitrous oxide emissions inventory. A detailed description of the methods applied for the calculation of N_2O emissions is given in the report "Austria's National Inventory Report 2010 – Submission under the United Nations Framework Convention on Climate Change and the Kyoto Protocol" (UMWELTBUNDESAMT 2010).

From total N excretion the following losses were subtracted:

- N excreted during grazing
- NH_3-N losses from housing
- NH_3-N losses during manure storage
- NO_X-N losses from manure management
- N_2O-N losses from manure management
- The remaining N is applied to agricultural soils.

NH_3 emission factors

The following default NH_3 emission factors for spreading of slurry and farmyard manure (expressed as share of TAN) have been used:

Table 195: Emission factors for NH_3 emissions from animal waste application.

Application technique	CORINAIR Emission factor [kg NH_3-N (kg TAN)$^{-1}$]
spreading solid manure cattle	0.79
spreading solid manure pigs	0.81
broadcast spreading liquid manure cattle	0.50
broadcast spreading liquid manure pigs	0.25

For spreading of cattle and pig solid manure the emission factors from the updated version of the EMEP/CORINAIR atmospheric emission inventory guidebook have been taken (see EEA 2009, Table 3-8).

Correction factors

Table 196 presents the correction factor (CF) for band spreading. The CF is multiplied with the EF of broadcast spreading (reference value: 1). Factors were taken from the Swiss computer based programme "DYNAMO" (Menzi et al. 2003, Reidy et al. 2007, Reidy & Menzi 2005).

Table 196: Correction factors for NH_3 emissions from animal waste application.

Application technique	[CF]
Broadcast spreading	1
Band spreading	0.7

6.2.1.7 Calculation of NH_3 emissions from sheep (4.B.3), goats (4.B.4), horses (4.B.6), poultry (4.B.9) and other animals (4.B.13)

Key Sources: no

The CORINAIR simple methodology uses an average emission factor per animal for each livestock category.

Table 197 presents the recommended ammonia emission factors for the different livestock categories given in the CORINAIR guidelines (EEA 2007, Table 4.1). Emission factors include emissions from housing, storage and surface spreading of waste.

Table 197: CORINAIR default ammonia emission factors (simple methodology) [(1)]

NFR	Livestock category	Housing [kg NH_3 head^{-1} yr^{-1}]	Storage [kg NH_3 head^{-1} yr^{-1}]	Spreading [kg NH_3 head^{-1} yr^{-1}]
4.B.3	Sheep	0.24	0.00	0.22
4.B.4	Goats	0.24	0.00	0.22
4.B.6	Horses (mules, asses)	2.90	0.00	2.20
4.B.9	Laying hens	0.19	0.03	0.15
4.B.9	Other Poultry (ducks, geese, turkeys)	0.48	0.06	0.38
4.B.13	Other animals	0.24	0.00	0.22

(1) *Emissions are expressed as kg NH_3 per animal, as counted in the annual agricultural census*

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.

6.2.1.8 NO_x emissions from animal husbandry

NO_X emissions from *4.B Manure Management* are calculated as follows:

$$NO_{X\ Total} = NO_{X\ (housing\ \&\ storage)} + NO_{X\ (spreading)}$$

NO_X emissions from manure management

NO_x emissions from manure management were calculated using the default Tier 1 emission factors per animal category as outlined in the EMEP/ EEA emission inventory guidebook 2009 (EEA 2009, Table 3-2).

NO_X emissions from animal manure spreading

NO_x emissions from animal manure spreading are not addressed explicitly in the CORINAIR Guidebook. (FREIBAUER & KALTSCHMITT 2001) suggest 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.

6.2.2 Recalculations

New national data on AWMS distribution have been implemented and a new time series of AWMS has been generated.

For cattle, the percentage of grazing has been reduced, which caused an increase in NH_3 emissions from manure management as more nitrogen came into storage. Additionally, NH_3 emissions from yards were not included in the former inventory.

For dairy cattle, the percentage of loose housing system increased, which lead to a limited increase in NH_3 emissions from dairy cattle housing.

For other cattle, NH_3 emissions from housing decreased as in the previous inventory 100 % loose housing systems were assumed whereas the detailed TIHALO survey showed lower percentages of loose housing systems.

For the first time in the fattening pigs category young swine from 20 to 50 kg were considered. In the previous submission these animals were treated like piglets and therefore not accounted (because the emission factor of breeding sows includes piglets). The consideration of pigs 20-50 kg in the fattening pigs category caused higher emissions from swine.

For breeding sows, the inventory revision resulted in a decrease in NH_3 emissions. Lower emissions from housing and storage due to a higher percentage of solid manure systems are the main reason for this decrease.

For the first time NO_x emissions from manure management have been estimated using the default emission factors of the new EMEP/CORINAIR emission inventory guidebook 2009 (EEA 2009).

6.3 NFR 4 D Agricultural Soils

Key Source: NH_3

NFR sector *4.D Agricultural Soils* includes emissios of ammonia (NH_3), nitrogen oxide (NO_x) and particulate matter (TSP, PM). The methodology for estimating PM emissions is presented in a separate chapter (chapter 6.6).

6.3.1 Methodological Issues

Under source category 4.D NH_3 and NO_x emissions from synthetic fertilizer application are reported. In compliance with the CORINAIR Guidelines, NH_3 emissions from manure application on agricultural soils are reported under source category *4 B manure management.*

Synthetic N-fertilizers (NFR 4.D.1.a)

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. 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 198), 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.

Activity Data

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”).

High inter-annual variations in N_2O emissions of sector 4.D mineral fertilizer use 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 intensified 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 198.

Table 198: Mineral fertilizer N consumption in Austria 1990–2008 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	136 842	2 833
1991	180 388	3 965	GB	160 384	3 965
1992	91 154	3 886	GB	135 771	3 926
1993	123 634	3 478	GB, RWA	107 394	3 682
1994	177 266	4 917	GB, RWA	150 450	4 198
1995	128 000	5 198	GB, RWA	152 633	5 058
1996	125 300	4 600	GB, RWA	126 650	4 899
1997	131 800	6 440	GB, RWA	128 550	5 520
1998	127 500	6 440	GB, RWA	129 650	6 440
1999	119 500	6 808	GB, RWA	123 500	6 624
2000	121 600	3 848	GB, RWA	120 550	5 328
2001	117 100	3 329	GB, RWA	119 350	3 589
2002	127 600	4 470	GB, RWA	122 350	3 900
2003	94 400	6 506	GB, RWA	111 000	5 488
2004	100 800	7 293	GB, RWA	97 600	6 900
2005	99 700	7 673	GB, RWA	100 250	7 483
2006	103 700	11 310	GB, RWA	101 700	9 491
2007	103 300	11 500	GB, RWA	103 500	11 405
2008	134 400	9 568	GB, RWA	118 850	10 534

GB: (BMLFUW 2000-2009): www.gruenerbericht.at

RWA: Raiffeisen Ware Austria, sales company

N-excretion on pasture, range and paddock (NFR 4.D.2.c)

Cattle and Swine

The CORINAIR emission factor of 0.05 kg NH_3-N/ kg N excreted has been used (Eidgenössische Forschungsanstalt 1997)

The average percentage of time Austrian cattle spent on pasture for the years 1990 and 2005 is presented in Table 181. Free range systems for pigs are uncommon in Austria and were therefore not estimated in the inventory revision.

Sheep, goats, horses, poultry and other animals

The CORINAIR simple methodology (EEA 2007, Table 4.1) uses an average emission factor per animal for each livestock category (see Table 199):

Table 199: CORINAIR default ammonia emission factors (simple methodology)

NFR	Livestock category	NH_3 loss grazing [kg NH_3 head^{-1} yr^{-1}]
4.B.3	Sheep	0.88
4.B.4	Goats	0.88
4.B.6	Horses (mules and asses included)	2.90
4.B.9	Laying hens	0.00
4.B.9	Other Poultry (ducks, geese, turkeys)	0.00
4.B.13	Other animals (deer)(1)	0.88

The emission factor of sheep has been used

6.3.2 Recalculations

The smaller share of grazed animals resulted in smaller emissions from pastures compared to the previous submission.

6.4 NFR 4 G Agriculture – Other

Key Source: no

In NRF category 4.G the following sources are included:

- NH_3 and NO_X-emissions from sewage sludge spreading
- NH_3 emissions from legume cropland
- NMVOC emissions from vegetation
- PM emissions from animal husbandry

The methodology for estimating PM emissions is presented in a separate chapter (chapter 6.7).

6.4.1 Methodological Issues

Sewage Sludge

NH_3

The CORINAIR emission factor of urea (EEA 2007, Table 5.1) has been taken (0.15 kg NH_3-N/ kg fertilizer N).

NO_x

NO_x emissions were estimated using a conservative emission factor of 1% of manure and sewage sludge nitrogen (FREIBAUER & KALTSCHMITT 2001).

Sewage sludge data

Agriculturally applied sewage sludge data were taken from Water Quality Report 2000 (PHILIPPITSCH et al. 2001), Report on sewage sludge (UMWELTBUNDESAMT 1997) and (GEWÄSSERSCHUTZBERICHT 2002). For 2001 to 2008 data from the National Austrian Waste Water Database operated by the Umweltbundesamt was used (data query December 2009, UMWELTBUNDESAMT 2009b).

The federal provinces (Bundesland) Burgenland and Steiermark did not report 2008 data. The values of 2007 have been used for the year 2008.

Table 200: Amount of sewage sludge (dry matter) produced in Austria, 1990–2008.

Year	Total [t dm]	agriculturally applied [t dm]	agriculturally applied [%]
1990	161 936	31 507	19.5
1991	161 936	31 507	19.5
1992	200 000	30 000	15.0
1993	300 000	45 000	15.0
1994	350 000	38 500	11.0
1995	390 500	42 400	10.9
1996	390 500	42 955	11.0
1997	390 500	42 955	11.0
1998	392 909	43 220	11.0
1999	392 909	43 220	11.0
2000	392 909	43 220	11.0
2001	398 800	41 600	10.4
2002	322 096	36 065	11.2
2003	315 130	39 186	12.4
2004	294 942	35 357	12.0
2005	290 110	35 541	12.3
2006	235 364	39 514	16.8
2007	239 102	40 858	17.1
2008	248 169	39 247	15.8

N content data of sewage sludge was obtained from (UMWELTBUNDESAMT 1997). The study contains sewage sludge analyses carried out by the Umweltbundesamt. Digested sludge samples from 17 municipal sewage sludge treatment plants taken in winter 1994/1995 were investigated with regard to more than one hundred inorganic, organic and biological parameters in order to get an idea of the quality of municipal sewage sludge. Following this study a mean value of 3.9% N in dry matter was taken.

In 2007 the N-content value of sewage sludge was re-examined. The comparison with national Studies (ZESSNER, M. 1999) and (ÖWAV-Regelblatt Nr. 17 – Landwirtschaftliche Verwertung von Klärschlamm 2004 – www.oewav.at) approved the value of 3.9% N/dm.

The amount of nitrogen input from agriculturally applied sewage sludge was calculated according following formula:

$F_{Sslu} = Sslu_N * Sslu_{agric}$

F_{Sslu} = *Annual nitrogen input to soils by agriculturally applied sewage sludge [t N]*

$Sslu_N$ = *Nitrogen content in dry matter [%] – 3.9%*

$Sslu_{agric}$ = *Annual amount of sewage sludge agriculturally applied [t/t] (see Table 200)*

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 1990–2008 can be found in Table 202.

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 (UMWELTBUNDESAMT 1998a) and ÖPUL 2007 (BMLFUW 2007); the values are constant over the time series.

(UMWELTBUNDESAMT 1998a) represents average data for Austria, which were used for calculating the Austrian Nitrogen Surface balance according to the OECD method. In the study available Austrian data and coefficients were put together, including literature and expert opinions from the Austrian "Fachbeirat für Bodenfruchtbarkeit und Bodenschutz" (advisory board for soil fertility and soil protection of the Federal Ministry for Agriculture and Forestry, Environment and Water Management). This advisory board is a platform of agricultural experts, which publishes regularly the "Richtlinien für die sachgerechte Düngung" (Austrian fertilizer recommendations).

NMVOC emissions from vegetation

CORINAIR simple methodology was applied. Biogenic emissions from vegetation canopies of natural grasslands are derived as described in the following equation (CORINAIR 1999, p. B 1104–7, Table 4.1). This method is also suggested to be applied for fertilized cultures.

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

E-NMVOC = *Annual NMVOC emissions from vegetation [t]*

CA = *Cropping area of vegetation [ha]*

ε–NMVOC = *NMVOC potential emission rate per unit of dry matter and time unit [mg/dry matter.hours]*

D = *Foliar biomass density [t dry matter/ha]*

Γ = *Time integral (over 6 or 12 months) of emission hours. This value includes a correction variable that represents the effect of short-term temperature and solar radiation changes [hours].*

Table 201: 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 203)*

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

Aboveground biomass of agricultural crops was calculated using official cropping area (see Table 202) and expansion factors for leaves. For simplification, wheat was considered to be representative for the vegetation cover of agricultural crop land (see Table 203).

Activity data

The yearly numbers of the legume cropping areas were taken from official statistics (BMLFUW 2000-2009). Data of agricultural land use are taken from the datapool of (BUNDESANSTALT FÜR AGRARWIRTSCHAFT 2009).

Table 202: Legume cropping areas and agricultural land use 1990–2009.

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
2007	28 111	20 183	4 479	101 861	1 376	1 792	722
2008	22 306	18 419	3 695	98 966	1 369	1 792	722

Table 203: Cereal production in Austria [t/ha].

Year	harvest per area [t/ha]	Year	harvest per area [t/ha]
1990	5.58	2000	5.42
1991	5.46	2001	5.87
1992	5.16	2002	5.85
1993	5.10	2003	5.27
1994	5.40	2004	6.53
1995	5.51	2005	6.17
1996	5.40	2006	5.75
1997	5.92	2007	5.88
1998	5.70	2008	6.86
1999	5.95		

6.4.2 Recalculations

For the first time NH_3 and NO_X emissions from sewage sludge spreading have been taken into account.

6.5 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% to national total emissions in 2008.

6.5.1 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 1 141 ha were burnt in 2008. The extrapolation to Austria's total cereal production area results in 1 790 ha burnt in 2008. This value was applied for the national inventory and corresponds to about 0.2% of total area under cereals 2008. 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 2000-2009). 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 204: Activity data for field burning of agricultural residues 1990–2008.

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
2007	49 842	3 738
2008	49 842	3 738

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 205 presents the resulting emission factors.

Table 205: 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

6.5.2 Recalculations

No recalculations have been done.

6.6 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).

6.6.1 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 2009).

Table 206: Agricultural land use data 1990–2008.

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	2000	1 382	1 124
1991	1 427	1 147	2001	1 380	1 124
1992	1 418	1 147	2002	1 379	1 124
1993	1 402	1 133	2003	1 380	1 139
1994	1 403	1 133	2004	1 379	1 139
1995	1 403	1 120	2005	1 380	1 099
1996	1 403	1 120	2006	1 377	1 099
1997	1 386	1 129	2007	1 376	1 070
1998	1 386	1 129	2008	1 369	1 070
1999	1 386	1 124			

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 207: 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 by an emission factor. Activity data was taken from national statistics.

6.7 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.

6.7.1 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.

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 208 the applied emission factors are listed.

Table 208: 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%.

6.7.2 Recalculations

No recalculations have been done.

6.8 Source-specific recalculations of NFR 4 including changes made in response to the review process

The following improvements were made in response to the issues raised in the Stage 3 in-depth review of emission inventories submitted under the UNECE LRTAP Convention and EU National Emissions Ceilings Directive (CEIP/S3.RR/2010/AUSTRIA).

General recommendations on cross-cutting issues	Fullfiled
Completeness:	
63. The agriculture inventory of Austria covers a wide set of pollutants and the inventory is complete with respect to the most important sources of emissions. The ERT commends Austria for the completeness and the quality of the agriculture inventory.	–
Transparency:	
64. The inventory is generally transparent and the IIR explains the methodology used to estimate several pollutants and source combinations. Emission Factors and activities are always provided in a very detailed manner. The ERT commends Austria for its efforts to make the inventory transparent. It is an example of good practices which other countries could learn from. Nevertheless, PM emissions from animal husbandry could be reported in 4B NFR sub-sectors instead of being reported in 4G or, at the minimum, reported as IE "Included Elsewhere" (instead of NA). The ERT also recommends that Austria provides a summary table indicating the tier levels used for each of the agriculture sources.	In NFR sub-sectors 4.B PM emissions from animal husbandry are now reported reported as IE "Included Elsewhere"

General recommendations on cross-cutting issues	Fullfiled
Accuracy:	
65. The uncertainty analysis provided is qualitative (level B for agriculture). The ERT encourages Party to undertake a quantitative uncertainty analysis for the agriculture sector in order to help inform the improvement process and to provide an indication of the reliability of the inventory data.	This task is included in the inventory improvement plan.
Recalculations:	
66. The ERT notes that recalculations were undertaken in response to the implementation of new statistical data, in particular AWMS. Recalculations (§ 7.2.2) are provided in a very detailed manner for each source in the Austrian IIR and the reporting is an example of good practice.	–
Improvement:	
67. The ERT commends Austria for its improvements in the 4B and 4D sectors because NOx emissions from 4B and 4D are estimated for the first time, and also because the NH3 emission model has recently been revised. The ERT also commends the Party for the good descriptions of the improvements achieved, which are clearly provided in the IIR.	–
Sector-specific recommendations	
68. There are no sector-specific recommendations.	–

7 WASTE (NFR SECTOR 6)

7.1 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 2008.

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 compost production as well as mechanical-biological treatment of residual waste.

NH_3 and CO emissions of this source have been identified as key category. The following Table 209 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 209: Contribution to National Total Emissions from NFR sector 6 Waste in 2008.

Pollutant	Source Category: 6 Waste	Pollutant	Source Category: 6 Waste
SO_2	0.25%	PAH	< 0.01%
NO_x	0.03%	Diox	0.42%
NMVOC	0.04%	HCB	0.08%
NH_3	2.25%	TSP	0.30%
CO	0.75%	PM10	0.24%
Cd	0.12%	PM2.5	0.13%
Hg	2.02%		
Pb	0.06%		

Small changes regarding methodology and emission factor were made since submission 2010.

The overall emission trend reflects changes in waste management policies as well as waste treatment facilities. According to the Landfill Ordinance[142] 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)

[142] Verordnung über die Ablagerung von Abfällen (Deponieverordnung), BGBl. Nr. 164/1996, BGBl. II Nr. 49/2004; geltende Fassung: Deponieverordnung 2008 (BGBl. II Nr. 39/2008).

are decreasing. Emissions arising from incineration of waste with energy recovery are taken into account in NFR Sector 1 A. 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).

The following list comprises primary and secondary measures which were implemented over the last years:

- 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.

7.1.1 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.

Completeness

Table 210 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 210: 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

7.2 NFR 6 A Waste Disposal on Land

7.2.1 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[143] – regulated in §31 Landfill Ordinance.

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 211. For emissions calculation waste deposited from 1950 onwards have been taken into account.

Between 1990 and 2008, residual waste decreased by 94%, non residual waste by 51%, and total waste by 83%.

[143] Regulated in § 31 Landfill Ordinance (Federal Gazette BGBl. Nr 39/2008)

Table 211: Activity data for "Residual waste" and "Non Residual Waste" 1990–2008.

Year	Residual waste [Mg]	Non-residual waste [Mg]	Total waste [Mg]
1990	1 995 747	648 702	2 644 448
1991	1 799 718	661 676	2 461 394
1992	1 614 157	674 909	2 289 067
1993	1 644 718	688 407	2 333 126
1994	1 142 067	702 175	1 844 242
1995	1 049 709	716 219	1 765 928
1996	1 124 169	730 543	1 854 713
1997	1 082 634	745 154	1 827 788
1998	1 081 114	760 057	1 841 171
1999	1 084 625	822 179	1 906 804
2000	1 052 061	826 874	1 878 935
2001	1 065 592	772 786	1 838 378
2002	1 174 543	792 753	1 967 296
2003	1 385 944	890 640	2 276 584
2004	282 656	344 747	627 403
2005	241 733	389 660	631 393
2006	260 068	425 091	685 159
2007	154 517	464 109	618 626
2008	129 324	319 927	449 251

In 1990 the Austrian Waste Management Law[144] 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 and then dropped as from the beginning of 2004 only pre-treated waste was allowed to be deposited. This is due to the implementation of the Landfill Ordinance[145], which prohibits the disposal of untreated waste and therefore leads to reduced waste volumes as well as decreased carbon content in deposited waste.

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

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

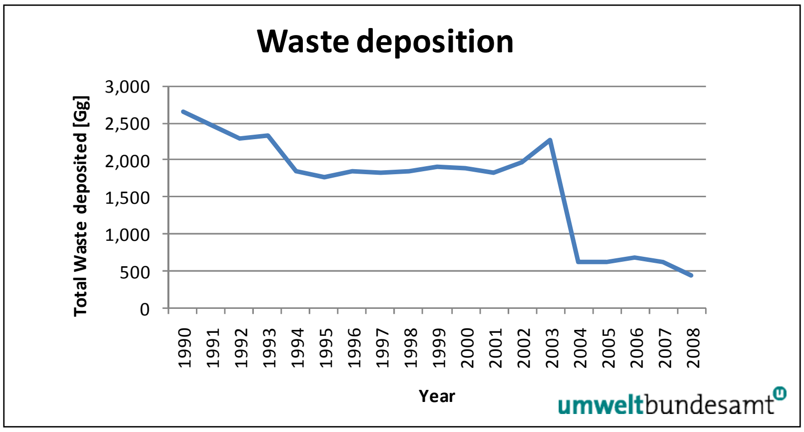

Figure 14: Deposited waste (residual and non residual waste) 1990–2008.

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 2008 only 3.7% 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 annual updates, recycling and treatment of waste from households and similar establishments was performed according to the following procedures.

Table 212: Recycling and treatment of waste from households and similar establishments.

Treatment	1989[1)]	1999[2)]	2004[2)]	2006[3)]	2008[4)]
Bio-technical treatment (mechanical-biological treatment)	16.7%[4)]	6.3 %	11.2%	17.9 %	8.8 %
thermal treatment (incineration)	5.9%	14.7 %	28.3%	23.7%	34.7 %
treatment in plants for hazardous waste	0.4%	0.8 %	1.2%	1.8%	2.3 %
recycling	12.9%	34.3 %	35.6%	34.8 %	32.3 %
recycling (biogenous waste)	1.0%	15.4 %	16.0%	17.9%	18.2 %
direct deposition at landfills ("residual waste")	63.1%	28.5 %	7.7%	3.8 %	3.7 %

1) *Federal Waste Management Plan (BUNDESABFALLWIRTSCHAFTSPLAN 2001)*

2) *Federal Waste Management Plan (BUNDESABFALLWIRTSCHAFTSPLAN 2006)*

3) *Annual update (2008) of the Federal Waste Management Plan (BUNDESABFALLWIRTSCHAFTSPLAN 2006)*

4) *Annual update (2009) of the Federal Waste Management Plan (BUNDESABFALLWIRTSCHAFTSPLAN 2006)*

5) *This value also includes plants used in the past to reduce odour emissions.*

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

- Data for 2008 was (for the first time) taken from the EDM (Electronic Data Management), administered by the BMLFUW. This is due to the fact that since the beginning of 2009 landfill operators are obliged to register their data (waste input-output report) directly and electronically (per upload) at the portal of http://edm.gv.at[146]
- From 1998 to 2007 data were taken from the database for solid waste disposals "Deponiedatenbank" ("Austrian landfill database") – a database, administered and maintained by the Umweltbundesamt until the end of 2008.
- From 1950 to 1997 the amounts of deposited residual waste were taken from national studies (HACKL & MAUSCHITZ 1999, UMWELTBUNDESAMT 2001c) and the respective Federal Waste Management Plans (BUNDESABFALLWIRTSCHAFTPLAN 1995, 2001).

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 (therefore included in the Austrian landfill database) and thus considered in the time series from 1998 onwards. To achieve a consistent time series, data of the two overlapping years[147] (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.

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.

For calculation emissions of "Non Residual Waste" the waste types are aggregated to the following categories:

- wood
- construction waste
- paper
- green waste
- sludge
- sorting residues, bulky waste, landfill fraction after mechanical-biological treatment,
- textiles
- fats

[146] According to §41 (1) Landfill Ordinance, Federal Gazette BGBl. Nr 39/2008

[147] Data available from the Federal Waste Management Plan (Bundesabfallwirtschaftsplan - BAWP) as well as from the Austrian landfill database.

The quantities of "non residual waste" from 1998 to 2007 were taken from the database for solid waste disposals "Deponiedatenbank" ("Austrian landfill database"), the value for 2008 was taken from the EDM[148] (Electronic Data Management). Only the amounts of waste with biodegradable lots were considered. Table 213 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.

[148] Electronic Data Management (EDM): part of the eGovernment-strategy of the Austrian Government, registration requirements and reports in the field of environment.
https://secure.umweltbundesamt.at/edm_portal/home.do?wfjs_enabled=true&wfjs_orig_req=/home.do

Table 213:Considered types of waste (list of waste[149]).

Waste Identification No	Type of Waste	Waste Identification No	Type of Waste
0303	wastes from pulp, paper and cardboard production and processing	170204	Glass, plastic and wood containing or contaminated with dangerous substances
1905	wastes from aerobic treatment of solid waste	170903	other construction and demolition wastes (including mixed wastes) containing dangerous substances
1908	wastes from wastewater treatment plants not otherwise specified	170904	mixed construction and demolition waste
1909	wastes from the preparation of water intended for human consumption or water for industrial use	190805	sludge from treatment of urban wastewater
1912	wastes from the mechanical treatment of waste (for example sorting. crushing. compacting. pelletising) not otherwise specified	190809	grease and oil mixture from oil/water separation containing only edible oil and fats
20303	waste from solvent extraction	200101/ 200102	paper and cardboard
30105	Sawdust, shavings, cuttings, wood, particle board and veneer	200108	biodegradable kitchen and canteen waste
30304	de-inking sludge from paper recycling	200111	textiles
30307	mechanically separated rejects from pulping of waste paper and cardboard	200201	Bio-degradable wastes
30310	fibre rejects, fibre-, filler-. and coating sludge from mechanical separation	200302	waste from markets
40106	Sludge, in particular from on-site effluent treatment containing chromium	200307	bulky waste
40109	waste from dressing and finishing	190811–14	sludge from treatment of industrial wastewater
40221	wastes from unprocessed textile fibres	200125	edible oil and fat
150103	wooden packaging	170201	wood

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 214 summarises the parameters used and the corresponding references.

[149] 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.

Table 214: Parameters for calculating methane emissions of SWDS.

Waste category/ Parameters	**residual waste**	**wood**	**paper**	**sludges**	**Sorting residues/ output MBT[150]/ bulky waste**	**Bio-waste**	**textiles**	**Construction waste**	**fats**
Methane correction factor	1 IPCC default for managed SWDS								
Fraction of degradable organic carbon dissimilated DOC_F	0.6	0.5	0.55	0.55	0.55	0.55	0.55	0.55	0.77
	The DOC_F for residual waste reflects the recent increase of biogenic components). IPCC default taking into account national waste expertises.								
DOC	See Table 216	0.45	0.3	0.11	0.16	0.16	0.5	0.09	0.2
	(HACKL & MAUSCHITZ 1999) (UMWELTBUNDESAMT 2003) (BAWP 2006)	(BAUMELER et al. 1998)							
L_0[1)]	0.106	0.165	0.121	0.444	0.065	0.064	0.202	0.034	0.113
Half life period	7	25	15	7	20	10	15	20	4
	National waste experts	(GILBERG et al. 2005)	(GILBERG et al. 2005)	Assumption: same as residual waste	IPCC default slow decay	Assumption: same as paper	Assumption: same as paper	IPCC default slow decay	(GILBERG et al. 2005)
Number of considered years[2)]	41	125	75	41	100	50	75	100	41
Fraction of CH_4 in Landfill Gas	0.55 Mean value cited in the literature, also within the IPCC range.								
Methane Oxidation in the upper layer	10% IPCC default								
Landfill gas recovery	see Figure 16 (UMWELTBUNDESAMT 2004e, 2008c)								

1) L_0 calculated for each waste category using the following equation and taking into account waste type specific parameters: $L_0 = [MCF (x) * DOC (x) * DOC_F * F * 16/12$ (Gg CH_4/Gg waste)]

2) The number of years accounted for in the emissions calculation of a particular year differs between the different fractions and amounted to 41 years at least (country-specific approach – to be in line with the base year calculation[151]) and 5 half times at most (as stipulated in the IPCC GPG).

150 MBT: **M**echanical-**b**iological **t**reatment

151 In the calculation of the base year (1990) emissions, waste deposited since 1950 (period equates 41 years) has been considered.

Biodegradable organic carbon (DOC) of residual waste

In 2004, the Umweltbundesamt investigated the amount of annually collected landfill gas by questionnaires sent to landfill operators (UMWELTBUNDESAMT 2004e), showing that in 2001, the amount of collected landfill gas was more than 5 times higher than in 1990. In 1990 only 9 landfills were equipped with landfill gas wells. In 2001 at all operating mass landfills landfill gas was collected.

In 2008 a further study was conducted (UMWELTBUNDESAMT 2008c) again sending questionnaires to landfill operators to get new data on collected landfill gas as well as information on its use. Results show, that from 2002 on the amount of landfill gas generated – and landfill gas recovered accordingly – decreased as a consequence of the reduced carbon content of deposited waste (despite a consistent recovery practice).

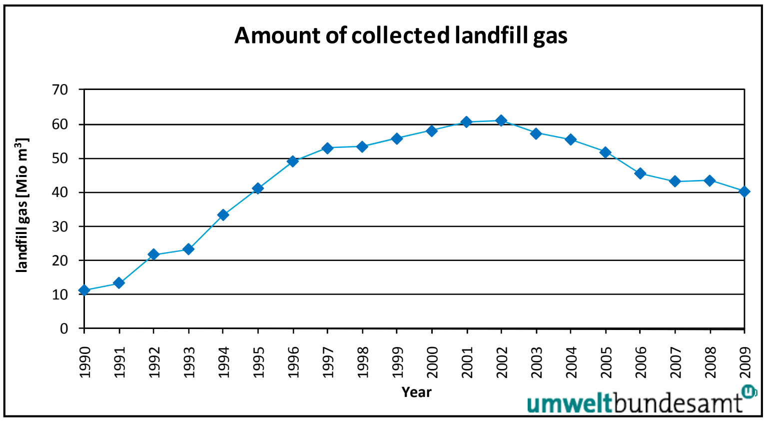

Figure 15: Development of DOC in residual waste.

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 is due to the increasing share of biogenic components in residual waste.

Table 215 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 216). For the years before 1990, quantities according to a national study (HACKL & MAUSCHITZ 1999) were used.

Table 215: Composition of residual waste (ROLLAND & SCHEIBENGRAF 2003), (BAWP 2006)

Residual waste	1990[1)]	1996[1)]	1999[1)]	2004[2)]	2008[3)]
	[% of moist mass]	[% of moist mass]	[% of moist mass]	[% of moist mass]	[% of moist mass]
Paper, cardboard	21.9	13.5	14	11	12
Glass	7.8	4.4	3	5	4
Metal	5.2	4.5	4.6	3	3
Plastic	9.8	10.6	15	10	10
Composite materials	11.3	13.8	–	8	10

Residual waste	1990[1)]	1996[1)]	1999[1)]	2004[2)]	2008[3)]
	[% of moist mass]	[% of moist mass]	[% of moist mass]	[% of moist mass]	[% of moist mass]
Textiles	3.3	4.1	4.2	6	6
Hygiene materials	–	–	12	11	8
Biogenic components	29.8	29.7	17.8	37	40
Hazardous household waste	1.4	0.9	0.3	2	1
Mineral components	7.2	3.8	–	4	3
Wood, leather, rubber, other components	2.3	1.1	2.6	1	–
Residual fraction	–	13.6	26.5	2	2

1) (UMWELTBUNDESAMT 2003)

2) (BUNDESABFALLWIRTSCHAFTSPLAN 2006)

3) Annual update (2009) of the Federal Waste Management Plan (BUNDESABFALLWIRTSCHAFTSPLAN 2006)

Table 216: Time series of bio-degradable organic carbon content of directly deposited residual waste

Year	bio-degradable organic carbon [g/kg Waste (moist mass)]	Year	bio-degradable organic carbon [g/kg Waste (moist mass)]
1950–1959	240 [1)]	1997	130 [2)]
1960–1969	230 [1)]	1998	130 [2)]
1970–1979	220 [1)]	1999	120 [2)]
1980–1989	210 [1)]	2000	120 [2)]
1990	200 [2)]	2001	132 [*)]
1991	190 [2)]	2002	144 [*)]
1992	180 [2)]	2003	157 [*)]
1993	170 [2)]	2004	168.9 [3)]
1994	160 [2)]	2005-2007	168.9 [*)]
1995	150 [2)]	2008	169.4 [4)]
1996	140 [2)]	2009	169.4 [*)]

1) (HACKL & MAUSCHITZ 1999)

2) (UMWELTBUNDESAMT 2003)

3) calculated according to waste composition 2001 (BUNDESABFALLWIRTSCHAFTSPLAN 2006)

4) calculated according to waste composition 2009 (Statusbericht 2009)

**) interpolated values (2001-2003) or the same value as of 2008 (2009)*

Landfill gas recovery

In 2004, the Umweltbundesamt investigated the amount of annually collected landfill gas by questionnaires sent to landfill operators (UMWELTBUNDESAMT 2004e), showing that in 2001, the amount of collected landfill gas was more than 5 times higher than in 1990. In 1990 only 9 landfills were equipped with landfill gas wells. In 2001 at all operating mass landfills landfill gas was collected.

In 2008 a further study was conducted (UMWELTBUNDESAMT 2008c) again sending questionnaires to landfill operators to get new data on collected landfill gas as well as information on its use. Results show, that from 2002 on the amount of landfill gas generated – and landfill gas recovered accordingly – decreased as a consequence of the reduced carbon content of deposited waste (despite a consistent recovery practice).

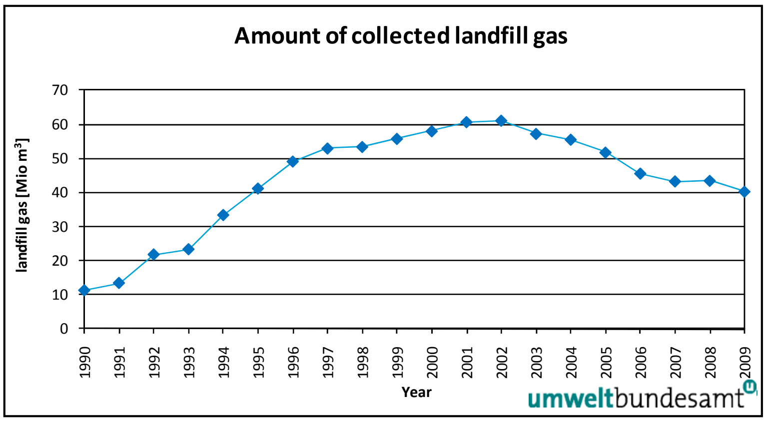

Figure 16: Amount of collected landfill gas 1990 to 2009 (UMWELTBUNDESAMT 2004, UMWELBUNDESAMT 2008)

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). [152]

Table 217: 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, only with regard to the relevant waste types (where particular matter emissions from handling can be expected). It is assumed that PM10 is 47% of TSP and PM2.5 is 15% of TSP.

Table 218: Emission factors for PM.

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

[152] according to UMWELTBUNDESAMT (2001b)

7.2.1.1 Recalculations

The following improvements have been made compared to last years' submission:

- Until submission 2010, more than 5 half lives[153] have been considered in the emissions calculation for some deposited waste fractions (residual waste: > 8; sludges: > 8; green waste: ~ 6; fats: ~ 15). To be in line with the IPCC GPG this was adjusted for in the submission 2011, whereupon now at least 41 years are considered (relevant for waste fractions showing half lives below 8 years) to be in accordance with the base year calculation[154]. This recalculation has led to slightly revised emission estimates for 1991 and onwards.
- The value of CH_4 recovered was amended taking into account the (since 2002) falling methane concentration in landfill gas recovered. Compared to submission 2010 now less CH_4 is recovered and consequently more emitted into the environment.
- The DOC of residual waste was adjusted slightly for the year 2008 as new information on waste composition became available.

7.3 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. Waste incineration plants are allocated to category 1 A 4 a if heat is recovered for own usage but not used for generation of public electricity or heat.

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.

[153] Pursuant to the IPCC GPG (5.7) it is usually necessary to include data for 3 to 5 half lives in order to achieve an acceptably accurate result.

[154] In the calculation for the base year 1990, waste deposited since 1950 has been considered.

Small scale waste burning

Emissions from wood waste are considered in categories 4 F and 4 G. It is assumed that other (illegal) small scale residential combustion occurs in heatings or stoves which is included in category 1 A 4. Especially when considering POPs emissions from this source the national emission factors consider this issue due to the fact that POP emission factors are derived from field measurements which consider the "memory effect" of illegal waste co-incineration. Residential biomass heatings are widely used in Austria and wood use is based on a bootom up model by using household cenus data. It is assumed that illegal waste incineration just replaces other solid fuels and therefore other pollutants such as TSP, heavy metals and NOX from wood waste are also expected to be included in category 1 A 4.

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 219: 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	NO	6 050	1 800	IE	IE	9 979
1993	NO	4 575	2 100	IE	IE	9 902
1994	NO	3 100	2 500	IE	IE	9 682
1995	NO	3 100	2 600	IE	IE	9 741
1996	NO	3 100	2 700	IE	IE	9 695

Year	Municipal Waste	Clinical Waste	Waste Oil	Hazardous waste	Sewage sludge	Corps
	[Mg]					
1997	NO	3 100	2 800	IE	IE	9 532
1998	NO	3 100	2 900	IE	IE	9 401
1999	NO	3 100	3 000	IE	IE	9 384
2000	NO	3 100	3 000	IE	IE	9 214
2001	NO	3 100	3 000	IE	IE	8 972
2002	NO	3 100	3 000	IE	IE	9 136
2003	NO	3 100	3 000	IE	IE	13 818
2004	NO	3 100	3 000	IE	IE	18 500
2005	NO	3 100	3 000	IE	IE	19 800
2006	NO	3 100	3 000	IE	IE	19 800
2007	NO	3 100	3 000	IE	IE	19 800
2008	NO	3 100	3 000	IE	IE	19 800
Trend 1990–2008	*-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 220 shows emission factors of the air pollutants.

Table 220: 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
1995–2008	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			
1995–2008	13.0		60.0			

Table 221: 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 1985–2008*

[(2)] *for 1980–1992*

[(3)] *for 1993–2008*

[(4)] *for 1985–1990*

[(5)] *for 1991*

[(6)] *for 1992–1995*

[(7)] *for 2000–2008*

7.3.1 Recalculations

6 C Incineration of Corps

Update of activity data according to expert judgements.

7.4 NFR 6 D Other Waste

Source Category Description

In this category NH_3 emissions from mechanical-biological treatment and composting of waste is addressed. 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. Two different fractions were considered:

- Residual waste treated in mechanical-biological treatment (MBT) plants
- 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

Since 2006, most of data required is available from a national publication referred to as 'Federal Waste Management Plan' (Bundesabfallwirtschaftsplan), which is (in part) updated annually ('Status Reports').

Table 222: Activity data for NFR Category 6 D Other Waste.

	Total waste	Mechanical-biological waste treatment (MBT)		Bio waste collected separately		Loppings; gardening waste		Home composting	
	[Gg]	[Mg]	source	[Mg]	source	[Mg]	source	[Mg]	source
1990	763	345 000	(BAUMELER et al. 1998)	10 436	Sum of data reported by the Austrian Federal Provinces, (AMLINGER 2003)	37 370	Sum of data reported by the Austrian Federal Provinces, (AMLINGER 2003)	370 000	(AMLINGER 2003)
1991	798	345 000		27 372		50 995		375 000	
1992	942	345 000		88 243		48 464		460 000	
1993	1 161	345 000		156 936		149 470		510 000	
1994	1 373	345 000		246 375		197 130		584 985	
1995	1 446	294 739	(ANGERER 1997)	301 809		249 264		600 000	
1996	1 515	281 378	expert judge-ment	334 371		283 127		616 000	
1997	1 488	243 780	(LAHL 1998)	351 862		229 643		662 571	
1998	1 541	239 671	(LAHL 2000)	362 572		241 835		696 487	
1999	1 621	265 672	(UMWELT-BUNDESAMT 2001e)	378 796		244 587		732 273	
2000	1 703	253 660	Inter-polated	374 271		303 239	Interpolated[155]	771 773	
2001	1 928	241 648		399 090		361 890		944 412	Inter-polated
2002	2 150	229 636		422 126		420 542		1 117 051	
2003	2 362	217 625	(UMWELTBUNDESAMT 2008d)	433 911		479 194		1 289 691	
2004	2 979	487 623		491 670	BAWP 2006	537 845		1 462 330	Calculated on basis of* Status Report2008
2005	3 236	623 393		543 420	Inter-polated	596 497		1 472 325	
2006	3 391	660 231		595 170	Status Report* 2007	655 148		1 479 963	
2007	3 503	684 322		618 570	Status Report* 2008	713 800	Status Re-port* 2008	1 485 871	Status Report* 2008
2008	3 537	684 322	extra-polated	650 700	Status Re-port* 2009	709 600	Status Re-port* 2009	1 492 242	Calculated on basis of Status Report* 2008[156]

*) *Annual updates (2007, 2008, 2009) of the Federal Waste Management Plan 2006 (**B**UNDES**A**BFALL**W**IRTSCHAFTS**P**LAN 2006)*

[155] Values between 1999 and 2007 were interpolated as originally used data for 2004 became obsolete (see 'Recalculations').

[156] In Status Report 2008 a value of the amount of home composted waste (in kg) per capita is given. This information is used to calculate the emission for the years 2004-2006 and 2008 too.

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 223: 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, 2005) (ANGERER & FRÖHLICH 2002)
Bio-waste, lopping, home composting	0.4	(AMLINGER et al. 2003, 2005)

7.4.1 Recalculations

The following improvements have been made compared to last years' submission:

Compost Production:

Activity data for organic waste composted have been updated for the years 2004-2007 due to new data and findings published in the Federal Waste Management Plan (BAWP) and its updates (Status Reports), resulting in significant higher emission values (for interpolated values too):

- Activity data for **bio-waste collected separately** has been updated for the years 2004-2007 as more current and accurate data became available on national level (BAWP and its yearly updates).
- **Loppings, gardening waste**: More accurate data became available for 2007 and 2008 and originally published data for 2004 (BAWP 2006) herewith became obsolete (do not represent the current state of knowledge any more, not even for 2004). Consequently, the values 2004-2006 used in previous submissions were now replaced by interpolated values (between 1999 and 2007). Also municipal gardening/park waste has now been taken into account.
- **Home composted** waste amounts of the years 2004-2006 have been revised due to new findings with regard to home composted amounts per capita taken from the annual update ('Status Report') 2008 to the BAWP 2006.

Mechanical-biologically treated waste:

- The minor recalculations of the values 1995-1999 are due to the correction of rounded values.

7.5 Source-specific recalculations of NFR 6 including changes made in response to the review process

The following improvements were made in response to the issues raised in the Stage 3 in-depth review of emission inventories submitted under the UNECE LRTAP Convention and EU National Emissions Ceilings Directive (CEIP/S3.RR/2010/AUSTRIA).

General recommendations on cross-cutting issues.	Fullfiled
63. The CLRTAP submission from Austria regarding Chapter 6 (Waste) is quite complete and presents emissions for major pollutants and for major activities following the EMEP Guidebook 2009. The methodologies and reasons for decreases or increases in emissions for sectors 6 A 1, 6 C and 6 D are well developed and presented in a way that allows good comprehension. Recalculations for all sectors are also well explained.	-
Completeness:	
64. With regard to Waste, the inventory is currently quite complete. However, some improvements have also been suggested from Austria during the review process. These are considered in detail in the Category Issues below.	-
Transparency:	
65. The Austrian IIR provides information about emission sources for Waste, as well as activity data and EFs. Trends are also clearly explained. A list of measures implemented for the sector is also present in the IIR, which increases transparency.	-
66. The methodology and references for 6 A 1 are well documented and different types of waste deposited are also described. For sector 6 C, sources of emissions are completely listed. Data and assumptions for the estimation of activity data for 6 C are clearly explained. It would help to improve transparency in 6 C if the data in the IIR were clearly allocated to the different NFR sub-categories (6 C a,b,c,d,e), and the ERT recommends that this should be undertaken. The NFR tables report emissions for each sub-category, and the corresponding data is thus assumed to be readily available.	-
Accuracy:	
67. Austria has provided a clear picture of the key sources in the IIR for the Waste sector. Austria also provided complete QA/QC checks for the waste sector.	-
68. Uncertainty analyses are presented for the waste sector. The majority are defined as category "C" or "D" which presents quite a high error range. The ERT notes that Austria uses the uncertainty assessment in prioritising improvements, and therefore encourages Austria to try and improve data to achieve a lower error range for the waste sectors.	This task is included in the inventory improvement plan.
Comparability:	
69. The IIR and NFR tables presented by Austria are easily comparable to other IIR and NFR Tables.	-
Recalculations:	
70. All recalculations and improvements made in the 2010 submissions are explained well, and clearly presented in the Waste sector. The ERT commends Austria for its detailed reporting.	-
Improvements:	
71. Specific improvements were reported in the IIR for waste. Especially for the documented categories 6 A 1, 6 C and 6 D.	-

General recommendations on cross-cutting issues.	Fullfiled
Sector-specific recommendations	
Category issue 1: 6 A Solid waste disposal on land: SOx, NOx, TSP, PM10, PM2.5	
72. The ERT noticed that no emissions of SOx and NOx were reported under 6 A. Austria has indicated that they are reported under Chapter 1, energy. However, Austria mentions in its IIR (page 269, 8.2.1) that most active landfills in Austria have gas collection systems. For those without energy recovery systems, NOx and SO2 emissions arise when burning (flaring) occurs and they should be reported as waste emissions. The ERT therefore recommends that Austria should use the notation key "IE" in the NFR Tables instead of "NA" to improve the transparency of the way in which emissions from flaring are reported. Or, if data on flaring are available, emissions should be reported in the Waste chapter.	-
73. The ERT encountered another transparency issue in 6 A 1. The ERT were not able to understand whether the emissions of TSP, PM10 and PM2.5 which are reported under 6 A 1 came from burning (flaring) or from deposition of waste (e.g. handling). Austria has confirmed that the emissions are from waste handling at landfills, and the ERT recommends that this explanation is included in the IIR.	Emissions arise from deposition of waste/ handling of waste on landfills. Only relevant waste types are covered.
Category issue 2: 6 B Wastewater handling: All pollutants	
74. No emissions are reported in category 6B (the notation keys NA or NR are used). Following questions from the ERT, Austria has explained that activity data are unknown for this category. Consequently, the ERT strongly recommends the use of the "NE" notation key instead of "NA". However, the ERT encourages Austria to try and obtain activity data for this category to make emission estimates, and therefore improve the IIR and the NFR tables.	There is unfortunately no activity data available for this years' submission.
Category issue 3: 6 C Waste incineration:	
75. Austria's IIR explains that some emissions from hazardous waste and sewage sludge incineration are reported in 1 A 4 a (and 1 A 1 a) for 1992 onwards. Where a plant recovers heat or generates electricity from waste burning for its own purposes, allocation to 1 A 4 a is correct. However, this is not a particularly common occurrence across Europe. So the ERT recommends that some text is added to explain this logic.	Explanation has been added.
Category issue 4: 6 C a Clinical waste incineration: TSP, PM10, PM2.5, AD	
76. Emissions from TSP, PM10 and PM2.5 are not reported (NE) although activity data are known and EFs are provided in the EMEP Guidebook 2009 (at least for TSP). The ERT has recommended that Austria should include emission estimates in its next submission.	We consider this in our next submission.
77. The IIR also explains that activity data are based on a waste flow database at the Umweltbundesamt which only has data for the years 1990 and 1994, the remaining time series being extrapolated from these data. This estimation is probably a good first approximation, but long extrapolations such as this should be avoided or supported by some new data. Consequently, the ERT recommends that Austria should investigate ways of obtaining new activity data to improve emission reporting.	We are aware about this issue. However more actual information is not available.
Category issue 5: 6 C b Industrial waste incineration: TSP, PM10, PM2.5, AD	
78. Emissions from TSP, PM10 and PM2.5, are not reported (NE) whereas activity data are known and EFs are provided in the EMEP Guidebook. The ERT has recommended that Austria should include emission estimates in its next submission.	We consider this in our next submission.
79. The IIR does not provide details on the activity data used for the category 6 C b (the ERT thinks that this is possibly Waste Oil). The ERT encourages Austria to describe the sub-categories reported in the NFR tables in the IIR.	Table 211 shows activity data for waste oilActivity data on all types of incinerated waste is provided in table 225 of the

General recommendations on cross-cutting issues.	Fullfiled
	IIR.
Category issue 6: 6 C c All pollutants	
80. No emissions are reported under 6 C c but the ERT has noticed from page 267 of the IIR ("Although an increasing amount of waste is incinerated, NOx, NMVOC and NH3 emissions from Waste Incineration (without energy recovery) are decreasing. Emissions arising from incineration of waste with energy recovery are taken into account in NFR Sector 1 A.") that waste incineration without energy recovery is still present and the ERT therefore presumes that emissions are still produced. It leads to a small inconsistency because these emissions are not reported. The ERT encourages Austria to clarify this point, and update reporting accordingly.	Waste incineration without energy recovery ends in 1991 and emission are reported in the NFR tables under category 6 C.
Category issue 7: 6 C d Cremation: TSP, PM10, PM2.5, AD	
81. Activity data for this source are based on expert judgement and have been constant since 2005. For more accurate emissions reporting, the ERT suggests that Austria should try to obtain statistical data from crematoria. Furthermore, emissions from TSP, PM10 and PM2.5, are not reported (NE) although activity data are known and EFs are provided in the EMEP Guidebook 2009 (at least for TSP). The ERT has recommended that Austria should include emission estimates in its next submission.	Data has been reported by the national association of crematoria operators. TSP will be estimated in next submission.
Category issue 8: 6 C e Small-scale waste burning: All pollutants	
82. No emissions for this category are reported. Austria explained that any biomass waste incineration is prohibited in Austria. However, illegal waste incineration does takes place, but Austria sets it as "NE". The ERT suggests that even if it is banned, illegal fires will happen, and therefore the ERT recommends making an emissions estimate - particularly because emissions (mostly PM) are still quite important. Austria may benefit from considering the methodologies used by other countries which report emissions from this source (for example the UK).	A chapter has been added for clarification. Emission factors will be changed to "IE" in the next submission,

8 RECALCULATIONS AND IMPROVEMENTS

8.1 Recalculations

8.1.1 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 2008 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 8.2.1.

8.1.2 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.

8.2 Improvements and Recalculations in response to the review process

Improvements made in response to the issues raised in the Stage 3 in-depth review of emission inventories submitted under the UNECE LRTAP Convention and EU National Emissions Ceilings are summarized in the following tables.

Table 224: Improvements made in response to the Stage 3 in-depth review of emission inventories submitted under the UNECE LRTAP Convention and EU National Emissions Ceilings – CROSS CUTTING ISSUES

REVIEW FINDINGS	Fullfiled
6. Nevertheless, the ERT identified some minor issues and will provide recommendations for improvements in this report. Revised sections for future submissions should include key category analysis, recalculations, and NECD/CLRTAP comparability.	Implemented in Chapter 1.4, Chapter 8, Chapter 12.3
INVENTORY SUBMISSION	
7. Austria has reported emissions for its protocol base years and a full time series up to 2008 (the latest year) for its protocol pollutants in the NFR09 format. Austria also submitted a detailed Informative Inventory Report (IIR). Austria did not provide 2008 gridded emissions.	Submission 2012
KEY CATEGORIES	
10. Austria does not provide a full level assessment for key categories in its IIR. The ERT recommends that Austria completely separates the level and trend assessment for key categories, and revises this chapter of the IIR accordingly.	Implemented in Chapter 1.4,
28.The ERT recommends that Austria strictly separates level and trend assessment for key categories and revises the corresponding chapter of the IIR.	
QUALITY	
12. Austria's IIR is generally well presented, but does not fully follow the IIR structure as proposed by the Guidelines. In particular the chapters on projections and improvement are missing (although the information is available elsewhere).	Implemented
29.The ERT encourages Austria to follow the proposed structure of the IIR even more closely, in particular by introducing chapter on projections and planned improvement at the end of the report.	
13. Austria's IIR provides a lot of detailed information on methodologies. However, it does not indicate the Tier level which methods are considered to be equivalent to. Including this information as a summary table, or with teach sector would be very helpful in improving transparency.	Submission 2012
30.The ERT recommends that Austria include an indication of the Tier levels for each of the methodologies explained in the IIR. This will improve transparency.	
Consistency, including recalculations and time-series	
17.Recalculations are generally explained in the major changes section (chapter 3.3) of the IIR, but the ERT recommend that the link between the changes in methodology and the resulting emission numbers are explained in more detail, to provide improved clarity.	Implemented in Chapter 8
31.The ERT encourages Austria to give more detailed information about the links between improvements of the methodologies and resulting recalculations in future IIR.	

REVIEW FINDINGS	Fullfiled
CLRTAP/NECD comparability	
19. Austria's data submission for NECD and CLRTAP differ significantly. As explained by the party, this is due to the usage of emission totals derived from fuel used in the case of the NEC directive as opposed to fuel sold for the CLRTAP submission. The ERT encourages Austria to improve the transparency of its reporting by including an explanatory note at the beginning of the IIR.	Implemented in Chapter 2.1.2, Chapter 2.2.2, Chapter 12.3
32.The ERT encourages Austria to improve the transparency of its reporting by including an explanatory note on the differences between NECD and CLRTAP reporting at the beginning of the IIR.	
Accuracy and uncertainties	
20. Austria compiled a qualitative uncertainty analysis and presents this clearly in its IIR. Austria uses both the results from their uncertainty analysis and key category analysis for the prioritisation of inventory improvement activities.	This task is included in the inventory improvement plan.
33. The ERT encourages Austria to assess the possibilities for compilation of a quantitative uncertainty analysis in the future. Result of such analysis could be used to prioritize planned improvements.	

Table 225: Improvements made in response to the Stage 3 in-depth review of emission inventories submitted under the UNECE LRTAP Convention and EU National Emissions Ceilings – NFR 1 A STATIONARY FUEL COMBUSTION ACTIVITIES

REVIEW FINDINGS	Fullfiled
Areas for improvements identified by Austria	
24.Improved emission factors for space heating.	Field measurement campaign is ongoing.
General recommendations on cross-cutting issues.	
Completeness:	
35. The ERT considers the inventory for the stationary energy sector to be quite complete and comprehensive, with good levels of detail in the methodology descriptions.	–
36. Only one case of incompleteness was identified. See sub-sector specific recommendations (Category issue 1).	–
Transparency:	
37. Austria has provided a detailed and generally transparent emissions inventory. Estimates are provided at the most detailed level for all energy sectors. Austria's methodology and emission factors in the IIR are considered by the ERT to be transparent and well described for the stationary energy sector. The ERT has one comment about the transparency in the IIR. See sub-sector specific recommendations (Category issue 2).	–
38. Emission trends are described in a thorough manner. The focus of the trend description is on 1990 and the base year. The ERT suggests that more information could be included for the entire time series.	This task is included in the inventory improvement plan.

REVIEW FINDINGS	Fullfiled
39. To improve transparency, the ERT recommends that rationales for choice of emission factors, when significantly different from default Guidebook emission factors, should be stated.	The rationale is always that CS emissions factors are derived from national measurements and/or expert guess which considers the national facility structure.
Accuracy:	
40. The ERT encourages Austria to undertake a quantitative uncertainty analysis for the stationary energy sector in order to help identify potential areas for further improvements and to provide an indication of the reliability of the inventory data.	This task is included in the inventory improvement plan.
41. Austria has detailed QA/QC checks by the sector experts themselves, and there is a second audit for every sector. The ERT commends Austria for these thorough OA/QC procedures. The ERT encourages Austria to specify source-specific QA/QC procedures.	
Comparability:	
42. The methods used are – as far as the ERT can understand – consistent with the methods proposed by the EMEP/EEA Guidebook.	–
No over- or underestimates have been discovered during the review process.	–
Consistency:	
43. The ERT finds that the time series in the Austrian inventory is consistent throughout, for the most part. One minor inconsistency has been identified. See sub-sector specific recommendations (Category issue 3).	–
Recalculations:	
44. The recalculations in the Austrian inventory are thoroughly explained in the IIR, including a description of how the recalculations affect the emissions. However, the IIR does not explain the rationale for all recalculations. The ERT encourages Austria to provide the rationale for all recalculations in its IIR.	Recalculations are due to improved census data reflected in the revision of the national energy balance.
Improvement:	
45. The ERT commends the Party for its clear improvement plan in the stationary energy sector. The ERT encourages Austria to perform a quantitative uncertainty analysis in order to identify other areas of the stationary energy sector where improvements of activity data or emission factors could be appropriate.	This task is included in the inventory improvement plan.
Category issue 2: 1 A 4 c i: All pollutants	
46. The ERT has noted that the emission factors used in sector 1 A 4 are somewhat unclear. The ERT recommends that Austria clarifies this chapter by a more detailed description of the emission factors used for each fuel type throughout the time series.	Emission factors for central heatings are provided in tables of chapter 3.1.6
Category issue 3: 1 A 4 c i: NMVOC and CO	
47. The ERT noted a jump in NMVOC emissions from 1 A 4 c i between 1996 and 1997. Austria provided information stating that this was due to a change in methodology, with new emission factors arising from this change. No interpolation method has been used to smooth the resulting jump in the emission time series. The ERT recognizes the challenges connected to finding good methods for merging separate time series, but recommends that Austria uses interpolation to splice the two time series more gradually.	It is foreseen to solve this issue after emissions factors from field measurement campaign are available.

Table 226: Improvements made in response to the Stage 3 in-depth review of emission inventories submitted under the UNECE LRTAP Convention and EU National Emissions Ceilings – 1 A MOBIL FUEL COMBUSTION ACTIVITIES

AREAS FOR IMPROVEMENTS IDENTIFIED BY AUSTRIA	Fullfiled
25. Introduction of an updated version of the "Handbook on Emission Factors" for transport.	The update of emission factors from HBEFA 2.1 – which are currently used in GLOBEMI – to the new version of HBEFA 3.1 has not been realised yet, but is planned to be implemented in the next submission. Information included in Chapter 3.3.5
General recommendations on cross-cutting issues.	
Completeness:	
50. The ERT considers the Transport sector to be complete and comprehensive for the pollutants reviewed.	–
Transparency & Comparability:	
51. The ERT commends the already good levels of detail in the methodology descriptions for the main sources within the transport sector (1A3a, b), encouraging the Party to further improve the transparency and comparability of its inventory by providing even more details where necessary.	Planned to be implemented in the next thorough update of the IIR.
52. On the other hand, the ERT notes that, compared to the main transport sub-categories, little information is provided on the "off-road" vehicles. Here, the Party provides information for all off-road vehicles together without further separation of sub-categories such as railways or navigation. The ERT therefore recommends that the Party includes much more detailed information and descriptions in its next submission for the sub-categories summed up under "off-road" at the moment.	As soon as the Umweltbundesamt budget allows a new study about off-road fuel consumption and pollutant emissions, input-data for the off-road traffic will be updated and recalculated with the model GEORG. Information included in Chapter 3.3.6
Accuracy:	
53. The ERT commends the Party for the QA/QC procedures implemented and the description of these procedures in the IIR.	–
54. The ERT encourages Austria to undertake specific uncertainty analysis for the Transport Sector in order to help inform the improvement process and to provide an indication of the reliability of the inventory data.	Planned to be implemented in submission 2012.
Recalculations:	
55. Austria has recalculated its inventory for almost all sectors in the year 2010, providing not only good information on the reasons within the IIR but also detailed data on the recalculated emissions on a very detailed level. The ERT commends the Party's efforts, encouraging Austria to try and provide such data on a level as disaggregated as possible.	Planned to be implemented in following submissions.
Improvements:	
56. The ERT commends the Party for its improvements carried out and still planned within the transport sector, encouraging the Party to further improve its inventory by attaching more attention to off-road mobile sources.	As soon as the Umweltbundesamt budget allows a new study about off-road fuel consumption and pollutant emissions, input-data for the off-road traffic will be updated and recalculated with the model GEORG. Information included in Chapter 3.3.6
Sub-sector Specific Recommendations.	
Category issue 1: 1.A.3a ii – Air Transport: Pb	
57. During the review the Party stated that production and import	Information included in Chapter 3.3.8

AREAS FOR IMPROVEMENTS IDENTIFIED BY AUSTRIA	Fullfiled
of leaded gasoline has been prohibited since 1993. In Austria and that earlier emission estimates are based on a lead content of 0.56 g Pb/litre for aviation gasoline. The Party also provided further explanatory information on the issue of emission factors used for lead emissions from avgas. The ERT thanks Austria for the information provided, and recommends that the Party provides additional explanatory information within the relevant IIR chapters in its next submission.	
Category issue 2: 1.A.3.bi & ii Road transport – Pb	
58. During the review the ERT asked the Party to provide additional information on the development of Pb emissions reported for these categories. Besides the information given above for avgas, Austria stated that from 1996 on a lead content of 0,1 mg/GJ has been estimated for gasoline due to the assumed use of lead additives for old non-catalyst vehicles and that a lead content of 0.02 mg/GJ has been assumed for diesel oil. The ERT thanks the Party for its detailed answer, asking the Party to include these assumptions in its IIR.	Information included in Chapter 3.3.8
Category issue 3: 1.A.3.b i: NMVOC, CO, NH_3	
59. The ERT noted some dips in the trends reported for 1990 emissions of NH_3, NMVOC and CO, asking the Party to provide some explanation on these issues. The ERT recommends that the Party include explanations in its IIR.	National NH_3, NMVOC and CO emissions show a constantly decreasing trend between 1985 and 1995 without any peaks. So, the dips can be explained by the methodology which is used for calculating fuel export (= total fuel sold minus inland and off-road consumption). Therefore, the dips must be a model output caused by changes in the Energy Balance. Information included in Chapter 3.3.5
Category issue 4: 1.A.3.b vi & vii: PM, TSP	
60. The ERT notes that particle emissions from tyre and brake wear (1A3bvi) are reported as 'IE', asking the Party to provide some information as to whether these emissions are part of 1A3bvii and why no separate reporting is possible. Austria states that PM emissions from tyre and brake wear are included in road abrasion and that it is not possible to develop separate emission factors (by road and vehicle type) from field emission measurements which consider total vehicle emissions. The ERT accepts this answer but wants to encourage the Party to further develop its models and to provide separate estimates for both sub-categories in future submissions.	Information included in Chapter 3.3.8 A separately reporting is not yet planned.
Category issue 5: 1.A.3.b vi & vii: Other HM	
61. The ERT notes that Austria reports emissions of all HM (besides Cd, Hg and Pb) as not reported (NR). The Party states that no such estimations have been carried out up to now. The ERT accepts this answer but anyhow wants to encourage Austria to provide estimates for 'Other HMs' in its next submission.	The reporting of 'Other HM' is not yet planned but this task is included in the inventory improvement plan.
Category issue 6: 1.A.4.a ii – All pollutants	
62. The ERT notes that Austria reports all emissions from 1A4aii as 'IE', giving no information, where these emissions are included. In contrast, under activity data only 'NO' occurs. The Party stated that emissions from mobile machinery are included in category 1A4bii and that it is not possible to split the data into commercial and non-commercial use. The ERT thanks Austria for the answer provided, and encourages the Party to provide	Wie lautet hier die Antwort für IE und AD NO A separately reporting is not yet planned.

AREAS FOR IMPROVEMENTS IDENTIFIED BY AUSTRIA	Fullfiled
more information on the notation keys used in its inventory in both IIR and NFR in its next submission. The ERT also encourages Austria to investigate whether it will be possible to gather new data to allow these two sources to be reported separately in the future.	

Table 227: Improvements made in response to the Stage 3 in-depth review of emission inventories submitted under the UNECE LRTAP Convention and EU National Emissions Ceilings – NFR 1 B FUGITIVE EMISSIONS

AREAS FOR IMPROVEMENTS IDENTIFIED BY AUSTRIA	Fullfiled
27. Looking into the possible omission of NMVOC emissions from coal mining, storage and handling.	Planned to be implemented in following submissions.
Sub-sector Specific Recommendations	**Fullfiled**
Category issue 1: 1 B 1 a: NMVOC	
47. The ERT notes that Austria does not estimate emissions of NMVOCs from coal mining and handling. Emission factors for NMVOC from this sector are provided in the EMEP/EEA Guidebook. Austria notes that there has been no coal mining in Austria after 2007. The ERT encourages Austria to apply the default emission factors from the Guidebook and to estimate NMVOC emissions from coal mining and handling for the years prior to 2007. Austria will consider including this in its improvement plan.	Planned to be implemented in following submissions.

Table 228: Improvements made in response to the Stage 3 in-depth review of emission inventories submitted under the UNECE LRTAP Convention and EU National Emissions Ceilings – NFR 2 Industrial Processes

AREAS FOR IMPROVEMENTS IDENTIFIED BY AUSTRIA	Fullfiled
26. Further investigation of the issue of possible double-counting in chipboard production	This task is included in the inventory improvement plan.
General recommendations on cross-cutting issues	
Completeness:	
63. The ERT considers the industrial processes sector to be almost complete. Only an emissions estimate for the Ferroalloys production is missing. TSP emissions are assumed to be negligible and would contribute 0.02% to the national total.	This task is included in the inventory improvement plan.
Transparency:	
64. The ERT notes that the Industrial Processes sector in the Austrian IIR is in general very well organised and includes almost all necessary information. This approach provides a high level of transparency. However, there are some categories which would benefit from improved transparency (see chapter Sector-specific Recommendations).	-
Accuracy:	
65. The ERT encourages Austria to undertake sector-specific quantitative uncertainty analysis for the industrial processes in order to help inform the improvement process and to provide an indication of the reliability of the inventory data.	This task is included in the inventory improvement plan.

AREAS FOR IMPROVEMENTS IDENTIFIED BY AUSTRIA	Fullfiled
66. Austria has implemented a quality management system (QMS) which is based on ISO/IEC 17020 *General criteria for the operation of various types of bodies performing inspections* and which incorporate many of the EMEP/EEA emission inventory guidebook 2009 requirements. ERT encourages Austria to provide more sector-specific information in the next submission.	Chapter 4.2.2.
Recalculations:	
67. Because of changes in methodologies and activity data, the ERT noted that Austria revised the emissions of the year 2007 for 2.D.2 Other Production – Food and Drink (Bread, Wine, Beer and Spirits). This recalculation had an insignificant influence on the total NMVOC emissions. Austria also revised emissions estimates of TSP, PM_{10} and $PM_{2.5}$ emissions from limestone and dolomite and excluded these emissions from the inventory. These recalculations had a very significant influence on the total TSP, PM_{10} and $PM_{2.5}$ emissions. The ERT appreciates Austria's plans to revise these emissions.	Chapter 4.3.1
Improvement:	
68. The Austrian IIR includes only very limited information about sector-specific improvements plans. The ERT encourages Austria to provide more sector-specific information about planned improvements in the next submission.	This task is included in the inventory improvement plan.
Sector-specific Recommendations	
Category issue 1: 2 A 1 Cement production	
69. The ERT noted that Austria reported SO_2 emissions from Cement production as NA. Austria has responded that the methodology does not allow combustion and process emissions to be split. The ERT encourages Austria to try and separate emissions from combustion and from processes and to report them under the relevant categories in future submissions. Where this is not possible the ERT encourages Austria to use the IE notation key and to provide comments in the IIR and NFR.	This task is included in the inventory improvement plan.
Category issue 2: 2 C 1 Iron and steel production	
70. The ERT notes that some data used for HM estimates are provided in table 162 of the IIR. However, the ERT suggests that Austria should present some activity data more clearly - in particular activity data for coke production, coke consumption in sinter plants and blast furnace gas production.	This task is included in the inventory improvement plan.
Category issue 3: 2 C 3 Aluminium production	
71. The ERT notes that the Austrian IIR does not use terminology used in NFR for chapter titles. This makes the IIR difficult to follow. The ERT recommends that Austria should increase the transparency of industrial processes reporting by ensuring that each category is described under individual and appropriately named chapters.	See relevant chapters.

Table 229: Improvements made in response to the Stage 3 in-depth review of emission inventories submitted under the UNECE LRTAP Convention and EU National Emissions Ceilings – NFR 3 SOLVENT AND OTHER PRODUCT USE

General recommendations on cross-cutting issues	Fullfiled
63. The Austrian solvent emissions inventory is complete and accurate. The ERT appreciates the efforts of Austria to provide a very good quality report.	–
Completeness:	
64. The ERT considers the solvent sector to be complete and comprehensive.	–
Transparency:	
65. Estimation approaches, activity data, assumptions and relevant documentation are transparently presented in the IIR.	–

Accuracy:	
66. The IIR indicates that no quantitative uncertainty assessment for any of the pollutants or pollutant groups has been made. The qualitative assessment provides the typical error range of 10-30% for NMVOC emissions in solvent sector. The ERT encourages Austria to present quantitative uncertainty assessments for the categories in the solvent sector to support future submissions.	This task is included in the inventory improvement plan.
QA/QC procedures:	
67. According to information provided, QA/QC procedures are set up for the solvents sector. The procedures are both general and sector-specific, and are regarded as being sufficient.	–
Comparability:	
68. Austria applied a combination of bottom-up and top-down approaches to estimate emissions from solvent uses. The output format complies with the latest NFR categories, and allows comparison with other Parties.	–
Consistency:	
69. Austria used the 2000 data (e.g. solvent content in paints, waste gas purification efficiency) for the subsequent years to estimate solvent use data as no new survey has been conducted. The approach is conservative though it might significantly overestimate NMVOC emissions in the solvent sector as some solvent uses and regulations associated with mitigating emissions were amended after 2000. The ERT encourages Austria to consider improving the estimates of data for 2000 onwards, and recalculating emissions.	This task is included in the inventory improvement plan.
Recalculations:	
70. Recalculations which have been done in the sector are transparently explained in the IIR.	–
Improvement:	
71. No improvements are planned for the sector.	–
Sector-specific Recommendations	
Category Issue 1: 3.A. Paints and Coatings – NMVOC	
72. Austria uses the "Not Applicable" notation key for the NMVOC emissions from the 3A3 "Other coating application" category. However, the Party explained that the paint use, and hence associated emissions, under 3A3 are accounted for in 3A1. The ERT recommends that Austria should use the appropriate notation key IE ("Included Elsewhere") and provide an explanation in the IIR that all paint use emissions are included under 3A1.	More description will provided in the next submission

Table 230: Improvements made in response to the Stage 3 in-depth review of emission inventories submitted under the UNECE LRTAP Convention and EU National Emissions Ceilings – NFR 4 AGRICULTURE

General recommendations on cross-cutting issues	Fullfiled
Completeness:	
63. The agriculture inventory of Austria covers a wide set of pollutants and the inventory is complete with respect to the most important sources of emissions. The ERT commends Austria for the completeness and the quality of the agriculture inventory.	–
Transparency:	
64. The inventory is generally transparent and the IIR explains the methodology used to estimate several pollutants and source combinations. Emission Factors and activities are always provided in a very detailed manner. The ERT commends Austria for its efforts to make the inventory transparent. It is an example of good practices which other countries could learn from. Nevertheless, PM emissions from animal husbandry could be reported in 4B NFR sub-sectors	In NFR sub-sectors 4.B PM emissions from animal husbandry are now reported reported as IE "Included

General recommendations on cross-cutting issues	Fullfiled
instead of being reported in 4G or, at the minimum, reported as IE "Included Elsewhere" (instead of NA). The ERT also recommends that Austria provides a summary table indicating the tier levels used for each of the agriculture sources.	Elsewhere"
Accuracy:	
65. The uncertainty analysis provided is qualitative (level B for agriculture). The ERT encourages Party to undertake a quantitative uncertainty analysis for the agriculture sector in order to help inform the improvement process and to provide an indication of the reliability of the inventory data.	This task is included in the inventory improvement plan.
Recalculations:	
66. The ERT notes that recalculations were undertaken in response to the implementation of new statistical data, in particular AWMS. Recalculations (§ 7.2.2) are provided in a very detailed manner for each source in the Austrian IIR and the reporting is an example of good practice.	–
Improvement:	
67. The ERT commends Austria for its improvements in the 4B and 4D sectors because NOx emissions from 4B and 4D are estimated for the first time, and also because the NH3 emission model has recently been revised. The ERT also commends the Party for the good descriptions of the improvements achieved, which are clearly provided in the IIR.	–
Sector-specific recommendations	
68. There are no sector-specific recommendations.	–

Table 231: Improvements made in response to the Stage 3 in-depth review of emission inventories submitted under the UNECE LRTAP Convention and EU National Emissions Ceilings – NFR 6 WASTE

General recommendations on cross-cutting issues.	Fullfiled
63. The CLRTAP submission from Austria regarding Chapter 6 (Waste) is quite complete and presents emissions for major pollutants and for major activities following the EMEP Guidebook 2009. The methodologies and reasons for decreases or increases in emissions for sectors 6 A 1, 6 C and 6 D are well developed and presented in a way that allows good comprehension. Recalculations for all sectors are also well explained.	-
Completeness:	
64. With regard to Waste, the inventory is currently quite complete. However, some improvements have also been suggested from Austria during the review process. These are considered in detail in the Category Issues below.	-
Transparency:	
65. The Austrian IIR provides information about emission sources for Waste, as well as activity data and EFs. Trends are also clearly explained. A list of measures implemented for the sector is also present in the IIR, which increases transparency.	-
66. The methodology and references for 6 A 1 are well documented and different types of waste deposited are also described. For sector 6 C, sources of emissions are completely listed. Data and assumptions for the estimation of activity data for 6 C are clearly explained. It would help to improve transparency in 6 C if the data in the IIR were clearly allocated to the different NFR sub-categories (6 C a,b,c,d,e), and the ERT recommends that this should be undertaken. The NFR tables report emissions for each sub-category, and the corresponding data is thus assumed to be readily available.	-
Accuracy:	
67. Austria has provided a clear picture of the key sources in the IIR for the Waste sector. Austria also provided complete QA/QC checks for the waste sector.	-

General recommendations on cross-cutting issues.	Fullfiled
68. Uncertainty analyses are presented for the waste sector. The majority are defined as category "C" or "D" which presents quite a high error range. The ERT notes that Austria uses the uncertainty assessment in prioritising improvements, and therefore encourages Austria to try and improve data to achieve a lower error range for the waste sectors.	This task is included in the inventory improvement plan.
Comparability:	
69. The IIR and NFR tables presented by Austria are easily comparable to other IIR and NFR Tables.	-
Recalculations:	
70. All recalculations and improvements made in the 2010 submissions are explained well, and clearly presented in the Waste sector. The ERT commends Austria for its detailed reporting.	-
Improvements:	
71. Specific improvements were reported in the IIR for waste. Especially for the documented categories 6 A 1, 6 C and 6 D.	-
Sector-specific recommendations	
Category issue 1: 6 A Solid waste disposal on land: SOx, NOx, TSP, PM10, PM2.5	
72. The ERT noticed that no emissions of SOx and NOx were reported under 6 A. Austria has indicated that they are reported under Chapter 1, energy. However, Austria mentions in its IIR (page 269, 8.2.1) that most active landfills in Austria have gas collection systems. For those without energy recovery systems, NOx and SO2 emissions arise when burning (flaring) occurs and they should be reported as waste emissions. The ERT therefore recommends that Austria should use the notation key "IE" in the NFR Tables instead of "NA" to improve the transparency of the way in which emissions from flaring are reported. Or, if data on flaring are available, emissions should be reported in the Waste chapter.	-
73. The ERT encountered another transparency issue in 6 A 1. The ERT were not able to understand whether the emissions of TSP, PM10 and PM2.5 which are reported under 6 A 1 came from burning (flaring) or from deposition of waste (e.g. handling). Austria has confirmed that the emissions are from waste handling at landfills, and the ERT recommends that this explanation is included in the IIR.	Emissions arise from deposition of waste/ handling of waste on landfills. Only relevant waste types are covered.
Category issue 2: 6 B Wastewater handling: All pollutants	
74. No emissions are reported in category 6B (the notation keys NA or NR are used). Following questions from the ERT, Austria has explained that activity data are unknown for this category. Consequently, the ERT strongly recommends the use of the "NE" notation key instead of "NA". However, the ERT encourages Austria to try and obtain activity data for this category to make emission estimates, and therefore improve the IIR and the NFR tables.	There is unfortunately no activity data available for this years' submission.
Category issue 3: 6 C Waste incineration:	
75. Austria's IIR explains that some emissions from hazardous waste and sewage sludge incineration are reported in 1 A 4 a (and 1 A 1 a) for 1992 onwards. Where a plant recovers heat or generates electricity from waste burning for its own purposes, allocation to 1 A 4 a is correct. However, this is not a particularly common occurrence across Europe. So the ERT recommends that some text is added to explain this logic.	Explanation has been added.
Category issue 4: 6 C a Clinical waste incineration: TSP, PM10, PM2.5, AD	
76. Emissions from TSP, PM10 and PM2.5 are not reported (NE) although activity data are known and EFs are provided in the EMEP Guidebook 2009 (at least for TSP). The ERT has recommended that Austria should include emission estimates in its next submission.	We consider this in our next submission.
77. The IIR also explains that activity data are based on a waste flow database at the Umweltbundesamt which only has data for the years 1990 and 1994, the	We are aware about this issue.

General recommendations on cross-cutting issues.	Fullfiled
remaining time series being extrapolated from these data. This estimation is probably a good first approximation, but long extrapolations such as this should be avoided or supported by some new data. Consequently, the ERT recommends that Austria should investigate ways of obtaining new activity data to improve emission reporting.	However more actual information is not available.
Category issue 5: 6 C b Industrial waste incineration: TSP, PM10, PM2.5, AD	
78. Emissions from TSP, PM10 and PM2.5, are not reported (NE) whereas activity data are known and EFs are provided in the EMEP Guidebook. The ERT has recommended that Austria should include emission estimates in its next submission.	We consider this in our next submission.
79. The IIR does not provide details on the activity data used for the category 6 C b (the ERT thinks that this is possibly Waste Oil). The ERT encourages Austria to describe the sub-categories reported in the NFR tables in the IIR.	Table 211 shows activity data for waste oilActivity data on all types of incinerated waste is provided in table 225 of the IIR.
Category issue 6: 6 C c All pollutants	
80. No emissions are reported under 6 C c but the ERT has noticed from page 267 of the IIR ("Although an increasing amount of waste is incinerated, NOx, NMVOC and NH3 emissions from Waste Incineration (without energy recovery) are decreasing. Emissions arising from incineration of waste with energy recovery are taken into account in NFR Sector 1 A.") that waste incineration without energy recovery is still present and the ERT therefore presumes that emissions are still produced. It leads to a small inconsistency because these emissions are not reported. The ERT encourages Austria to clarify this point, and update reporting accordingly.	Waste incineration without energy recovery ends in 1991 and emission are reported in the NFR tables under category 6 C.
Category issue 7: 6 C d Cremation: TSP, PM10, PM2.5, AD	
81. Activity data for this source are based on expert judgement and have been constant since 2005. For more accurate emissions reporting, the ERT suggests that Austria should try to obtain statistical data from crematoria. Furthermore, emissions from TSP, PM10 and PM2.5, are not reported (NE) although activity data are known and EFs are provided in the EMEP Guidebook 2009 (at least for TSP). The ERT has recommended that Austria should include emission estimates in its next submission.	Data has been reported by the national association of crematoria operators. TSP will be estimated in next submission.
Category issue 8: 6 C e Small-scale waste burning: All pollutants	
82. No emissions for this category are reported. Austria explained that any biomass waste incineration is prohibited in Austria. However, illegal waste incineration does takes place, but Austria sets it as "NE". The ERT suggests that even if it is banned, illegal fires will happen, and therefore the ERT recommends making an emissions estimate - particularly because emissions (mostly PM) are still quite important. Austria may benefit from considering the methodologies used by other countries which report emissions from this source (for example the UK).	A chapter has been added for clarification. Emission factors will be changed to "IE" in the next submission,

8.2.1 Major Changes by Sector

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

ENERGY (1.A)

Update of activity data:

1.A.1.a Public Electricity and Heat Production

Part of industrial waste was shifted from sector *1.A.4.a Other Sectors - Commercial/Institutional* to *1.A.1.a Public Electricity and Heat Production* due to a revision of the national energy balance. The biogas consumption has been revised downwards resulting in lower emissions.

1.A.2 Manufactoring Industries and Construction

Due to the inter-sectoral shift of waste consumption as described above, emissions from industrial waste incineration have been increased in 2008.

1.A.3.b Road Transport

A methodological update of the quantity structure of road transport resulted in a reduction of fuel consumption of inland road transport. This reduction can be explained by the ex post consideration of real-world road performance data for 2007, 2008 and 2009, which especially shows the downturn of road freight transport caused by the economic slowdown.

1.A.3.c Railways

Activity data was revised according to a methodological update of rail passenger kilometers, which has no significant effect on emission data for 2008.

1.A.3.d.2 National Navigation (Shipping)

A new method was introduced to report emissions from national and international navigation separately. Thus, the recalculations for the year 2008 show high deviations compared to last year, but have an insignificant effect in absolute numbers.

1.A.4. Other Sectors – stationary fuel combustion

In the national energy balance the coal consumption has been revised downwards and the natural gas consumption has been revised upwards. A big part of incinerated industrial waste was shifted to sector *1.A.1.a Public Electricity and Heat Production.*

Revised data on biomass consumption caused lower NMVOC emissions from 2001 onwards.

Improvements of methodologies and emission factors:

1.A.3.b Road Transport

Revised road freight performance data has been implemented in the GLOBEMI calculation model for the years 2007, 2008 and 2009. Thus, statements about real-world road freight performance in Austria are possible.

Adaption of age pattern and failure rates of the Austrian vehicle fleet according to actual fleet structure data from national statistics.

1.A.3.c Railways:

Revised data on rail passenger transport from the Federal Ministry for Transport, Innovation and Technology has been implemented in the GLOBEMI calculation model, which has no significant effect on GHG emissions.

FUGITIVE EMISSIONS (1 B)

Update of emission factors:

1.B.2.b Natural gas: a minor transcription error during the calculation of one the material specific emission factors was corrected.

INDUSTRIAL PROCESSES (2)

Update of activity data:

2 C 1 Pig Iron and Electric Furnace Activity

Activity data for 2008 was updated as revised data of the energy balance became available in 2010. This leads to a minor change in emissions.

SOLVENT USE (3)

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 were updated from 2007 onwards.

The activity data from 2002 onwards concerning non-solvent use and the solvent content of products has been updated by surveys at companies and associations.

Introduction of new commodities chart for biogenic based solvents like bio-ethanol in the short-term and foreign trade statistics

AGRICULTURE (4)

Improvements of methodologies and emission factors:

4.B.8 Swine

The correction of a transcription error in the calculation of the N amount left for spreading/ fattening pigs resulted in lower NO_x emissions of swine.

4.F Field burning of agricultural wastes

Emissions are now calculated on the basis of relevant crops (wheat, barley, rye, oats). For residue/crop product country specific data have been applied. The recalculation resulted in slightly lower emissions.

WASTE (6)

Improvements of methodologies and emission factors

6.A.1 Managed waste disposal on land:

In this years' submission in the calculations three adjustments have been implemented:

1. Until submission 2010 for some deposited waste fractions more than 5 half lives (pursuant to IPCC GPG) have been considered in the emissions calculation. This has been adjusted in this years' submission leading to slightly revised emission estimates for 1991 and onwards.

2. The value of CH4 recovered was amended taking into account the (since 2002) falling methane concentration in landfill gas recovered (landfill gas excluding CH4 recovery is the basis for NMVOC and NH3 calculation).

3. The biodegradable organic carbon (DOC) of residual waste was adjusted slightly for the year 2008 as new information on waste composition became available.

8.2.2 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[157]. Detailed explanations are provided in chapters 3.1 and 3.3.

Table 232: Recalculation difference of SO_2 emissions in general with respect to submission 2008.

NFR Category SO_2 emissions		Absolute difference [Gg]						Relative difference	
		1990	1995	2000	2006	2007	2008	1990 Δ%	2008 Δ%
1 A 1	Energy Industries	0.000	0.000	0.003	-0.091	0.034	0.247	=	7.80%
1 A 2	Manufacturing Industries and Construction	0.000	0.000	-0.036	0.195	0.388	0.386	0.00%	3.65%
1 A 3	Transport	0.014	0.009	0.009	-0.001	0.001	-0.001	0.28%	-0.28%
1 A 4	Other Sectors	0.000	0.000	0.037	-0.142	-0.270	-0.590	0.00%	-8.49%
1 A 5	Other	0.000	0.000	0.000	0.000	0.000	0.000	=	=
1 B	Fugitive Emissions from Fuels	0.000	0.000	0.000	0.000	0.000	0.000	=	=
2	Industrial Processes	0.000	0.000	0.000	0.000	0.000	-0.001	=	-0.12%
3	Solvent and Other Product Use	NA=	NA=	NA=	NA=	NA=	NA=	=	=
4	Agriculture	0.000	0.000	0.000	0.000	0.000	0.000	-18.95%	-28.12%

157 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 SO_2 emissions		Absolute difference [Gg]						Relative difference	
		1990	1995	2000	2006	2007	2008	1990 Δ%	2008 Δ%
6	Waste	0.000	0.000	0.000	0.000	0.000	0.000	=	=
	Total Emissions	**0.014**	**0.008**	**0.013**	**-0.039**	**0.152**	**0.040**	**0.02%**	**0.18%**

Table 233: Recalculation difference of NO_x emissions in general with respect to submission 2008.

NFR Category NO_x emissions		Absolute difference [Gg]						Relative difference	
		1990	1995	2000	2006	2007	2008	1990 Δ%	2008 Δ%
1 A 1	Energy Industries	0.000	0.000	0.036	-0.432	-0.562	-0.200	=	-1.49%
1 A 2	Manufacturing Industries and Construction	-0.005	-0.009	-0.046	0.143	0.342	0.606	-0.02%	1.81%
1 A 3	Transport	-0.003	-0.103	-0.701	-3.691	-3.463	-2.150	0.00%	-1.69%
1 A 4	Other Sectors	0.000	-0.001	0.071	0.301	0.179	-0.234	0.00%	-0.94%
1 A 5	Other	0.000	0.000	0.000	0.000	0.000	0.000	=	=
1 B	Fugitive Emissions from Fuels	IE=	IE=	IE=	IE=	IE=	IE=	=	=
2	Industrial Processes	0.000	0.000	0.000	0.000	0.000	-0.003	=	-0.19%
3	Solvent and Other Product Use	NA=	NA=	NA=	NA=	NA=	NA=	=	=
4	Agriculture	-0.338	-0.336	-0.308	-0.280	-0.288	-0.269	-4.94%	-4.42%
6	Waste	0.000	0.000	0.000	0.000	0.000	0.000	=	=
	Total Emissions	**-0.347**	**-0.449**	**-0.947**	**-3.959**	**-3.792**	**-2.250**	**-0.18%**	**-1.09%**

Table 234: Recalculation difference of NMVOC emissions in general with respect to submission 2008.

NFR Category NMVOC emissions		Absolute difference [Gg]						Relative difference	
		1990	1995	2000	2006	2007	2008	1990 Δ%	2008 Δ%
1 A 1	Energy Industries	0.00	0.00	0.00	-0.02	0.01	0.10	=	16.59%
1 A 2	Manufacturing Industries and Construction	-0.03	-0.04	-0.05	-0.06	-0.03	0.08	-1.63%	3.43%
1 A 3	Transport	2.08	2.85	1.77	-3.05	-3.28	-3.08	2.95%	-16.19%
1 A 4	Other Sectors	0.00	0.00	-0.04	-1.22	-2.06	-1.20	0.00%	-3.39%
1 A 5	Other	0.00	0.00	0.00	0.00	0.00	0.00	=	=
1 B	Fugitive Emissions from Fuels	0.00	0.00	0.00	0.00	0.00	0.00	-0.01%	-0.02%
2	Industrial Processes	0.00	0.00	0.00	0.00	0.00	0.05	=	1.08%
3	Solvent and Other Product Use	0.00	0.00	0.00	1.31	0.65	-8.90	=	-9.16%
4	Agriculture	0.00	0.00	0.00	0.00	0.00	0.00	0.00%	=
6	Waste	0.00	0.00	0.00	0.00	0.00	0.00	=	0.80%
	Total Emissions	2.05	2.81	1.68	-3.03	-4.71	-12.94	0.75%	-7.92%

Table 235: Recalculation difference of NH_3 emissions in general with respect to submission 2008.

NFR Category NH_3 emissions		Absolute difference [Gg]						Relative difference	
		1990	1995	2000	2006	2007	2008	1990 Δ%	2008 Δ%
1 A 1	Energy Industries	0.000	0.000	0.001	-0.020	-0.008	0.005	=	1.13%
1 A 2	Manufacturing Industries and Construction	0.000	0.000	-0.001	0.003	0.009	-0.013	0.00%	-2.53%
1 A 3	Transport	0.010	0.135	0.070	0.018	-0.031	-0.069	0.37%	-4.05%
1 A 4	Other Sectors	0.000	0.000	0.006	0.005	0.003	-0.005	0.00%	-0.72%
1 A 5	Other	0.000	0.000	0.000	0.000	0.000	0.000	=	=
1 B	Fugitive Emissions from Fuels	IE=	IE=	IE=	IE=	IE=	IE=	=	=
2	Industrial Processes	0.000	0.000	0.000	0.000	0.000	0.000	=	=
3	Solvent and Other Product Use	NA=	NA=	NA=	NA=	NA=	NA=	=	=
4	Agriculture	-0.005	-0.008	-0.012	-0.010	-0.012	-0.010	-0.01%	-0.02%
6	Waste	0.000	0.000	0.000	0.000	0.000	-0.001	=	-0.04%
	Total Emissions	**0.005**	**0.127**	**0.064**	**-0.005**	**-0.039**	**-0.093**	**0.01%**	**-0.15%**

Table 236: Recalculation difference of CO emissions in general with respect to submission 2008.

NFR Category		Absolute difference [Gg]						Relative difference	
CO emissions		1990	1995	2000	2006	2007	2008	1990 Δ%	2008 Δ%
1 A 1	Energy Industries	0.000	0.000	0.004	-0.091	0.071	0.414	=	10.04%
1 A 2	Manufacturing Industries and Construction	-0.920	-1.140	-1.727	-1.953	-1.832	1.559	-0.40%	1.02%
1 A 3	Transport	-0.860	-5.066	-9.218	0.466	-2.626	-4.683	-0.13%	-2.39%
1 A 4	Other Sectors	-0.014	-0.017	-0.443	-11.470	-16.454	-11.634	0.00%	-3.72%
1 A 5	Other	0.000	0.000	0.000	0.000	0.000	0.000	=	=
1 B	Fugitive Emissions from Fuels	IE=	IE=	IE=	IE=	IE=	IE=	=	=
2	Industrial Processes	0.000	0.000	0.000	0.000	0.000	-0.006	=	-0.02%
3	Solvent and Other Product Use	NA=	NA=	NA=	NA=	NA=	NA=	=	=
4	Agriculture	-0.260	-0.283	-0.372	-0.280	-0.330	-0.311	-20.69%	-29.48%
6	Waste	0.000	-0.057	-0.093	0.055	0.051	0.043	=	0.83%
	Total Emissions	-2.053	-6.562	-11.848	-13.272	-21.120	-14.618	-0.14%	-2.10%

Table 237: Recalculation difference of TSP emissions in general with respect to submission 2008.

NFR Category		Absolute difference [Mg]						Relative difference	
TSP emissions		**1990**	**1995**	**2000**	**2006**	**2007**	**2008**	**1990 Δ%**	**2008 Δ%**
1 A 1	Energy Industries	0.00	0.00	1.14	-80.49	-17.63	47.84	=	3.64%
1 A 2	Manufacturing Industries and Construction	-0.05	-0.06	-7.78	61.64	156.19	349.80	0.00%	7.99%
1 A 3	Transport	8.97	33.11	-2.80	18.92	-235.20	-359.04	0.08%	-2.20%
1 A 4	Other Sectors	-0.51	-0.63	-5.95	-312.62	-314.05	-964.12	0.00%	-8.46%
1 A 5	Other	0.00	0.00	0.00	0.00	0.00	0.00	=	=
1 B	Fugitive Emissions from Fuels	0.00	0.00	0.00	-1.02	5.50	17.73	=	3.61%
2	Industrial Processes	3 228.19	5 193.34	4 247.85	3 863.66	3 822.42	3 970.66	21.11%	30.81%
3	Solvent and Other Product Use	0.00	0.00	0.00	0.00	0.00	0.00	=	=
4	Agriculture	-22.84	-25.32	-34.06	-25.50	-30.30	-28.50	-0.18%	-0.24%
6	Waste	0.00	0.00	0.00	0.00	0.00	0.00	=	=
	Total Emissions	**3 213.77**	**5 200.44**	**4 198.41**	**3 524.58**	**3 386.93**	**3 034.36**	**5.43%**	**5.10%**

Table 238: Recalculation difference of PM10 emissions in general with respect to submission 2008.

NFR Category		Absolute difference [Mg]						Relative difference	
PM10 emissions		**1990**	**1995**	**2000**	**2006**	**2007**	**2008**	**1990 Δ%**	**2008 Δ%**
1 A 1	Energy Industries	0.00	0.00	1.03	-70.91	-14.79	44.95	=	3.72%
1 A 2	Manufacturing Industries and Construction	-0.05	-0.06	-7.01	55.47	140.55	314.81	0.00%	9.86%
1 A 3	Transport	9.03	33.09	-2.84	18.23	-88.94	-125.03	0.14%	-1.53%
1 A 4	Other Sectors	-0.46	-0.56	-5.36	-281.36	-282.64	-866.61	0.00%	-8.45%
1 A 5	Other	0.00	0.00	0.00	0.00	0.00	0.00	=	=
1 B	Fugitive Emissions from Fuels	0.00	0.00	0.00	-0.49	2.59	8.37	=	3.60%
2	Industrial Processes	1 498.31	2 411.86	1 971.47	1 791.26	1 771.05	1 838.69	16.77%	28.52%
3	Solvent and Other Product Use	0.00	0.00	0.00	0.00	0.00	0.00	=	=
4	Agriculture	-22.84	-25.32	-34.06	-25.50	-30.30	-28.50	-0.39%	-0.52%
6	Waste	0.00	0.00	0.00	0.00	0.00	0.00	=	=
	Total Emissions	**1 484.00**	**2 419.00**	**1 923.24**	**1 486.69**	**1 497.53**	**1 186.69**	**3.88%**	**3.34%**

Table 239: Recalculation difference of PM2.5 emissions in general with respect to submission 2008.

NFR Category		Absolute difference [Mg]						Relative difference	
PM2.5 emissions		**1990**	**1995**	**2000**	**2006**	**2007**	**2008**	**1990 ∆%**	**2008 ∆%**
1 A 1	Energy Industries	0.00	0.00	0.88	-59.10	-11.52	40.52	=	3.95%
1 A 2	Manufacturing Industries and Construction	-0.05	-0.06	-5.74	46.20	118.57	265.29	0.00%	11.45%
1 A 3	Transport	9.05	33.08	-2.85	17.97	-37.75	-43.12	0.21%	-0.81%
1 A 4	Other Sectors	-0.41	-0.50	-4.76	-250.10	-251.24	-769.63	0.00%	-8.34%
1 A 5	Other	0.00	0.00	0.00	0.00	0.00	0.00	=	=
1 B	Fugitive Emissions from Fuels	0.00	0.00	0.00	-0.15	0.81	2.64	=	3.59%
2	Industrial Processes	147.94	239.00	194.64	181.06	180.95	188.41	4.81%	14.40%
3	Solvent and Other Product Use	0.00	0.00	0.00	0.00	0.00	0.00	=	=
4	Agriculture	-21.65	-24.01	-32.30	-24.18	-28.73	-27.02	-1.53%	-2.04%
6	Waste	0.00	0.00	0.00	0.00	0.00	0.00	=	=
	Total Emissions	**134.87**	**247.51**	**149.87**	**-88.31**	**-28.91**	**-342.92**	**0.56%**	**-1.63%**

Table 240: Recalculation difference of Cd emissions in general with respect to submission 2008.

NFR Category		Absolute difference [Mg]						Relative difference	
Cd emissions		**1990**	**1995**	**2000**	**2006**	**2007**	**2008**	**1990 ∆%**	**2008 ∆%**
1 A 1	Energy Industries	0.000	0.000	0.000	-0.006	-0.001	0.003	=	1.17%
1 A 2	Manufacturing Industries and Construction	0.000	0.000	0.000	0.002	0.008	0.018	0.00%	8.44%
1 A 3	Transport	0.000	0.000	0.000	0.000	-0.001	-0.002	0.00%	-2.03%
1 A 4	Other Sectors	0.000	0.000	0.000	-0.011	-0.010	-0.025	-0.01%	-7.27%
1 A 5	Other	0.000	0.000	0.000	0.000	0.000	0.000	=	=
1 B	Fugitive Emissions from Fuels	NA=	NA=	0.000	NA=	NA=	NA=	=	=
2	Industrial Processes	0.000	0.000	0.000	0.000	0.000	0.000	=	-0.01%
3	Solvent and Other Product Use	0.000	0.000	0.000	0.000	0.000	0.000	=	=
4	Agriculture	0.000	0.000	0.000	0.000	0.000	0.000	-12.78%	-18.88%
6	Waste	0.000	0.000	0.000	0.000	0.000	0.000	=	0.42%
	Total Emissions	0.00	0.00	0.00	-0.02	-0.01	-0.01	-0.02%	-0.51%

Table 241: Recalculation difference of Hg emissions in general with respect to submission 2008.

NFR Category		Absolute difference [Mg]						Relative difference	
Hg emissions		1990	1995	2000	2006	2007	2008	1990 ∆%	2008 ∆%
1 A 1	Energy Industries	0.000	0.000	0.000	-0.004	-0.001	0.002	=	1.23%
1 A 2	Manufacturing Industries and Construction	0.000	0.000	0.000	0.002	0.005	0.021	0.00%	7.43%
1 A 3	Transport	0.000	0.000	0.000	0.000	0.000	0.000	0.01%	0.06%
1 A 4	Other Sectors	0.000	0.000	0.000	-0.011	-0.010	-0.016	0.00%	-7.85%
1 A 5	Other	0.000	0.000	0.000	0.000	0.000	0.000	=	=
1 B	Fugitive Emissions from Fuels	NA=	NA=	0.000	NA=	NA=	NA=	=	=
2	Industrial Processes	0.000	0.000	0.000	0.000	0.000	0.000	=	-0.01%
3	Solvent and Other Product Use	NA=	NA=	0.000	NA=	NA=	NA=	=	=
4	Agriculture	0.000	0.000	0.000	0.000	0.000	0.000	-14.78%	-21.86%
6	Waste	0.000	0.000	0.000	0.000	0.000	0.000	=	0.00%
	Total Emissions	**0.00**	**0.00**	**0.00**	**-0.01**	**-0.01**	**0.01**	**0.00%**	**0.74%**

Table 242: Recalculation difference of Pb emissions in general with respect to submission 2008.

NFR Category		Absolute difference [Gg]						Relative difference	
Pb emissions		1990	1995	2000	2006	2007	2008	1990 ∆%	2008 ∆%
1 A 1	Energy Industries	0.000	0.000	0.000	-0.090	-0.036	0.040	=	2.20%
1 A 2	Manufacturing Industries and Construction	-0.087	0.000	0.000	0.012	0.086	0.239	-0.90%	7.35%
1 A 3	Transport	-0.110	0.000	0.000	0.000	0.000	0.000	-0.07%	0.12%
1 A 4	Other Sectors	0.000	0.000	0.000	-0.099	-0.091	-0.199	0.00%	-7.88%
1 A 5	Other	0.000	0.000	0.000	0.000	0.000	0.000	=	=
1 B	Fugitive Emissions from Fuels	NA=	NA=	0.000	NA=	NA=	NA=	=	=
2	Industrial Processes	0.000	0.000	0.000	0.000	0.000	-0.001	=	-0.01%
3	Solvent and Other Product Use	0.000	0.000	0.000	0.000	0.000	0.000	=	=
4	Agriculture	-0.002	-0.002	0.000	-0.002	-0.002	-0.002	-11.74%	-17.32%
6	Waste	0.000	0.000	0.000	0.000	0.000	0.000	=	0.07%
	Total Emissions	**-0.20**	**0.00**	**0.00**	**-0.18**	**-0.04**	**0.08**	**-0.09%**	**0.53%**

Table 243: Recalculation difference of PAH emissions in general with respect to submission 2008.

NFR Category		Absolute difference [Mg]						Relative difference	
PAH emissions		**1990**	**1995**	**2000**	**2006**	**2007**	**2008**	**1990 ∆%**	**2008 ∆%**
1 A 1	Energy Industries	0.000	0.000	0.000	-0.002	-0.001	0.000	=	2.71%
1 A 2	Manufacturing Industries and Construction	-0.001	-0.001	0.000	-0.001	0.004	0.019	-1.36%	9.20%
1 A 3	Transport	0.000	-0.007	0.000	-0.002	-0.002	-0.002	-0.03%	-0.15%
1 A 4	Other Sectors	0.000	-0.001	0.000	-0.346	-0.344	-0.409	-0.01%	-6.86%
1 A 5	Other	0.000	0.000	0.000	0.000	0.000	0.000	0.00%	=
1 B	Fugitive Emissions from Fuels	NA=	NA=	0.000	NA=	NA=	NA=	=	=
2	Industrial Processes	0.000	0.000	0.000	0.000	0.000	0.000	=	-0.07%
3	Solvent and Other Product Use	0.000	0.000	0.000	NE=	NE=	NE=	=	=
4	Agriculture	0.000	0.000	0.000	0.000	0.000	0.000	=	=
6	Waste	0.000	0.000	0.000	0.000	0.000	0.000	=	=
	Total Emissions	0.00	-0.01	0.00	-0.35	-0.34	-0.39	-0.01%	-4.76%

Table 244: Recalculation difference of Dioxin/Furan (PCDD/F) emissions in general with respect to submission 2008.

NFR Category		Absolute difference [g]						Relative difference	
Dioxin/Furan (PCDD/F) emissions		**1990**	**1995**	**2000**	**2006**	**2007**	**2008**	**1990 ∆%**	**2008 ∆%**
1 A 1	Energy Industries	0.000	0.000	0.000	-0.065	-0.031	0.024	=	2.59%
1 A 2	Manufacturing Industries and Construction	-0.002	-0.003	0.000	0.040	0.159	0.551	0.00%	9.75%
1 A 3	Transport	-0.003	-0.065	0.000	-0.058	-0.060	-0.061	-0.07%	-5.54%
1 A 4	Other Sectors	-0.002	-0.003	0.000	-1.350	-1.270	-2.041	0.00%	-7.15%
1 A 5	Other	0.000	0.000	0.000	0.000	0.000	0.000	0.00%	=
1 B	Fugitive Emissions from Fuels	NA=	NA=	0.000	NA=	NA=	NA=	=	=
2	Industrial Processes	0.000	0.000	0.000	0.000	0.000	-0.004	=	-0.10%
3	Solvent and Other Product Use	0.000	NE=	0.000	NE=	NE=	NE=	=	=
4	Agriculture	0.000	0.000	0.000	0.000	0.000	0.000	=	=
6	Waste	0.000	0.000	0.000	0.000	0.000	0.000	=	=
	Total Emissions	**-0.01**	**-0.07**	**0.00**	**-1.43**	**-1.20**	**-1.53**	**0.00%**	**-3.82%**

Table 245: Recalculation difference of HCB emissions in general with respect to submission 2008.

NFR Category		Absolute difference [kg]						Relative difference	
HCB emissions		1990	1995	2000	2006	2007	2008	1990 Δ%	2008 Δ%
1 A 1	Energy Industries	0.000	0.000	0.000	-0.013	-0.007	0.004	=	1.11%
1 A 2	Manufacturing Industries and Construction	0.000	-0.001	0.000	0.006	0.025	0.087	0.00%	5.53%
1 A 3	Transport	-0.001	-0.013	0.000	-0.012	-0.012	-0.012	-0.07%	-5.54%
1 A 4	Other Sectors	-0.003	-0.004	0.000	-2.177	-2.118	-2.716	-0.01%	-7.27%
1 A 5	Other	0.000	0.000	0.000	0.000	0.000	0.000	=	=
1 B	Fugitive Emissions from Fuels	NA=	NA=	0.000	NA=	NA=	NA=	=	=
2	Industrial Processes	0.000	0.000	0.000	0.000	0.000	-0.001	=	-0.02%
3	Solvent and Other Product Use	0.000	0.000	0.000	NE=	NE=	NE=	=	=
4	Agriculture	0.000	0.000	0.000	0.000	0.000	0.000	=	=
6	Waste	0.000	0.000	0.000	0.000	0.000	0.000	=	=
	Total Emissions	0.00	-0.02	0.00	-2.20	-2.11	-2.64	0.00%	-6.06%

9 PROJECTIONS

As outlined in the 'Guidelines for Reporting Emission Data under the Convention on Long-Range Transboundary Air Pollution' (ECE/EB.AIR/2008/4)

§ 36 parties to the Gothenburg Protocol shall report their latest available projections at least every five years, and provide any updated projections annually by 15 February, for the years 2010, 2015, 2020, 2030 and 2050.

§ 37 projected emissions for sulphur dioxide (SO2), nitrogen oxides (NO_x), ammonia (NH_3), particulate matter-10 (PM10), PM2.5 and non-methane volatile organic compounds (NMVOCs) should be reported using table IV.2a of annex IV to these Guidelines. Parties should complete the tables at the requested level of aggregation. Where values for individual categories or aggregated NFR categories are not available, the notation keys defined in section II.C of annex I to these Guidelines should be used.

Austria presents emission projections "with measures" for 2010, 2015 and 2020 in the report[158] 'AUSTRIA'S NATIONAL AIR EMISSION PROJECTIONS 2010–2020. Submission under the UN/ECE Convention on Long-Range Transboundary Air Pollution. (UMWELTBUNDESAMT 2010) The report 'AUSTRIA'S NATIONAL AIR EMISSION PROJECTIONS 2010–2030. Submission under the UN/ECE Convention on Long-Range Transboundary Air Pollution. will be published in summer 2011. The report include background information to enable a quantitative understanding of the key socioeconomic assumptions used in the preparation of the projections.

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11 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)

12 ANNEX

1. NFR for 2009
2. Footnotes to NFR
3. Emission trends per sector – submission under UNECE/LRTAP
4. Austria's emissions for SO_2, NO_x, NMVOC and NH_3 according to the submission under NEC directive
5. Extracts from Austrian Legislation

12.1 Nomenclature for Reporting (NFR) – Format of Reporting under the UNECE/LRTAP Convention

12.1.1 NFR for 2009

(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 (Revised UNECE/EMEP Reporting Guidelines ECE/EB.AIR/97)

				NECD pollutants																	
AT: 11.02.2011: 2009	*NFR sectors to be reported to LRTAP*			**Main Pollutants** (from 1980)				**Particulate Matter** (from 2000)			**Other** (from 1980)	**Priority Heavy Metals** (from 1990)			**Other Heavy Metals** (from 1990)						
				NOx (as NO_2)	NMVOC	SOx (as SO_2)	NH_3	$PM_{2.5}$	PM_{10}	TSP	CO	Pb	Cd	Hg	As	Cr	Cu	Ni	Se	Zn	PCDD/ PCDF (dioxines/ furanes)
NFR Aggregation for Gridding and LPS (GNFR)	*NFR Code*	*annot atio*	*Longname*	**Gg NO_2**	**Gg**	**Gg SO_2**	**Gg**	**Gg**	**Gg**	**Gg**	**Gg**	**Mg**	**Mg**	**Mg**	**Mg**	**Mg**	**Mg**	**Mg**	**Mg**	**Mg**	**g I-Teq**
A_PublicPower	1 A 1 a	(a)	1 A 1 a Public electricity and heat production	9.60	0.75	2.56	0.32	0.91	1.09	1.20	4.22	1.56	0.12	0.16	NR	NR	NR	NR	NR	NR	0.93
B_IndustrialComb	1 A 1 b	(a)	1 A 1 b Petroleum refining	1.05	IE	0.58	0.10	0.08	0.09	0.10	0.50	0.31	0.14	0.01	NR	NR	NR	NR	NR	NR	0.02
B_IndustrialComb	1 A 1 c	(a)	1 A 1 c Manufacture of solid fuels and other energy industries	1.39	0.00	NA	0.01	0.10	0.10	0.10	0.09	NA	NA	NA	NR	NR	NR	NR	NR	NR	0.00
B_IndustrialComb	1 A 2 a	(a)	1 A 2 a Stationary combustion in manufacturing industries and construction: Iron and steel	4.56	0.28	4.75	0.04	0.13	0.13	0.15	117.04	0.13	0.00	0.00	NR	NR	NR	NR	NR	NR	0.03
B_IndustrialComb	1 A 2 b	(a)	1 A 2 b Stationary Combustion in manufacturing industries and construction: Non-ferrous metals	0.24	0.00	0.11	0.00	0.01	0.01	0.01	0.05	1.05	0.02	0.01	NR	NR	NR	NR	NR	NR	2.22
B_IndustrialComb	1 A 2 c	(a)	1 A 2 c Stationary combustion in manufacturing industries and construction: Chemicals	1.22	0.16	0.46	0.03	0.26	0.31	0.35	1.04	0.29	0.01	0.01	NR	NR	NR	NR	NR	NR	0.48
B_IndustrialComb	1 A 2 d	(a)	1 A 2 d Stationary combustion in manufacturing industries and construction: Pulp, Paper and Print	5.11	0.24	1.06	0.08	0.17	0.21	0.23	2.12	0.79	0.09	0.07	NR	NR	NR	NR	NR	NR	0.65
B_IndustrialComb	1 A 2 e	(a)	1 A 2 e Stationary combustion in manufacturing industries and construction: Food processing, beverages and tobacco	0.86	0.02	0.33	0.02	0.04	0.04	0.05	0.13	0.00	0.00	0.00	NR	NR	NR	NR	NR	NR	0.03
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)	11.24	0.61	3.15	0.22	1.35	2.18	3.32	18.34	1.06	0.10	0.21	NR	NR	NR	NR	NR	NR	2.48
I_OffRoadMob	1 A 2 f ii		1 A 2 f ii Mobile Combustion in manufacturing industries and construction: (Please specify in your IIR)	8.43	0.94	0.01	0.00	0.52	0.52	0.52	6.01	0.00	0.00	0.00	NR	NR	NR	NR	NR	NR	0.09
J_ AviLTO	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	2.69	0.00	0.00	0.00	NR	NR	NR	NR	NR	NR	NE
J_AviLTO	1 A 3 a i (i)		1 A 3 a i (i) International aviation (LTO)	1.03	0.38	0.09	0.00	0.09	0.09	0.09	1.39	0.00	0.00	0.00	NR	NR	NR	NR	NR	NR	NE
G_RoadRail	1 A 3 b i		1 A 3 b i Road transport: Passenger cars	37.45	6.78	0.07	1.31	1.65	1.65	1.65	127.27	0.01	0.00	0.00	NR	NR	NR	NR	NR	NR	0.32
G_RoadRail	1 A 3 b ii		1 A 3 b ii Road transport:Light duty vehicles	5.50	0.39	0.01	0.03	0.35	0.35	0.35	4.54	0.00	0.00	0.00	NR	NR	NR	NR	NR	NR	0.07
G_RoadRail	1 A 3 b iii		1 A 3 b iii Road transport:, Heavy duty vehicles	65.09	1.95	0.05	0.05	1.18	1.18	1.18	12.33	0.00	0.00	0.00	NR	NR	NR	NR	NR	NR	0.56
G_RoadRail	1 A 3 b iv		1 A 3 b iv Road transport: Mopeds & motorcycles	0.46	1.79	NA	0.00	NA	NA	NA	21.92	0.00	0.00	0.00	NR	NR	NR	NR	NR	NR	0.01
G_RoadRail	1 A 3 b v		1 A 3 b v Road transport: Gasoline evaporation	NA	2.18	NA	NA	NA	NA	NA	NA	NA	NA	NA	NR	NR	NR	NR	NR	NR	IE
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	NA	NA	NR	NR	NR	NR	NR	NR	NA
G_RoadRail	1 A 3 b vii		1 A 3 b vii Road transport: Automobile road abrasion	NA	NA	NA	NA	0.99	3.31	9.94	NA	NA	0.09	NA	NR	NR	NR	NR	NR	NR	NA
G_RoadRail	1 A 3 c	(a)	1 A 3 c Railways	1.66	0.25	0.06	0.00	0.41	0.77	1.81	1.47	0.00	0.00	0.00	NR	NR	NR	NR	NR	NR	0.01
H_Shipping	1 A 3 d i (ii)		1 A 3 d i (ii) International inland waterways	0.36	0.05	0.01	0.00	0.06	0.06	0.06	0.32	0.00	0.00	0.00	NR	NR	NR	NR	NR	NR	0.00
H_Shipping	1 A 3 d ii	(a)	1 A 3 d ii National navigation (Shipping)	0.33	0.35	0.01	0.00	0.05	0.05	0.05	2.17	0.00	0.00	0.00	NR	NR	NR	NR	NR	NR	0.01

Table IV 1 (Revised UNECE/EMEP Reporting Guidelines ECE/EB.AIR/97)

AT: 11.02.2011: 2009	*NFR sectors to be reported to LRTAP*			**POPs** (1) (from 1990)								**Activity Data** (From 1990)						
				PAHs														
				benzo(a) pyrene	benzo(b) fluoranthene	benzo(k) fluoranthene	Indeno (1,2,3-cd) pyrene	Total 1-4	HCB	HCH	PCBs	Liquid Fuels	Solid Fuels	Gaseous Fuels	Biomass	Other Fuels	*Other activity (specified)*	*Other Activity Units*
NFR Aggregation for Gridding and LPS (GNFR)	*NFR Code*	*annot atio*	*Longname*	**Mg**	**Mg**	**Mg**	**Mg**	**Mg**	**kg**	**kg**	**kg**	**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	NR	NR	NR	NR	0.02	0.38	NR	NR	9,004	32,439	87,426	46,557	14,167	NA	TJ NCV
B_IndustrialComb	1 A 1 b	(a)	1 A 1 b Petroleum refining	NR	NR	NR	NR	0.00	0.00	NR	NR	37,770	NO	2,963	NO	NO	NA	TJ NCV
B_IndustrialComb	1 A 1 c	(a)	1 A 1 c Manufacture of solid fuels and other energy industries	NR	NR	NR	NR	NA	0.00	NR	NR	NO	NO	9,266	NO	NO	NA	TJ NCV
B_IndustrialComb	1 A 2 a	(a)	1 A 2 a Stationary combustion in manufacturing industries and construction: Iron and steel	NR	NR	NR	NR	0.00	0.00	NR	NR	7,017	35,129	18,961	6	NO	NA	TJ NCV
B_IndustrialComb	1 A 2 b	(a)	1 A 2 b Stationary Combustion in manufacturing industries and construction: Non-ferrous metals	NR	NR	NR	NR	0.00	1.00	NR	NR	294	156	4,193	NO	NO	NA	TJ NCV
B_IndustrialComb	1 A 2 c	(a)	1 A 2 c Stationary combustion in manufacturing industries and construction: Chemicals	NR	NR	NR	NR	0.02	0.07	NR	NR	784	738	15,995	2,108	3,459	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	NR	NR	NR	NR	0.00	0.13	NR	NR	1,316	3,799	31,366	35,252	118	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	NR	NR	NR	NR	0.00	0.00	NR	NR	2,394	135	12,491	433	NO	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)	NR	NR	NR	NR	0.09	0.39	NR	NR	6,779	5,467	32,758	21,176	11,376	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)	NR	NR	NR	NR	0.11	0.02	NR	NR	15,170	NO	NO	1,306	NO	NA	TJ NCV
J_ AviLTO	1 A 3 a ii (i)		1 A 3 a ii (i) Civil aviation (Domestic, LTO)	NR	NR	NR	NR	NE	NE	NR	NR	421	NA	NA	NA	NA	NA	TJ NCV
J_AviLTO	1 A 3 a i (i)		1 A 3 a i (i) International aviation (LTO)	NR	NR	NR	NR	NE	NE	NR	NR	3,698	NA	NA	NA	NA	NA	TJ NCV
G_RoadRail	1 A 3 b i		1 A 3 b i Road transport: Passenger cars	NR	NR	NR	NR	0.71	0.06	NR	NR	164,324	NA	NO	11,649	NA	NA	TJ NCV
G_RoadRail	1 A 3 b ii		1 A 3 b ii Road transport:Light duty vehicles	NR	NR	NR	NR	0.16	0.01	NR	NR	23,454	NA	NO	1,981	NA	NA	TJ NCV
G_RoadRail	1 A 3 b iii		1 A 3 b iii Road transport:, Heavy duty vehicles	NR	NR	NR	NR	0.64	0.11	NR	NR	92,165	NA	NO	7,935	NA	NA	TJ NCV
G_RoadRail	1 A 3 b iv		1 A 3 b iv Road transport: Mopeds & motorcycles	NR	NR	NR	NR	0.06	0.00	NR	NR	1,875	NA	NO	NO	NA	NA	TJ NCV
G_RoadRail	1 A 3 b v		1 A 3 b v Road transport: Gasoline evaporation	NR	NR	NR	NR	NA	NA	NR	NR	NO	NA	NA	NA	NA	1,815	kt Gasoline
G_RoadRail	1 A 3 b vi		1 A 3 b vi Road transport: Automobile tyre and brake wear	NR	NR	NR	NR	NA	NA	NR	NR	NA	NA	NA	NA	NA	61,628	10^6 km
G_RoadRail	1 A 3 b vii		1 A 3 b vii Road transport: Automobile road abrasion	NR	NR	NR	NR	NA	NA	NR	NR	NA	NA	NA	NA	NA	61,628	10^6 km
G_RoadRail	1 A 3 c	(a)	1 A 3 c Railways	NR	NR	NR	NR	0.01	0.00	NR	NR	2,001	5	NO	172	NO	NA	TJ NCV
H_Shipping	1 A 3 d i (ii)		1 A 3 d i (ii) International inland waterways	NR	NR	NR	NR	0.00	0.00	NR	NR	417	NO	NO	NO	NO	NA	TJ NCV
H_Shipping	1 A 3 d ii	(a)	1 A 3 d ii National navigation (Shipping)	NR	NR	NR	NR	0.01	0.00	NR	NR	482	NO	NO	871	NO	NA	TJ NCV

Table IV 1 (Revised UNECE/EMEP Reporting Guidelines ECE/EB.AIR/97)

AT: 11.02.2011: 2009	*NFR sectors to be reported to LRTAP*			NECD pollutants: Main Pollutants (from 1980)				Particulate Matter (from 2000)			Other (from 1980)	Priority Heavy Metals (from 1990)			Other Heavy Metals (from 1990)						
				NOx (as NO_2)	NMVOC	SOx (as SO_2)	NH_3	$PM_{2.5}$	PM_{10}	TSP	CO	Pb	Cd	Hg	As	Cr	Cu	Ni	Se	Zn	PCDD/ PCDF (dioxines/ furanes)
NFR Aggregation for Gridding and LPS (GNFR)	*NFR Code*	*annot atio*	*Longname*	**Gg NO_2**	**Gg**	**Gg SO_2**	**Gg**	**Gg**	**Gg**	**Gg**	**Gg**	**Mg**	**Mg**	**Mg**	**Mg**	**Mg**	**Mg**	**Mg**	**Mg**	**Mg**	**g I-Teq**
B_IndustrialComb	1 A 3 e		1 A 3 e Pipeline compressors	1.16	0.00	NA	0.01	0.00	0.00	0.00	0.08	NA	NA	NA	NR	NR	NR	NR	NR	NR	0.00
C_SmallComb	1 A 4 a i		1 A 4 a i Commercial / institutional: Stationary	1.85	0.51	0.68	0.07	0.33	0.35	0.37	6.57	0.18	0.03	0.01	NR	NR	NR	NR	NR	NR	1.35
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	IE
C_SmallComb	1 A 4 b i		1 A 4 b i Residential: Stationary plants	11.00	25.34	4.92	0.52	6.07	6.73	7.39	240.53	1.91	0.23	0.16	NR	NR	NR	NR	NR	NR	21.28
I_OffRoadMob	1 A 4 b ii		1 A 4 b ii Residential: Household and gardening (mobile)	0.64	1.99	0.00	0.00	0.04	0.04	0.04	17.00	0.00	0.00	0.00	NR	NR	NR	NR	NR	NR	0.05
C_SmallComb	1 A 4 c i		1 A 4 c i Agriculture/Forestry/Fishing: Stationary	0.90	1.63	0.16	0.04	0.43	0.48	0.54	15.56	0.18	0.05	0.02	NR	NR	NR	NR	NR	NR	2.30
I_OffRoadMob	1 A 4 c ii		1 A 4 c ii Agriculture/Forestry/Fishing: Off-road vehicles and other machinery	8.94	3.72	0.01	0.00	1.35	1.50	1.74	16.12	0.00	0.00	0.00	NR	NR	NR	NR	NR	NR	0.08
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	NO
C_SmallComb	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	IE
I_OffRoadMob	1 A 5 b	(a)	1 A 5 b Other, Mobile (including military, land based and recreational boats)	0.08	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	0.00
E_Fugitive	1 B 1 a	(a)	1 B 1 a Fugitive emission from solid fuels: Coal mining and handling	NA	NA	NA	NA	0.06	0.19	0.39	NA	NA	NA	NA	NR	NR	NR	NR	NR	NR	NA
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	IE
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	NO
E_Fugitive	1 B 2 a i		1 B 2 a i Exploration, production, transport	NA	0.50	NA	NA	NA	NA	NA	NA	NA	NA	NA	NR	NR	NR	NR	NR	NR	NA
E_Fugitive	1 B 2 a iv		1 B 2 a iv Refining / storage	NA	0.81	NA	NA	NA	NA	NA	NA	NA	NA	NA	NR	NR	NR	NR	NR	NR	NA
E_Fugitive	1 B 2 a v		1 B 2 a v Distribution of oil products	NA	0.78	NA	NA	NA	NA	NA	NA	NA	NA	NA	NR	NR	NR	NR	NR	NR	NA
E_Fugitive	1 B 2 b	(a)	1 B 2 b Natural gas	NA	0.02	0.24	NA	NA	NA	NA	NA	NA	NA	NA	NR	NR	NR	NR	NR	NR	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	IE
E_Fugitive	1 B 3		1 B 3 Other fugitive emissions from geothermal energy production , peat and other energy extraction not included in 1 B 2	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NR	NR	NR	NR	NR	NR	NO
D_IndProcess	2 A 1	(a)	2 A 1 Cement production	NA	NA	NA	NA	0.06	0.07	0.08	NA	NA	NA	NA	NR	NR	NR	NR	NR	NR	NA
D_IndProcess	2 A 2	(a)	2 A 2 Lime production	NA	NA	NA	NA	0.06	0.08	0.09	NA	NA	NA	NA	NR	NR	NR	NR	NR	NR	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	NR	NR	NR	NR	NR	NR	NA

Table IV 1 (Revised UNECE/EMEP Reporting Guidelines ECE/EB.AIR/97)

AT: 11.02.2011: 2009	*NFR sectors to be reported to LRTAP*			POPs [1] (from 1990)								Activity Data (From 1990)						
				PAHs					HCB	HCH	PCBs	Liquid Fuels	Solid Fuels	Gaseous Fuels	Biomass	Other Fuels	*Other activity (specified)*	*Other Activity Units*
				benzo(a) pyrene	benzo(b) fluoranthene	benzo(k) fluoranthene	Indeno (1,2,3-cd) pyrene	Total 1-4										
NFR Aggregation for Gridding and LPS (GNFR)	*NFR Code*	*annot atio*	*Longname*	**Mg**	**Mg**	**Mg**	**Mg**	**Mg**	**kg**	**kg**	**kg**	**TJ NCV**	**TJ NCV**	**TJ NCV**	**TJ NCV**	**TJ NCV**		
B_IndustrialComb	1 A 3 e		1 A 3 e Pipeline compressors	NR	NR	NR	NR	NA	0.00	NR	NR	NO	NO	7,707	NO	NO	NA	TJ NCV
C_SmallComb	1 A 4 a i		1 A 4 a i Commercial / institutional: Stationary	NR	NR	NR	NR	0.09	0.83	NR	NR	11,223	245	30,271	3,255	432	NA	TJ NCV
I_OffRoadMob	1 A 4 a ii		1 A 4 a ii Commercial / institutional: Mobile	NR	NR	NR	NR	IE	IE	NR	NR	NO	NO	NO	NO	NO	NA	TJ NCV
C_SmallComb	1 A 4 b i		1 A 4 b i Residential: Stationary plants	NR	NR	NR	NR	4.60	28.43	NR	NR	56,335	3,341	49,604	64,897	NO	NA	TJ NCV
I_OffRoadMob	1 A 4 b ii		1 A 4 b ii Residential: Household and gardening (mobile)	NR	NR	NR	NR	0.03	0.01	NR	NR	1,730	NO	NO	116	NO	NA	TJ NCV
C_SmallComb	1 A 4 c i		1 A 4 c i Agriculture/Forestry/Fishing: Stationary	NR	NR	NR	NR	0.51	3.75	NR	NR	678	70	562	7,676	NO	NA	TJ NCV
I_OffRoadMob	1 A 4 c ii		1 A 4 c ii Agriculture/Forestry/Fishing: Off-road vehicles and other machinery	NR	NR	NR	NR	0.07	0.02	NR	NR	11,096	NA	NA	103	NA	NA	TJ NCV
H_Shipping	1A 4 c iii		1A 4 c iii Agriculture/Forestry/Fishing: National fishing	NR	NR	NR	NR	NO	NO	NR	NR	NO	NA	NO	NO	NA	NA	TJ NCV
C_SmallComb	1 A 5 a	(a)	1 A 5 a Other stationary (including military)	NR	NR	NR	NR	IE	IE	NR	NR	NO	NO	NO	NO	NO	NA	TJ NCV
I_OffRoadMob	1 A 5 b	(a)	1 A 5 b Other, Mobile (including military, land based and recreational boats)	NR	NR	NR	NR	0.00	0.00	NR	NR	628	NO	NO	2	NO	NA	TJ NCV
E_Fugitive	1 B 1 a	(a)	1 B 1 a Fugitive emission from solid fuels: Coal mining and handling	NR	NR	NR	NR	NA	NA	NR	NR	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	NR	NR	NR	NR	IE	IE	NR	NR	NA	NA	NA	NA	NA	1,693	coal used for transformation [Mt]
E_Fugitive	1 B 1 c	(a)	1 B 1 c Other fugitive emissions from solid fuels	NR	NR	NR	NR	NO	NO	NR	NR	NA	NA	NA	NA	NA	NO	Please specify
E_Fugitive	1 B 2 a i		1 B 2 a i Exploration, production, transport	NR	NR	NR	NR	NA	NA	NR	NR	NA	NA	NA	NA	NA	1	Crude Oil produced [Mt]
E_Fugitive	1 B 2 a iv		1 B 2 a iv Refining / storage	NR	NR	NR	NR	NA	NA	NR	NR	NA	NA	NA	NA	NA	8	Crude Oil Refined [Mt]
E_Fugitive	1 B 2 a v		1 B 2 a v Distribution of oil products	NR	NR	NR	NR	NA	NA	NR	NR	NA	NA	NA	NA	NA	2	Oil Consumed [Mt]
E_Fugitive	1 B 2 b	(a)	1 B 2 b Natural gas	NR	NR	NR	NR	NA	NA	NR	NR	NA	NA	NA	NA	NA	1,670	Gas throughput [Mn3]
E_Fugitive	1 B 2 c	(a)	1 B 2 c Venting and flaring	NR	NR	NR	NR	IE	IE	NR	NR	NA	NA	NA	NA	NA	NA	Gas vented Flared [TJ]
E_Fugitive	1 B 3		1 B 3 Other fugitive emissions from geothermal energy production , peat and other energy extraction not included in 1 B 2	NR	NR	NR	NR	NO	NR	NR	NR	NO	NO	NO	NO	NO	NO	Geothermal energy extracted [Tj]
D_IndProcess	2 A 1	(a)	2 A 1 Cement production	NR	NR	NR	NR	NA	NA	NR	NR	NA	NA	NA	NA	NA	3,428	Clinker Production [kt]
D_IndProcess	2 A 2	(a)	2 A 2 Lime production	NR	NR	NR	NR	NA	NA	NR	NR	NA	NA	NA	NA	NA	695	Lime Produced [kt]
D_IndProcess	2 A 3	(a)	2 A 3 Limestone and dolomite use	NR	NR	NR	NR	NA	NA	NR	NR	NA	NA	NA	NA	NA	514	Limestone and Dolomite used [kt]

Table IV 1 (Revised UNECE/EMEP Reporting Guidelines ECE/EB.AIR/97)

AT: 11.02.2011: 2009	*NFR sectors to be reported to LRTAP*			NECD pollutants – Main Pollutants (from 1980)				Particulate Matter (from 2000)			Other (from 1980)	Priority Heavy Metals (from 1990)			Other Heavy Metals (from 1990)						
				NOx (as NO_2)	NMVOC	SOx (as SO_2)	NH_3	$PM_{2.5}$	PM_{10}	TSP	CO	Pb	Cd	Hg	As	Cr	Cu	Ni	Se	Zn	PCDD/ PCDF (dioxines/ furanes)
NFR Aggregation for Gridding and LPS (GNFR)	*NFR Code*	*annot atio*	*Longname*	**Gg NO_2**	**Gg**	**Gg SO_2**	**Gg**	**Gg**	**Gg**	**Gg**	**Gg**	**Mg**	**Mg**	**Mg**	**Mg**	**Mg**	**Mg**	**Mg**	**Mg**	**Mg**	**g I-Teq**
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	NR	NR	NR	NR	NR	NR	NA
D_IndProcess	2 A 5	(a)	2 A 5 Asphalt roofing	NA	IE	NA	NA	NA	NA	NA	9.78	NA	NA	NA	NR	NR	NR	NR	NR	NR	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	NR	NR	NR	NR	NR	NR	NA
D_IndProcess	2 A 7 a		2 A 7 a Quarrying and mining of minerals other than coal	NA	NA	NA	NA	0.54	4.83	10.31	NA	NA	NA	NA	NR	NR	NR	NR	NR	NR	NA
D_IndProcess	2 A 7 b		2 A 7 b Construction and demolition	NA	NA	NA	NA	0.14	1.41	2.82	NA	NA	NA	NA	NR	NR	NR	NR	NR	NR	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	NR	NR	NR	NR	NR	NR	IE
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	NA
D_IndProcess	2 B 1	(a)	2 B 1 Ammonia production	0.13	IE	NA	0.01	NA	NA	NA	0.04	NA	NA	NA	NR	NR	NR	NR	NR	NR	NA
D_IndProcess	2 B 2	(a)	2 B 2 Nitric acid production	0.10	NA	NA	0.00	NA	NA	NA	NA	NA	NA	NA	NR	NR	NR	NR	NR	NR	NA
D_IndProcess	2 B 3	(a)	2 B 3 Adipic acid production	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NR	NR	NR	NR	NR	NR	NO
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	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)	0.07	1.32	0.77	0.07	0.12	0.22	0.38	11.07	0.00	0.00	0.00	NR	NR	NR	NR	NR	NR	NA
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	NA
D_IndProcess	2 C 1	(a)	2 C 1 Iron and steel production	0.07	0.20	0.04	IE	0.28	0.64	0.91	1.60	5.16	0.17	0.24	NR	NR	NR	NR	NR	NR	2.60
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	NE
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	NO
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	NO
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	NO
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	NO
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	NO
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	0.14	0.40	NA	NE	NE	NE	0.29	IE	IE	IE	NR	NR	NR	NR	NR	NR	IE
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	NA

Table IV 1 (Revised UNECE/EMEP Reporting Guidelines ECE/EB.AIR/97)

AT: 11.02.2011: 2009	*NFR sectors to be reported to LRTAP*			POPs [1] (from 1990)									Activity Data (From 1990)						
				PAHs															
				benzo(a) pyrene	benzo(b) fluoranthene	benzo(k) fluoranthene	Indeno (1,2,3-cd) pyrene	Total 1-4	HCB	HCH	PCBs		Liquid Fuels	Solid Fuels	Gaseous Fuels	Biomass	Other Fuels	*Other activity (specified)*	*Other Activity Units*
NFR Aggregation for Gridding and LPS (GNFR)	*NFR Code*	*annot atio*	*Longname*	**Mg**	**Mg**	**Mg**	**Mg**	**Mg**	**kg**	**kg**	**kg**		**TJ NCV**	**TJ NCV**	**TJ NCV**	**TJ NCV**	**TJ NCV**		
D_IndProcess	2 A 4	(a)	2 A 4 Soda ash production and use	NR	NR	NR	NR	NA	NA	NR	NR		NA	NA	NA	NA	NA	NA	Soda Ash Production kt
D_IndProcess	2 A 5	(a)	2 A 5 Asphalt roofing	NR	NR	NR	NR	NA	NA	NR	NR		NA	NA	NA	NA	NA	28	Roofing Material Production [Mio m2]
D_IndProcess	2 A 6	(a)	2 A 6 Road paving with asphalt	NR	NR	NR	NR	NA	NA	NR	NR		NA	NA	NA	NA	NA	1,308	Asphalt Production [kt]
D_IndProcess	2 A 7 a		2 A 7 a Quarrying and mining of minerals other than coal	NR	NR	NR	NR	NA	NA	NR	NR		NA	NA	NA	NA	NA	NO	Material quarried [Mt]
D_IndProcess	2 A 7 b		2 A 7 b Construction and demolition	NR	NR	NR	NR	NA	NA	NR	NR		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	NR	NR	NR	NR	IE	IE	NR	NR		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)	NR	NR	NR	NR	NA	NA	NR	NR		NA	NA	NA	NA	NA	NO	Please specify
D_IndProcess	2 B 1	(a)	2 B 1 Ammonia production	NR	NR	NR	NR	NA	NA	NR	NR		NA	NA	NA	NA	NA	449	Ammonia Production [kt]
D_IndProcess	2 B 2	(a)	2 B 2 Nitric acid production	NR	NR	NR	NR	NA	NA	NR	NR		NA	NA	NA	NA	NA	496	Nitric Acid Production [kt]
D_IndProcess	2 B 3	(a)	2 B 3 Adipic acid production	NR	NR	NR	NR	NO	NO	NR	NR		NA	NA	NA	NA	NA	NO	Adipic Acid Production [kt]
D_IndProcess	2 B 4	(a)	2 B 4 Carbide production	NR	NR	NR	NR	NA	NA	NR	NR		NA	NA	NA	NA	NA	32	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)	NR	NR	NR	NR	NA	NA	NR	NR		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)	NR	NR	NR	NR	NA	NA	NR	NR		NA	NA	NA	NA	NA	NO	Please specify
D_IndProcess	2 C 1	(a)	2 C 1 Iron and steel production	NR	NR	NR	NR	0.14	2.94	NR	NR		NA	NA	NA	NA	NA	5,077	Steel Produced [kt]
D_IndProcess	2 C 2	(a)	2 C 2 Ferroalloys production	NR	NR	NR	NR	NE	NE	NR	NR		NA	NA	NA	NA	NA	13	Ferroalloys Production [kt]
D_IndProcess	2 C 3	(a)	2 C 3 Aluminum production	NR	NR	NR	NR	NO	NO	NR	NR		NA	NA	NA	NA	NA	NO	Aluminium production [kt]
D_IndProcess	2 C 5 a		2 C 5 a Copper production	NR	NR	NR	NR	NO	NO	NR	NR		NA	NA	NA	NA	NA	NO	Copper production [kt]
D_IndProcess	2 C 5 b		2 C 5 b Lead production	NR	NR	NR	NR	NO	NO	NR	NR		NA	NA	NA	NA	NA	NO	Lead production [kt]
D_IndProcess	2 C 5 c		2 C 5 c Nickel production	NR	NR	NR	NR	NO	NO	NR	NR		NA	NA	NA	NA	NA	NO	Nickel production [kt]
D_IndProcess	2 C 5 d		2 C 5 d Zinc production	NR	NR	NR	NR	NO	NO	NR	NR		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)	NR	NR	NR	NR	IE	IE	NR	NR		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)	NR	NR	NR	NR	NA	NA	NR	NR		NA	NA	NA	NA	NA	NO	Amount (kt)

Table IV 1 (Revised UNECE/EMEP Reporting Guidelines ECE/EB.AIR/97)

				NECD pollutants																	
AT: 11.02.2011: 2009	*NFR sectors to be reported to LRTAP*			**Main Pollutants** (from 1980)				**Particulate Matter** (from 2000)			**Other** (from 1980)	**Priority Heavy Metals** (from 1990)			**Other Heavy Metals** (from 1990)						
				NOx (as NO_2)	NMVOC	SOx (as SO_2)	NH_3	$PM_{2.5}$	PM_{10}	TSP	CO	Pb	Cd	Hg	As	Cr	Cu	Ni	Se	Zn	PCDD/ PCDF (dioxines/ furanes)
NFR Aggregation for Gridding and LPS (GNFR)	*NFR Code*	*annot atio*	*Longname*	**Gg NO_2**	**Gg**	**Gg SO_2**	**Gg**	**Gg**	**Gg**	**Gg**	**Gg**	**Mg**	**Mg**	**Mg**	**Mg**	**Mg**	**Mg**	**Mg**	**Mg**	**Mg**	**g I-Teq**
D_IndProcess	2 D 1	(a)	2 D 1 Pulp and paper	0.88	0.64	NA	NA	NA	NA	NA	0.64	NA	NA	NA	NR	NR	NR	NR	NR	NR	NA
D_IndProcess	2 D 2	(a)	2 D 2 Food and drink	NA	2.24	NA	NA	0.00	0.00	0.00	NA	NA	NA	NA	NR	NR	NR	NR	NR	NR	0.13
D_IndProcess	2 D 3		2 D 3 Wood processing	NA	NA	NA	NA	0.17	0.44	1.09	NA	NA	NA	NA	NR	NR	NR	NR	NR	NR	NA
D_IndProcess	2 E		2 E Production of POPs	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NR	NR	NR	NR	NR	NR	NO
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	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 column to the right)	NA	NA	NA	0.00	NA	NA	NA	NA	NA	NA	NA	NR	NR	NR	NR	NR	NR	NA
F_Solvents	3 A 1		3 A 1 Decorative coating application	NA	7.51	NA	NA	NA	NA	NA	NA	NA	NA	NA	NR	NR	NR	NR	NR	NR	NA
F_Solvents	3 A 2		3 A 2 Industrial coating application	NA	10.48	NA	NA	NA	NA	NA	NA	NA	NA	NA	NR	NR	NR	NR	NR	NR	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	NR	NR	NR	NR	NR	NR	NA
F_Solvents	3 B 1		3 B 1 Degreasing	NA	8.47	NA	NA	NA	NA	NA	NA	NA	NA	NA	NR	NR	NR	NR	NR	NR	NA
F_Solvents	3 B 2		3 B 2 Dry cleaning	NA	0.34	NA	NA	NA	NA	NA	NA	NA	NA	NA	NR	NR	NR	NR	NR	NR	NA
F_Solvents	3 C	(a)	3 C Chemical products	NA	5.44	NA	NA	NA	NA	NA	NA	0.02	0.00	NA	NR	NR	NR	NR	NR	NR	NA
F_Solvents	3 D 1		3 D 1 Printing	NA	5.26	NA	NA	NA	NA	NA	NA	NA	NA	NA	NR	NR	NR	NR	NR	NR	NA
F_Solvents	3 D 2		3 D 2 Domestic solvent use including fungicides	NA	14.96	NA	NA	NA	NA	NA	NA	NA	NA	NA	NR	NR	NR	NR	NR	NR	NA
F_Solvents	3 D 3		3 D 3 Other product use	NA	11.64	NA	NA	0.44	0.44	0.44	NA	NA	NA	NA	NR	NR	NR	NR	NR	NR	NE
O_AgriLivestock	4 B 1 a	(a)	4 B 1 a Cattle dairy	1.50	NA	NA	15.29	IE	IE	IE	NA	NA	NA	NA	NR	NR	NR	NR	NR	NR	NA
O_AgriLivestock	4 B 1 b	(a)	4 B 1 b Cattle non-dairy	1.97	NA	NA	20.14	IE	IE	IE	NA	NA	NA	NA	NR	NR	NR	NR	NR	NR	NA
O_AgriLivestock	4 B 2	(a)	4 B 2 Buffalo	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NR	NR	NR	NR	NR	NR	NO
O_AgriLivestock	4 B 3	(a)	4 B 3 Sheep	0.07	NA	NA	0.16	IE	IE	IE	NA	NA	NA	NA	NR	NR	NR	NR	NR	NR	NA
O_AgriLivestock	4 B 4	(a)	4 B 4 Goats	0.01	NA	NA	0.03	IE	IE	IE	NA	NA	NA	NA	NR	NR	NR	NR	NR	NR	NA
O_AgriLivestock	4 B 6	(a)	4 B 6 Horses	0.11	NA	NA	0.44	IE	IE	IE	NA	NA	NA	NA	NR	NR	NR	NR	NR	NR	NA

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AT: 11.02.2011: 2009	NFR sectors to be reported to LRTAP			POPs (1) (from 1990)									Activity Data (From 1990)						
				PAHs					HCB	HCH	PCBs		Liquid Fuels	Solid Fuels	Gaseous Fuels	Biomass	Other Fuels	*Other activity (specified)*	*Other Activity Units*
				benzo(a) pyrene	benzo(b) fluoranthene	benzo(k) fluoranthene	Indeno (1,2,3-cd) pyrene	Total 1-4											
NFR Aggregation for Gridding and LPS (GNFR)	*NFR Code*	*annot atio*	*Longname*	**Mg**	**Mg**	**Mg**	**Mg**	**Mg**	**kg**	**kg**	**kg**		**TJ NCV**	**TJ NCV**	**TJ NCV**	**TJ NCV**	**TJ NCV**		
D_IndProcess	2 D 1	(a)	2 D 1 Pulp and paper	NR	NR	NR	NR	NA	NA	NR	NR		NA	NA	NA	NA	NA	1,514	Pulp production [kt]
D_IndProcess	2 D 2	(a)	2 D 2 Food and drink	NR	NR	NR	NR	0.04	0.03	NR	NR		NA	NA	NA	NA	NA	1,528	Bread, Wine, Beer, Spirits Production [kt]
D_IndProcess	2 D 3		2 D 3 Wood processing	NR	NR	NR	NR	NA	NA	NR	NR		NA	NA	NA	NA	NA	NO	Please specify
D_IndProcess	2 E		2 E Production of POPs	NR	NR	NR	NR	NO	NO	NR	NR		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)	NR	NR	NR	NR	NA	NA	NR	NR		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 column to the right)	NR	NR	NR	NR	NA	NA	NR	NR		NA	NA	NA	NA	NA	NA	NA
F_Solvents	3 A 1		3 A 1 Decorative coating application	NR	NR	NR	NR	NA	NA	NR	NR		NA	NA	NA	NA	NA	9	Solvents used [kt]
F_Solvents	3 A 2		3 A 2 Industrial coating application	NR	NR	NR	NR	NA	NA	NR	NR		NA	NA	NA	NA	NA	32	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)	NR	NR	NR	NR	NA	NA	NR	NR		NA	NA	NA	NA	NA	IE	Solvents used [kt]
F_Solvents	3 B 1		3 B 1 Degreasing	NR	NR	NR	NR	NA	NA	NR	NR		NA	NA	NA	NA	NA	16	Solvents used [kt]
F_Solvents	3 B 2		3 B 2 Dry cleaning	NR	NR	NR	NR	NA	NA	NR	NR		NA	NA	NA	NA	NA	0	Solvents used [kt]
F_Solvents	3 C	(a)	3 C Chemical products	NR	NR	NR	NR	NA	NA	NR	NR		NA	NA	NA	NA	NA	11	Solvents used [kt]
F_Solvents	3 D 1		3 D 1 Printing	NR	NR	NR	NR	NA	NA	NR	NR		NA	NA	NA	NA	NA	8	Solvents used [kt]
F_Solvents	3 D 2		3 D 2 Domestic solvent use including fungicides	NR	NR	NR	NR	NA	NA	NR	NR		NA	NA	NA	NA	NA	18	Solvents used [kt]
F_Solvents	3 D 3		3 D 3 Other product use	NR	NR	NR	NR	NE	NE	NR	NR		NO	NO	NO	NO	NO	417	Solvents used [kt]
O_AgriLivestock	4 B 1 a	(a)	4 B 1 a Cattle dairy	NR	NR	NR	NR	NA	NA	NR	NR		NA	NA	NA	NA	NA	533	Population Size (1000 head)
O_AgriLivestock	4 B 1 b	(a)	4 B 1 b Cattle non-dairy	NR	NR	NR	NR	NA	NA	NR	NR		NA	NA	NA	NA	NA	1,493	Population Size (1000 head)
O_AgriLivestock	4 B 2	(a)	4 B 2 Buffalo	NR	NR	NR	NR	NO	NO	NR	NR		NA	NA	NA	NA	NA	NO	Population Size (1000 head)
O_AgriLivestock	4 B 3	(a)	4 B 3 Sheep	NR	NR	NR	NR	NA	NA	NR	NR		NA	NA	NA	NA	NA	345	Population Size (1000 head)
O_AgriLivestock	4 B 4	(a)	4 B 4 Goats	NR	NR	NR	NR	NA	NA	NR	NR		NO	NO	NO	NO	NO	68	Population Size (1000 head)
O_AgriLivestock	4 B 6	(a)	4 B 6 Horses	NR	NR	NR	NR	NA	NA	NR	NR		NA	NA	NA	NA	NA	87	Population Size (1000 head)

Table IV 1 (Revised UNECE/EMEP Reporting Guidelines ECE/EB.AIR/97)

AT: 11.02.2011: 2009	NFR sectors to be reported to LRTAP			NECD pollutants: Main Pollutants (from 1980)				Particulate Matter (from 2000)			Other (from 1980)	Priority Heavy Metals (from 1990)			Other Heavy Metals (from 1990)						
				NOx (as NO_2)	NMVOC	SOx (as SO_2)	NH_3	$PM_{2.5}$	PM_{10}	TSP	CO	Pb	Cd	Hg	As	Cr	Cu	Ni	Se	Zn	PCDD/ PCDF (dioxines/ furanes)
NFR Aggregation for Gridding and LPS (GNFR)	*NFR Code*	*annot atio*	*Longname*	**Gg NO_2**	**Gg**	**Gg SO_2**	**Gg**	**Gg**	**Gg**	**Gg**	**Gg**	**Mg**	**Mg**	**Mg**	**Mg**	**Mg**	**Mg**	**Mg**	**Mg**	**Mg**	**g I-Teq**
O_AgriLivestock	4 B 7	(a)	4 B 7 Mules and asses	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	NR	NR	NR	NR	NR	NR	IE
O_AgriLivestock	4 B 8	(a)	4 B 8 Swine	0.82	NA	NA	11.38	IE	IE	IE	NA	NA	NA	NA	NR	NR	NR	NR	NR	NR	NA
O_AgriLivestock	4 B 9 a		4 B 9 a Laying hens	0.13	NA	NA	4.57	IE	IE	IE	NA	NA	NA	NA	NR	NR	NR	NR	NR	NR	NA
O_AgriLivestock	4 B 9 b		4 B 9 b Broilers	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	NR	NR	NR	NR	NR	NR	IE
O_AgriLivestock	4 B 9 c		4 B 9 c Turkeys	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	NR	NR	NR	NR	NR	NR	IE
O_AgriLivestock	4 B 9 d		4 B 9 d Other poultry	0.02	NA	NA	0.62	IE	IE	IE	NA	NA	NA	NA	NR	NR	NR	NR	NR	NR	NA
O_AgriLivestock	4 B 13	(a)	4 B 13 Other	0.01	NA	NA	0.02	IE	IE	IE	NA	NA	NA	NA	NR	NR	NR	NR	NR	NR	NA
P_AgriOther	4 D 1 a	(b)	4 D 1 a Synthetic N-fertilizers	1.09	NA	NA	4.89	NA	NA	NA	NA	NA	NA	NA	NR	NR	NR	NR	NR	NR	NA
P_AgriOther	4 D 2 a		4 D 2 a Farm-level agricultural operations including storage, handling and transport of agricultural products	IE	NA	NA	IE	1.08	4.88	10.84	NA	NA	NA	NA	NR	NR	NR	NR	NR	NR	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	NR	NR	NR	NR	NR	NR	NA
P_AgriOther	4 D 2 c		4 D 2 c N-excretion on pasture range and paddock unspecified (Please specify the sources included/excluded in the notes column to the right)	IE	NA	NA	1.01	NA	NA	NA	NA	NA	NA	NA	NR	NR	NR	NR	NR	NR	NA
Q_AgriWastes	4 F	(a)	4 F Field burning of agricultural wastes	0.02	0.10	0.00	0.03	0.10	0.10	0.10	0.69	0.01	0.00	0.00	NR	NR	NR	NR	NR	NR	0.14
P_AgriOther	4 G	(a)	4 G Agriculture other(c)	0.05	1.73	NA	0.54	0.10	0.47	1.05	NA	NA	NA	NA	NR	NR	NR	NR	NR	NR	NA
L_OtherWasteDisp	6 A	(a)	6 A Solid waste disposal on land	NA	0.06	NA	0.00	0.03	0.08	0.18	4.88	0.00	0.00	0.00	NR	NR	NR	NR	NR	NR	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	NA
N_WasteIncin	6 C a		6 C a Clinical wasteincineration (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	0.00
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	0.00
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	NO
N_WasteIncin	6 C d		6 C d Cremation	0.01	0.00	NA	NA	NE	NE	NE	0.01	0.00	NA	0.02	NR	NR	NR	NR	NR	NR	0.16
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	NE
L_OtherWasteDisp	6 D	(a)	6 D Other waste(e)	NA	NA	NA	1.44	NA	NA	NA	NA	NA	NA	NA	NR	NR	NR	NR	NR	NR	NA

Table IV 1 (Revised UNECE/EMEP Reporting Guidelines ECE/EB.AIR/97)

AT: 11.02.2011: 2009	*NFR sectors to be reported to LRTAP*			POPs [1] (from 1990)								Activity Data (From 1990)						
				PAHs														
				benzo(a) pyrene	benzo(b) fluoranthene	benzo(k) fluoranthene	Indeno (1,2,3-cd) pyrene	Total 1-4	HCB	HCH	PCBs	Liquid Fuels	Solid Fuels	Gaseous Fuels	Biomass	Other Fuels	*Other activity (specified)*	*Other Activity Units*
NFR Aggregation for Gridding and LPS (GNFR)	*NFR Code*	*annot atio*	*Longname*	**Mg**	**Mg**	**Mg**	**Mg**	**Mg**	**kg**	**kg**	**kg**	**TJ NCV**	**TJ NCV**	**TJ NCV**	**TJ NCV**	**TJ NCV**		
O_AgriLivestock	4 B 7	(a)	4 B 7 Mules and asses	NR	NR	NR	NR	IE	IE	NR	NR	NA	NA	NA	NA	NA	IE	Population Size (1000 head)
O_AgriLivestock	4 B 8	(a)	4 B 8 Swine	NR	NR	NR	NR	NA	NA	NR	NR	NA	NA	NA	NA	NA	3,137	Population Size (1000 head)
O_AgriLivestock	4 B 9 a		4 B 9 a Laying hens	NR	NR	NR	NR	NA	NA	NR	NR	NA	NA	NA	NA	NA	12,354	Population Size (1000 head)
O_AgriLivestock	4 B 9 b		4 B 9 b Broilers	NR	NR	NR	NR	IE	IE	NR	NR	NA	NA	NA	NA	NA	IE	Population Size (1000 head)
O_AgriLivestock	4 B 9 c		4 B 9 c Turkeys	NR	NR	NR	NR	IE	IE	NR	NR	NA	NA	NA	NA	NA	IE	Population Size (1000 head)
O_AgriLivestock	4 B 9 d		4 B 9 d Other poultry	NR	NR	NR	NR	NA	NA	NR	NR	NA	NA	NA	NA	NA	673	Population Size (1000 head)
O_AgriLivestock	4 B 13	(a)	4 B 13 Other	NR	NR	NR	NR	NA	NA	NR	NR	NA	NA	NA	NA	NA	41	Population Size (1000 head)
P_AgriOther	4 D 1 a	(b)	4 D 1 a Synthetic N-fertilizers	NR	NR	NR	NR	NA	NA	NR	NR	NA	NA	NA	NA	NA	110,350,000	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	NR	NR	NR	NR	NA	NA	NR	NR	NA	NA	NA	NA	NA	NO	Please specify
P_AgriOther	4 D 2 b		4 D 2 b Off-farm storage, handling and transport of bulk agricultural products	NR	NR	NR	NR	NA	NA	NR	NR	NA	NA	NA	NA	NA	NO	Please specify
P_AgriOther	4 D 2 c		4 D 2 c N-excretion on pasture range and paddock unspecified (Please specify the sources included/excluded in the notes column to the right)	NR	NR	NR	NR	NA	NA	NR	NR	NA	NA	NA	NA	NA	9,727,673	kg N/yr
Q_AgriWastes	4 F	(a)	4 F Field burning of agricultural wastes	NR	NR	NR	NR	0.18	0.03	NR	NR	NA	NA	NA	NA	NA	2	Area burned k ha/yr
P_AgriOther	4 G	(a)	4 G Agriculture other(c)	NR	NR	NR	NR	NA	NA	NR	NR	NA	NA	NA	NA	NA	NA	NA
L_OtherWasteDisp	6 A	(a)	6 A Solid waste disposal on land	NR	NR	NR	NR	NA	NA	NR	NR	NA	NA	NA	NA	NA	307	Annual deposition of MSW at the SWDS [Gg]
M_WasteWater	6 B	(a)	6 B Waste-water handling	NR	NR	NR	NR	NA	NA	NR	NR	NA	NA	NA	NA	NA	845	Total organic product [Gg DC/yr]
N_WasteIncin	6 C a		6 C a Clinical wasteincineration (d)	NR	NR	NR	NR	NA	0.00	NR	NR	NA	NA	NA	NA	NA	3	Waste incinerated [Gg]
N_WasteIncin	6 C b		6 C b Industrial waste incineration (d)	NR	NR	NR	NR	0.00	0.00	NR	NR	NA	NA	NA	NA	NA	3	Waste incinerated [Gg]
N_WasteIncin	6 C c		6 C c Municipal waste incineration (d)	NR	NR	NR	NR	NO	NO	NR	NR	NA	NA	NA	NA	NA	NO	MSW incinerated [Gg]
N_WasteIncin	6 C d		6 C d Cremation	NR	NR	NR	NR	0.00	0.03	NR	NR	NA	NA	NA	NA	NA	9,137	Incineration of corpses [Number]
N_WasteIncin	6 C e		6 C e Small scale waste burning	NR	NR	NR	NR	NE	NE	NR	NR	NA	NA	NA	NA	NA	NO	Amount of waste burned [kt]
L_OtherWasteDisp	6 D	(a)	6 D Other waste(e)	NR	NR	NR	NR	NA	NA	NR	NR	NA	NA	NA	NA	NA	NO	Please specify

Table IV 1 (Revised UNECE/EMEP Reporting Guidelines ECE/EB.AIR/97)

				NECD pollutants																	
AT: 11.02.2011: 2009	*NFR sectors to be reported to LRTAP*			**Main Pollutants** (from 1980)				**Particulate Matter** (from 2000)			**Other** (from 1980)	**Priority Heavy Metals** (from 1990)			**Other Heavy Metals** (from 1990)						
				NOx (as NO_2)	NMVOC	SOx (as SO_2)	NH_3	$PM_{2.5}$	PM_{10}	TSP	CO	Pb	Cd	Hg	As	Cr	Cu	Ni	Se	Zn	PCDD/ PCDF (dioxines/ furanes)
NFR Aggregation for Gridding and LPS (GNFR)	*NFR Code*	*annot atio*	*Longname*	**Gg NO_2**	**Gg**	**Gg SO_2**	**Gg**	**Gg**	**Gg**	**Gg**	**Gg**	**Mg**	**Mg**	**Mg**	**Mg**	**Mg**	**Mg**	**Mg**	**Mg**	**Mg**	**g I-Teq**
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	NO
	NATIONAL TOTAL	(f) (h)	National total for the entire territory	187.32	123.12	20.58	63.50	19.78	35.14	59.98	648.78	12.68	1.06	0.91	NR	NR	NR	NR	NR	NR	35.99
	National total (FU)	(h)	National total accounting transport emissions based on fuel used	145.35	121.84	20.55	63.21	18.77	32.62	55.52	616.46	12.68	1.05	0.91	NR	NR	NR	NR	NR	NR	35.65
	GRID TOTAL	(g)	National total for the EMEP grid domain	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
	Memo Items. NOT TO BE INCLUDED IN NATIONAL TOTALS UNLESS OTHERWISE ST																				
K_CivilAviCruise	1 A 3 a ii (ii)		1 A 3 a ii (ii) Civil aviation (Domestic, Cruise)	0.18	0.01	0.01	0.00	0.01	0.01	0.01	0.04	0.00	0.00	0.00	NR	NR	NR	NR	NR	NR	NE
T_IntAviCruise	1 A 3 a i (ii)		1 A 3 a i (ii) International aviation (Cruise)	6.69	0.44	0.52	0.00	0.56	0.56	0.56	0.78	0.00	0.00	0.00	NR	NR	NR	NR	NR	NR	NE
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	NO
z_Memo	1 A 3	(i)	Transport (fuel used)	71.14	12.96	0.26	1.10	3.94	6.62	14.28	141.85	0.01	0.09	0.00	NR	NR	NR	NR	NR	NR	0.64
z_Memo	7 B		7 B Other not included in nationaltotal of the entire territory (Please specify in notes and your IIR)	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
S_Natural	11A		(11 08 Volcanoes)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NR	NR	NR	NR	NR	NR	NO
S_Natural	11 B		Forest fires	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	0.01
S_Natural	11 C		Other natural emissions (Please specify in notes and your IIR)	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR

Table IV 1 (Revised UNECE/EMEP Reporting Guidelines ECE/EB.AIR/97)

AT: 11.02.2011: 2009	*NFR sectors to be reported to LRTAP*			**POPs** [(1)] (from 1990)								**Activity Data** (From 1990)						
				PAHs					HCB	HCH	PCBs							
				benzo(a) pyrene	benzo(b) fluoranthene	benzo(k) fluoranthene	Indeno (1,2,3-cd) pyrene	Total 1-4				Liquid Fuels	Solid Fuels	Gaseous Fuels	Biomass	Other Fuels	*Other activity (specified)*	*Other Activity Units*
NFR Aggregation for Gridding and LPS (GNFR)	*NFR Code*	*annot atio*	*Longname*	**Mg**	**Mg**	**Mg**	**Mg**	**Mg**	**kg**	**kg**	**kg**	**TJ NCV**	**TJ NCV**	**TJ NCV**	**TJ NCV**	**TJ NCV**		
R_Other	7 A	(a)	7 A Other (included in national total for entire territory)	NR	NR	NR	NR	NO	NO	NR	NR	NA	NA	NA	NA	NA	NA	NA
	NATIONAL TOTAL	(f) (h)	National total for the entire territory	NR	NR	NR	NR	7.50	38.26	NR	NR	451,055	81,525	303,564	205,494	29,552	NA	NA
	National total (FU)	(h)	National total accounting transport emissions based on fuel used	NR	NR	NR	NR	7.07	38.19	NR	NR	NA	NA	NA	NA	NA	NA	NA
	GRID TOTAL	(g)	National total for the EMEP grid domain	NR	NR	NR	NR	NR	NR	NR	NR	NA	NA	NA	NA	NA	NA	NA
	UNFCCC national total		National total as reported under UNFCCC	NR	NR	NR	NR	NR	NR	NR	NR	NO	NO	NO	NO	NO	NO	
	Memo Items. NOT TO BE INCLUDED IN NATIONAL TOTALS UNLESS OTHERWISE ST																	
K_CivilAviCruise	1 A 3 a ii (ii)		1 A 3 a ii (ii) Civil aviation (Domestic, Cruise)	NR	NR	NR	NR	NE	NE	NR	NR	NO	NA	NA	NA	NA	NA	TJ NCV
T_IntAviCruise	1 A 3 a i (ii)		1 A 3 a i (ii) International aviation (Cruise)	NR	NR	NR	NR	NE	NE	NR	NR	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	NR	NR	NR	NR	NO	NO	NR	NR	NO	NA	NA	NA	NA	NA	TJ NCV
z_Memo	1 A 3	(i)	Transport (fuel used)	NR	NR	NR	NR	1.17	0.13	NR	NR	NO	NO	NO	NO	NO	NO	
z_Memo	7 B		7 B Other not included in nationaltotal of the entire territory (Please specify in notes and your IIR)	NR	NR	NR	NR	NR	NR	NR	NR	NA	NA	NA	NA	NA	NA	NA
S_Natural	11A		(11 08 Volcanoes)	NR	NR	NR	NR	NO	NO	NR	NR	NA	NA	NA	NA	NA	NO	Please specify
S_Natural	11 B		Forest fires	NR	NR	NR	NR	0.12	0.00	NR	NR	NA	NA	NA	NA	NA	NO	Area of forest burned [ha]
S_Natural	11 C		Other natural emissions (Please specify in notes and your IIR)	NR	NR	NR	NR	NR	NR	NR	NR	NO	NO	NO	NO	NO	NO	

12.1.2 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	Substance(s) reported	Sub-source description
1 A 2 f	Main, HM, POPs	Other fuel combustion in industry: ISIC codes according to Guidelines.
1 A 5 a		
1 A 5 b	Main, HM, POPs	Military aviation and road transport
1 B 1 c		NO
1 B 3		NO
2 A 7 d		
2 B 5 a		
2 B 5 b	Main, HM, POPs	Bulk production: Sulphuric acid, Ammonium nitrate, NPK-fertilizers, Urea, Clorine, Ethylene, Phytosanitary, Other anorganic products.
2 C 5 e		Other non ferrous metal production: light alloy casting; Secondary aluminium, copper, lead and zinc production.
2 C 5 f		
2 G		
3 A 3		
4 B 13	NH_3, NO_x	game animals, mainly deer (pasture)
4 G	NO_x, NMVOC, NH_3, TSP, PM	sewage sludge spreading (NO_x, NH_3). legumes (NH_3). agricultural vegetation (NMVOC). animal husbandry (TSP, PM)
6 D		
7 A		
7 B		
11 C		

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		

12.2 Emission Trends per Sector- Submission under UNECE/LRTAP

Table A-1: Emission trends for SO_2 [Gg] 1980–2009 - Submission under UNECE/LRTAP.

	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	330.33	327.78	2.56	13.14	NA	0.03	NE	0.41	NO	343.91	0.11
1981	288.23	286.34	1.89	13.02	NA	0.03	NE	0.41	NO	301.69	0.12
1982	274.04	272.30	1.75	12.89	NA	0.03	NE	0.41	NO	287.38	0.11
1983	199.35	197.76	1.59	12.77	NA	0.03	NE	0.41	NO	212.56	0.13
1984	182.38	180.71	1.67	12.65	NA	0.03	NE	0.41	NO	195.47	0.18
1985	166.64	165.11	1.53	12.07	NA	0.03	NE	0.41	NO	179.15	0.20
1986	148.06	146.60	1.46	11.28	NA	0.03	NE	0.41	NO	159.79	0.17
1987	127.15	125.63	1.52	10.28	NA	0.03	NE	0.41	NO	137.87	0.19
1988	98.64	97.00	1.65	3.92	NA	0.04	NE	0.22	NO	102.82	0.21
1989	88.80	87.07	1.73	3.31	NA	0.04	NE	0.14	NO	92.28	0.26
1990	72.09	70.09	2.00	2.22	NA	0.00	NE	0.07	NO	74.38	0.26
1991	69.53	68.23	1.30	1.90	NA	0.00	NE	0.06	NO	71.49	0.29
1992	53.39	51.39	2.00	1.67	NA	0.00	NE	0.04	NO	55.09	0.31
1993	51.99	49.89	2.10	1.42	NA	0.00	NE	0.04	NO	53.46	0.33
1994	46.37	45.09	1.28	1.42	NA	0.00	NE	0.05	NO	47.83	0.34
1995	45.99	44.46	1.53	1.37	NA	0.00	NE	0.05	NO	47.41	0.38
1996	43.33	42.13	1.20	1.29	NA	0.00	NE	0.05	NO	44.67	0.43
1997	38.89	38.82	0.07	1.27	NA	0.00	NE	0.05	NO	40.21	0.44
1998	34.36	34.32	0.04	1.18	NA	0.00	NE	0.05	NO	35.59	0.46
1999	32.60	32.46	0.14	1.12	NA	0.00	NE	0.06	NO	33.77	0.45
2000	30.54	30.39	0.15	1.09	NA	0.00	NE	0.06	NO	31.68	0.48
2001	31.53	31.37	0.16	1.21	NA	0.00	NE	0.06	NO	32.80	0.47
2002	30.01	29.87	0.14	1.21	NA	0.00	NE	0.06	NO	31.28	0.43
2003	30.83	30.68	0.15	1.21	NA	0.00	NE	0.06	NO	32.10	0.40
2004	26.21	26.07	0.14	1.22	NA	0.00	NE	0.06	NO	27.49	0.47
2005	26.02	25.88	0.13	1.22	NA	0.00	NE	0.06	NO	27.29	0.55
2006	26.98	26.81	0.17	1.22	NA	0.00	NE	0.06	NO	28.26	0.58
2007	23.58	23.40	0.18	1.22	NA	0.00	NE	0.06	NO	24.87	0.61
2008	21.20	21.03	0.16	1.23	NA	0.00	NE	0.06	NO	22.48	0.61
2009	19.32	19.08	0.24	1.21	NA	0.00	NE	0.06	NO	20.58	0.53

Table A-2: Emission trends for NO_x [Gg] 1980–2009 - Submission under UNECE/LRTAP.

	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	209.54	209.54	IE	13.98	NA	7.20	NE	0.25	NO	230.97	1.01
1981	197.11	197.11	IE	12.71	NA	7.19	NE	0.25	NO	217.27	1.10
1982	194.93	194.93	IE	11.45	NA	7.32	NE	0.25	NO	213.96	1.02
1983	197.95	197.95	IE	10.27	NA	7.45	NE	0.25	NO	215.92	1.27
1984	199.42	199.42	IE	9.07	NA	7.59	NE	0.25	NO	216.33	1.71
1985	205.14	205.14	IE	7.88	NA	7.53	NE	0.25	NO	220.79	1.86
1986	198.88	198.88	IE	6.68	NA	7.38	NE	0.25	NO	213.19	1.64
1987	195.12	195.12	IE	5.49	NA	7.61	NE	0.25	NO	208.48	1.82
1988	190.94	190.94	IE	5.27	NA	7.52	NE	0.17	NO	203.89	2.00
1989	185.42	185.42	IE	4.99	NA	7.26	NE	0.13	NO	197.81	2.46
1990	183.47	183.47	IE	4.80	NA	6.51	NE	0.10	NO	194.88	2.44
1991	190.89	190.89	IE	4.48	NA	6.70	NE	0.09	NO	202.16	2.76
1992	181.60	181.60	IE	4.55	NA	6.32	NE	0.06	NO	192.54	3.00
1993	179.04	179.04	IE	1.98	NA	6.11	NE	0.05	NO	187.18	3.18
1994	172.99	172.99	IE	1.92	NA	6.53	NE	0.04	NO	181.49	3.31
1995	173.27	173.27	IE	1.46	NA	6.65	NE	0.05	NO	181.43	3.73
1996	195.68	195.68	IE	1.42	NA	6.32	NE	0.05	NO	203.46	4.14
1997	183.72	183.72	IE	1.50	NA	6.32	NE	0.05	NO	191.58	4.29
1998	197.65	197.65	IE	1.46	NA	6.33	NE	0.05	NO	205.49	4.43
1999	190.56	190.56	IE	1.44	NA	6.16	NE	0.05	NO	198.22	4.33
2000	198.69	198.69	IE	1.54	NA	6.05	NE	0.05	NO	206.33	6.44
2001	208.36	208.36	IE	1.57	NA	6.02	NE	0.05	NO	216.00	6.32
2002	215.17	215.17	IE	1.63	NA	5.95	NE	0.05	NO	222.81	5.67
2003	226.20	226.20	IE	1.34	NA	5.83	NE	0.05	NO	233.42	5.21
2004	224.48	224.48	IE	1.28	NA	5.67	NE	0.05	NO	231.48	6.09
2005	229.30	229.30	IE	1.75	NA	5.65	NE	0.05	NO	236.75	6.99
2006	215.64	215.64	IE	1.82	NA	5.65	NE	0.05	NO	223.16	7.54
2007	209.39	209.39	IE	1.71	NA	5.72	NE	0.05	NO	216.87	7.99
2008	197.18	197.18	IE	1.59	NA	5.82	NE	0.05	NO	204.65	7.90
2009	180.21	180.21	IE	1.26	NA	5.80	NE	0.05	NO	187.32	6.86

Table A-3: Emission trends for NMVOC [Gg] 1980–2009 - Submission under UNECE/LRTAP.

	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	173.76	161.09	12.67	17.73	206.56	4.55	NE	0.16	NO	402.76	0.07
1981	174.17	161.99	12.17	17.12	182.78	4.48	NE	0.16	NO	378.70	0.08
1982	173.90	162.44	11.46	16.76	180.30	4.60	NE	0.16	NO	375.72	0.08
1983	175.87	164.59	11.28	16.24	177.85	4.51	NE	0.16	NO	374.63	0.09
1984	179.66	168.23	11.43	15.73	175.43	4.57	NE	0.16	NO	375.55	0.13
1985	179.54	168.09	11.45	15.21	172.64	4.61	NE	0.16	NO	372.15	0.14
1986	174.02	162.49	11.52	14.83	172.26	4.52	NE	0.16	NO	365.78	0.12
1987	170.11	158.43	11.69	14.36	171.88	4.54	NE	0.16	NO	361.05	0.14
1988	162.97	151.38	11.59	14.57	171.48	4.66	NE	0.16	NO	353.84	0.15
1989	156.59	144.76	11.83	14.54	149.04	4.61	NE	0.16	NO	324.95	0.18
1990	148.35	136.22	12.13	11.10	114.43	1.85	NE	0.16	NO	275.89	0.18
1991	154.86	141.80	13.06	12.58	96.93	1.85	NE	0.16	NO	266.37	0.20
1992	147.23	134.21	13.02	13.78	78.54	1.79	NE	0.15	NO	241.48	0.22
1993	145.58	132.84	12.74	15.05	79.91	1.76	NE	0.14	NO	242.45	0.24
1994	135.94	125.81	10.13	13.57	75.02	1.81	NE	0.13	NO	226.47	0.25
1995	131.14	122.46	8.68	11.95	81.27	1.82	NE	0.13	NO	226.31	0.29
1996	130.63	122.88	7.75	10.37	77.47	1.80	NE	0.12	NO	220.40	0.34
1997	110.00	102.79	7.21	9.06	83.48	1.88	NE	0.11	NO	204.54	0.37
1998	102.91	97.23	5.68	7.71	75.46	1.84	NE	0.11	NO	188.04	0.40
1999	96.88	91.93	4.95	6.04	69.41	1.88	NE	0.10	NO	174.32	0.39
2000	89.34	84.37	4.97	4.96	82.35	1.79	NE	0.10	NO	178.53	0.42
2001	84.17	81.05	3.12	4.38	86.90	1.86	NE	0.10	NO	177.40	0.41
2002	77.66	74.40	3.26	4.57	92.50	1.86	NE	0.10	NO	176.69	0.37
2003	73.97	70.75	3.22	4.26	93.54	1.73	NE	0.10	NO	173.60	0.34
2004	68.85	65.81	3.04	4.40	79.53	1.98	NE	0.09	NO	154.85	0.40
2005	68.49	65.64	2.86	4.71	89.31	1.86	NE	0.09	NO	164.47	0.47
2006	61.39	58.51	2.88	4.87	105.04	1.79	NE	0.08	NO	173.17	0.50
2007	57.38	54.89	2.49	4.89	95.71	1.79	NE	0.08	NO	159.85	0.53
2008	55.40	53.16	2.25	4.80	88.21	1.95	NE	0.07	NO	150.43	0.52
2009	52.57	50.46	2.11	4.56	64.10	1.83	NE	0.07	NO	123.12	0.45

Table A-4: Emission trends for NH_3 [Gg] 1980–2009 - Submission under UNECE/LRTAP.

	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	61.32	NE	0.01	NO	63.15	0.001
1981	1.41	1.41	IE	0.30	NA	62.83	NE	0.01	NO	64.55	0.001
1982	1.39	1.39	IE	0.29	NA	62.96	NE	0.01	NO	64.65	0.001
1983	1.37	1.37	IE	0.28	NA	63.87	NE	0.01	NO	65.53	0.001
1984	1.40	1.40	IE	0.29	NA	64.82	NE	0.01	NO	66.51	0.001
1985	1.44	1.44	IE	0.28	NA	63.91	NE	0.01	NO	65.63	0.001
1986	1.45	1.45	IE	0.26	NA	63.20	NE	0.01	NO	64.91	0.001
1987	1.44	1.44	IE	0.26	NA	63.85	NE	0.01	NO	65.56	0.001
1988	2.20	2.20	IE	0.28	NA	62.48	NE	0.01	NO	64.97	0.001
1989	3.17	3.17	IE	0.27	NA	61.75	NE	0.01	NO	65.20	0.002
1990	4.04	4.04	IE	0.27	NA	60.80	NE	0.36	NO	65.46	0.002
1991	5.64	5.64	IE	0.51	NA	61.46	NE	0.37	NO	67.98	0.002
1992	6.55	6.55	IE	0.37	NA	59.63	NE	0.42	NO	66.97	0.002
1993	7.45	7.45	IE	0.22	NA	60.11	NE	0.50	NO	68.28	0.002
1994	8.12	8.12	IE	0.17	NA	61.15	NE	0.57	NO	70.02	0.002
1995	7.96	7.96	IE	0.10	NA	62.13	NE	0.58	NO	70.77	0.003
1996	7.48	7.48	IE	0.10	NA	60.50	NE	0.60	NO	68.68	0.003
1997	6.95	6.95	IE	0.10	NA	61.15	NE	0.59	NO	68.79	0.003
1998	6.98	6.98	IE	0.10	NA	61.52	NE	0.60	NO	69.20	0.003
1999	6.28	6.28	IE	0.12	NA	60.05	NE	0.64	NO	67.08	0.003
2000	5.76	5.76	IE	0.10	NA	58.13	NE	0.66	NO	64.65	0.003
2001	5.58	5.58	IE	0.08	NA	58.12	NE	0.74	NO	64.52	0.003
2002	5.50	5.50	IE	0.06	NA	57.36	NE	0.81	NO	63.73	0.003
2003	5.31	5.31	IE	0.08	NA	57.37	NE	0.88	NO	63.64	0.003
2004	4.83	4.83	IE	0.06	NA	56.85	NE	1.17	NO	62.90	0.003
2005	4.48	4.48	IE	0.07	NA	56.86	NE	1.29	NO	62.70	0.004
2006	3.93	3.93	IE	0.07	NA	57.22	NE	1.35	NO	62.58	0.004
2007	3.60	3.60	IE	0.08	NA	58.39	NE	1.40	NO	63.47	0.004
2008	3.20	3.20	IE	0.08	NA	58.04	NE	1.41	NO	62.73	0.004
2009	2.85	2.85	IE	0.09	NA	59.12	NE	1.44	NO	63.50	0.004

Table A-5: Emission trends for CO [Gg] 1980–2009 - Submission under UNECE/LRTAP.

	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	1 731.7	1 731.7	IE	52.8	NA	23.8	NE	10.6	NO	1 818.9	0.2
1981	1 721.2	1 721.2	IE	50.7	NA	20.5	NE	10.6	NO	1 803.0	0.2
1982	1 728.3	1 728.3	IE	48.3	NA	24.0	NE	10.6	NO	1 811.2	0.2
1983	1 717.3	1 717.3	IE	47.9	NA	24.6	NE	10.6	NO	1 800.3	0.3
1984	1 764.2	1 764.2	IE	48.1	NA	26.3	NE	10.6	NO	1 849.2	0.3
1985	1 735.9	1 735.9	IE	46.7	NA	26.2	NE	10.6	NO	1 819.4	0.4
1986	1 675.4	1 675.4	IE	44.7	NA	23.2	NE	10.4	NO	1 753.7	0.3
1987	1 609.0	1 609.0	IE	44.9	NA	24.1	NE	10.4	NO	1 688.5	0.4
1988	1 529.5	1 529.5	IE	45.9	NA	27.8	NE	10.7	NO	1 613.9	0.4
1989	1 504.4	1 504.4	IE	46.3	NA	27.3	NE	11.1	NO	1 589.0	0.5
1990	1 374.7	1 374.7	IE	46.4	NA	1.0	NE	11.2	NO	1 433.2	0.5
1991	1 443.4	1 443.4	IE	41.7	NA	1.0	NE	11.1	NO	1 497.2	0.5
1992	1 411.3	1 411.3	IE	45.0	NA	1.0	NE	10.8	NO	1 468.0	0.6
1993	1 377.5	1 377.5	IE	47.2	NA	0.9	NE	10.6	NO	1 436.1	0.6
1994	1 323.3	1 323.3	IE	48.6	NA	1.0	NE	10.0	NO	1 382.9	0.7
1995	1 214.4	1 214.4	IE	45.1	NA	0.9	NE	9.4	NO	1 269.8	0.7
1996	1 194.4	1 194.4	IE	39.4	NA	0.9	NE	8.9	NO	1 243.6	0.8
1997	1 100.1	1 100.1	IE	38.3	NA	0.9	NE	8.4	NO	1 147.7	0.9
1998	1 062.0	1 062.0	IE	34.9	NA	0.9	NE	8.1	NO	1 105.8	0.9
1999	988.6	988.6	IE	30.6	NA	1.0	NE	7.7	NO	1 027.8	0.9
2000	918.7	918.7	IE	27.4	NA	0.8	NE	7.4	NO	954.2	0.8
2001	884.4	884.4	IE	24.2	NA	0.9	NE	7.1	NO	916.6	0.8
2002	849.2	849.2	IE	23.9	NA	0.9	NE	7.1	NO	881.1	0.7
2003	843.2	843.2	IE	23.6	NA	0.8	NE	7.3	NO	874.9	0.6
2004	804.8	804.8	IE	23.9	NA	1.3	NE	6.8	NO	836.7	0.7
2005	789.5	789.5	IE	24.2	NA	0.8	NE	6.4	NO	820.9	0.9
2006	740.9	740.9	IE	24.5	NA	0.7	NE	6.1	NO	772.2	0.9
2007	689.7	689.7	IE	24.7	NA	0.7	NE	5.7	NO	720.8	1.0
2008	651.0	651.0	IE	24.5	NA	0.7	NE	5.3	NO	681.5	1.0
2009	619.8	619.8	IE	23.4	NA	0.7	NE	4.9	NO	648.8	0.8

Table A-6: Emission trends for Cd [kg] 1985–2009 - Submission under UNECE/LRTAP.

	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	2 084.2	NA	837.1	0.2	32.4	NE	138.3	NO	3 092.2	0.2
1986	1 824.3	1 824.3	NA	709.6	0.2	28.7	NE	121.4	NO	2 684.2	0.2
1987	1 406.1	1 406.1	NA	654.0	0.2	29.7	NE	104.6	NO	2 194.6	0.2
1988	1 195.5	1 195.5	NA	619.6	0.2	34.2	NE	77.8	NO	1 927.3	0.2
1989	1 058.4	1 058.4	NA	580.8	0.2	33.6	NE	61.1	NO	1 734.1	0.2
1990	1 060.3	1 060.3	NA	456.6	0.2	1.9	NE	59.2	NO	1 578.1	0.2
1991	1 091.8	1 091.8	NA	384.5	0.2	1.9	NE	48.4	NO	1 526.8	0.3
1992	975.6	975.6	NA	263.9	0.2	1.9	NE	5.3	NO	1 246.9	0.3
1993	940.1	940.1	NA	215.6	0.2	1.8	NE	4.6	NO	1 162.2	0.3
1994	879.7	879.7	NA	177.5	0.2	1.9	NE	3.9	NO	1 063.1	0.3
1995	811.2	811.2	NA	159.7	0.2	1.8	NE	1.9	NO	974.8	0.3
1996	844.7	844.7	NA	146.9	0.2	1.8	NE	1.8	NO	995.4	0.4
1997	803.2	803.2	NA	162.9	0.2	1.8	NE	1.8	NO	969.8	0.4
1998	735.9	735.9	NA	160.4	0.2	1.8	NE	1.7	NO	899.9	0.4
1999	775.8	775.8	NA	167.7	0.2	1.8	NE	1.7	NO	947.1	0.4
2000	738.8	738.8	NA	182.8	0.2	1.6	NE	1.6	NO	925.1	0.4
2001	767.8	767.8	NA	179.5	0.2	1.8	NE	1.6	NO	950.9	0.4
2002	745.4	745.4	NA	189.5	0.2	1.7	NE	1.6	NO	938.4	0.4
2003	784.7	784.7	NA	190.2	0.2	1.6	NE	1.6	NO	978.3	0.3
2004	778.0	778.0	NA	197.9	0.2	2.2	NE	1.6	NO	979.8	0.4
2005	855.8	855.8	NA	218.1	0.2	1.6	NE	1.5	NO	1 077.2	0.5
2006	839.5	839.5	NA	222.2	0.2	1.5	NE	1.5	NO	1 064.9	0.5
2007	862.6	862.6	NA	235.2	0.2	1.5	NE	1.4	NO	1 100.9	0.5
2008	904.2	904.2	NA	234.3	0.2	1.5	NE	1.4	NO	1 141.6	0.5
2009	878.9	878.9	NA	173.3	0.2	1.5	NE	1.3	NO	1 055.1	0.5

Table A-7: Emission trends for Hg [kg] 1985–2009 - Submission under UNECE/LRTAP.

	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	2 980.0	2 980.0	NA	670.6	NA	5.8	NE	86.1	NO	3 742.5	0.1
1986	2 601.6	2 601.6	NA	629.1	NA	5.1	NE	78.8	NO	3 314.6	0.1
1987	2 157.5	2 157.5	NA	606.6	NA	5.3	NE	71.5	NO	2 840.9	0.1
1988	1 781.7	1 781.7	NA	593.6	NA	6.1	NE	63.7	NO	2 445.1	0.1
1989	1 591.6	1 591.6	NA	579.4	NA	6.0	NE	57.3	NO	2 234.3	0.1
1990	1 560.5	1 560.5	NA	527.6	NA	0.3	NE	53.6	NO	2 142.0	0.1
1991	1 500.0	1 500.0	NA	492.2	NA	0.3	NE	45.5	NO	2 038.0	0.1
1992	1 180.8	1 180.8	NA	435.4	NA	0.3	NE	23.9	NO	1 640.4	0.1
1993	956.1	956.1	NA	412.0	NA	0.3	NE	22.8	NO	1 391.1	0.1
1994	758.5	758.5	NA	398.1	NA	0.3	NE	21.4	NO	1 178.3	0.1
1995	713.2	713.2	NA	466.2	NA	0.3	NE	20.3	NO	1 200.0	0.1
1996	708.8	708.8	NA	430.8	NA	0.3	NE	18.3	NO	1 158.1	0.1
1997	683.0	683.0	NA	433.6	NA	0.3	NE	16.1	NO	1 132.9	0.1
1998	601.1	601.1	NA	333.5	NA	0.3	NE	14.0	NO	948.8	0.1
1999	645.1	645.1	NA	275.9	NA	0.3	NE	12.1	NO	933.3	0.1
2000	641.6	641.6	NA	241.4	NA	0.2	NE	10.0	NO	893.3	0.1
2001	699.5	699.5	NA	244.9	NA	0.3	NE	9.8	NO	954.4	0.1
2002	647.3	647.3	NA	260.9	NA	0.3	NE	9.9	NO	918.4	0.1
2003	684.6	684.6	NA	261.4	NA	0.2	NE	14.6	NO	960.9	0.1
2004	643.2	643.2	NA	271.7	NA	0.3	NE	19.3	NO	934.5	0.1
2005	673.8	673.8	NA	304.8	NA	0.2	NE	20.6	NO	999.5	0.2
2006	679.1	679.1	NA	310.7	NA	0.2	NE	20.6	NO	1 010.7	0.2
2007	661.2	661.2	NA	328.8	NA	0.2	NE	20.6	NO	1 010.8	0.2
2008	680.3	680.3	NA	326.5	NA	0.2	NE	20.6	NO	1 027.6	0.2
2009	649.2	649.2	NA	244.4	NA	0.2	NE	20.6	NO	914.4	0.2

Table A-8: Emission trends for Pb [kg] 1985–2009 - Submission under UNECE/LRTAP.

	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	258 175.5	258 175.5	NA	62 447.2	20.0	173.7	NE	5 845.7	NO	326 662.1	0.2
1986	254 983.1	254 983.1	NA	52 375.3	20.0	153.9	NE	5 268.9	NO	312 801.3	0.2
1987	253 990.8	253 990.8	NA	47 854.7	20.0	159.2	NE	4 692.2	NO	306 716.9	0.2
1988	228 302.7	228 302.7	NA	45 156.6	20.0	183.2	NE	2 591.4	NO	276 253.9	0.2
1989	199 222.8	199 222.8	NA	41 738.3	20.0	180.2	NE	1 638.2	NO	242 799.4	0.2
1990	185 255.8	185 255.8	NA	32 092.8	20.0	11.4	NE	1 015.8	NO	218 395.7	0.2
1991	151 558.1	151 558.1	NA	27 091.3	20.0	11.2	NE	777.6	NO	179 458.2	0.3
1992	105 424.4	105 424.4	NA	18 609.2	20.0	11.3	NE	488.3	NO	124 553.2	0.3
1993	71 658.2	71 658.2	NA	15 146.0	20.0	10.5	NE	381.1	NO	87 215.7	0.3
1994	47 463.8	47 463.8	NA	12 025.4	20.0	11.0	NE	265.7	NO	59 785.8	0.3
1995	11 329.3	11 329.3	NA	4 680.1	20.0	10.8	NE	9.2	NO	16 049.3	0.3
1996	11 183.8	11 183.8	NA	4 260.7	20.0	10.4	NE	9.1	NO	15 484.1	0.4
1997	9 635.8	9 635.8	NA	4 791.8	20.0	10.5	NE	9.0	NO	14 467.2	0.4
1998	8 239.5	8 239.5	NA	4 703.5	20.0	10.4	NE	9.0	NO	12 982.4	0.4
1999	7 470.2	7 470.2	NA	4 906.9	20.0	10.5	NE	9.0	NO	12 416.5	0.4
2000	6 383.1	6 383.1	NA	5 481.3	20.0	9.6	NE	8.9	NO	11 903.0	0.4
2001	6 647.9	6 647.9	NA	5 350.9	20.0	10.4	NE	8.9	NO	12 038.1	0.4
2002	6 508.7	6 508.7	NA	5 649.8	20.0	10.0	NE	8.9	NO	12 197.4	0.4
2003	6 803.7	6 803.7	NA	5 676.3	20.0	9.3	NE	8.9	NO	12 518.2	0.3
2004	6 965.8	6 965.8	NA	5 899.5	20.0	12.4	NE	8.8	NO	12 906.6	0.4
2005	7 145.6	7 145.6	NA	6 493.7	20.0	9.3	NE	8.8	NO	13 677.3	0.5
2006	7 086.2	7 086.2	NA	6 608.4	20.0	8.9	NE	8.7	NO	13 732.3	0.5
2007	7 339.5	7 339.5	NA	7 000.6	20.0	9.0	NE	8.7	NO	14 377.8	0.5
2008	7 696.0	7 696.0	NA	6 975.5	20.0	9.0	NE	8.6	NO	14 709.1	0.5
2009	7 486.4	7 486.4	NA	5 157.4	20.0	8.7	NE	8.6	NO	12 681.1	0.5

Table A-9: Emission trends for PAH [kg] 1985–2009 - Submission under UNECE/LRTAP.

	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	11 953.0	11 953.0	NA	7 883.7	151.7	7 065.8	NE	0.3	NO	27 054.5	NE
1986	11 295.4	11 295.4	NA	7 815.5	151.7	7 062.9	NE	0.3	NO	26 325.9	NE
1987	11 120.4	11 120.4	NA	7 911.1	151.7	7 062.9	NE	0.3	NO	26 246.5	NE
1988	10 007.9	10 007.9	NA	7 460.1	151.7	7 062.9	NE	0.3	NO	24 682.9	NE
1989	9 511.0	9 511.0	NA	7 566.8	151.7	7 062.9	NE	0.2	NO	24 292.7	NE
1990	9 526.0	9 526.0	NA	7 436.5	151.7	249.8	NE	0.2	NO	17 364.3	NE
1991	10 368.5	10 368.5	NA	7 175.5	151.7	249.8	NE	0.2	NO	17 945.7	NE
1992	9 443.7	9 443.7	NA	3 585.3	109.5	249.8	NE	0.0	NO	13 388.2	NE
1993	9 315.9	9 315.9	NA	524.2	73.9	248.5	NE	0.0	NO	10 162.5	NE
1994	8 420.0	8 420.0	NA	591.9	55.8	248.5	NE	0.0	NO	9 316.2	NE
1995	8 876.7	8 876.7	NA	492.4	35.9	246.7	NE	0.0	NO	9 651.7	NE
1996	9 586.8	9 586.8	NA	897.6	15.0	246.7	NE	0.0	NO	10 746.1	NE
1997	8 600.3	8 600.3	NA	466.7	6.8	243.2	NE	0.0	NO	9 317.0	NE
1998	8 319.3	8 319.3	NA	410.0	NE	243.2	NE	0.0	NO	8 972.5	NE
1999	8 315.7	8 315.7	NA	250.1	NE	241.7	NE	0.0	NO	8 807.5	NE
2000	7 783.4	7 783.4	NA	192.5	NE	241.7	NE	0.0	NO	8 217.6	NE
2001	8 259.9	8 259.9	NA	183.4	NE	241.7	NE	0.0	NO	8 685.0	NE
2002	7 880.6	7 880.6	NA	190.3	NE	241.7	NE	0.0	NO	8 312.7	NE
2003	7 991.8	7 991.8	NA	190.7	NE	237.6	NE	0.0	NO	8 420.1	NE
2004	7 953.2	7 953.2	NA	196.9	NE	304.1	NE	0.0	NO	8 454.2	NE
2005	8 572.5	8 572.5	NA	216.1	NE	207.6	NE	0.0	NO	8 996.2	NE
2006	7 611.8	7 611.8	NA	219.7	NE	197.1	NE	0.0	NO	8 028.6	NE
2007	7 442.4	7 442.4	NA	230.4	NE	205.2	NE	0.0	NO	7 878.0	NE
2008	7 434.6	7 434.6	NA	229.1	NE	181.4	NE	0.0	NO	7 845.1	NE
2009	7 137.0	7 137.0	NA	181.0	NE	183.5	NE	0.0	NO	7 501.4	NE

Table A-10:Emission trends for Dioxin/Furan (PCDD/F) [g] 1985–2009 - Submission under UNECE/LRTAP.

	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	116.05	116.05	NA	50.81	0.24	5.05	NE	15.89	NO	188.04	NE
1988	110.18	110.18	NA	41.60	1.06	5.05	NE	15.48	NO	173.36	NE
1989	101.89	101.89	NA	41.13	1.06	5.05	NE	15.29	NO	164.42	NE
1990	102.21	102.21	NA	39.00	1.06	0.18	NE	18.19	NO	160.65	NE
1991	81.21	81.21	NA	35.15	1.04	0.18	NE	17.75	NO	135.34	NE
1992	54.16	54.16	NA	21.89	0.02	0.18	NE	0.53	NO	76.78	NE
1993	49.54	49.54	NA	17.01	0.02	0.18	NE	0.22	NO	66.98	NE
1994	44.68	44.68	NA	11.26	NE	0.18	NE	0.08	NO	56.21	NE
1995	45.94	45.94	NA	12.23	NE	0.18	NE	0.08	NO	58.43	NE
1996	48.31	48.31	NA	11.17	NE	0.18	NE	0.08	NO	59.74	NE
1997	46.96	46.96	NA	12.15	NE	0.18	NE	0.08	NO	59.37	NE
1998	44.55	44.55	NA	11.45	NE	0.18	NE	0.08	NO	56.26	NE
1999	40.76	40.76	NA	12.60	NE	0.18	NE	0.08	NO	53.61	NE
2000	37.73	37.73	NA	14.05	NE	0.18	NE	0.08	NO	52.04	NE
2001	39.47	39.47	NA	13.55	NE	0.18	NE	0.08	NO	53.28	NE
2002	36.99	36.99	NA	3.24	NE	0.18	NE	0.08	NO	40.48	NE
2003	37.12	37.12	NA	2.98	NE	0.17	NE	0.12	NO	40.40	NE
2004	36.76	36.76	NA	3.30	NE	0.22	NE	0.16	NO	40.44	NE
2005	38.96	38.96	NA	4.02	NE	0.15	NE	0.17	NO	43.30	NE
2006	34.79	34.79	NA	4.76	NE	0.15	NE	0.17	NO	39.86	NE
2007	34.14	34.14	NA	4.08	NE	0.15	NE	0.17	NO	38.53	NE
2008	34.69	34.69	NA	3.54	NE	0.13	NE	0.17	NO	38.54	NE
2009	32.96	32.96	NA	2.73	NE	0.14	NE	0.17	NO	35.99	NE

Table A-11:Emission trends for HCB [kg] 1985–2009 - Submission under UNECE/LRTAP.

	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	106 315	NE
1986	80 309	80 309	NA	13 215	8 118	1 010	NE	1 112	NO	103 764	NE
1987	83 159	83 159	NA	13 181	8 113	1 010	NE	1 111	NO	106 575	NE
1988	76 981	76 981	NA	11 160	8 218	1 010	NE	704	NO	98 073	NE
1989	72 906	72 906	NA	11 064	9 342	1 010	NE	519	NO	94 840	NE
1990	72 743	72 743	NA	9 712	9 053	37	NE	392	NO	91 937	NE
1991	69 881	69 881	NA	8 032	6 392	37	NE	275	NO	84 616	NE
1992	57 108	57 108	NA	4 941	7 491	37	NE	106	NO	69 684	NE
1993	53 744	53 744	NA	3 702	6 473	37	NE	45	NO	64 001	NE
1994	48 171	48 171	NA	2 453	1 252	37	NE	17	NO	51 931	NE
1995	50 355	50 355	NA	2 670	3	36	NE	17	NO	53 081	NE
1996	53 290	53 290	NA	2 440	3	36	NE	17	NO	55 787	NE
1997	49 206	49 206	NA	2 655	3	36	NE	17	NO	51 917	NE
1998	46 604	46 604	NA	2 500	3	36	NE	17	NO	49 159	NE
1999	44 753	44 753	NA	2 756	3	36	NE	17	NO	47 564	NE
2000	41 118	41 118	NA	3 074	4	36	NE	17	NO	44 248	NE
2001	43 022	43 022	NA	2 978	4	36	NE	16	NO	46 056	NE
2002	39 284	39 284	NA	3 170	NE	36	NE	16	NO	42 506	NE
2003	38 490	38 490	NA	3 178	NE	35	NE	24	NO	41 727	NE
2004	37 606	37 606	NA	3 301	NE	44	NE	32	NO	40 983	NE
2005	41 827	41 827	NA	3 691	NE	31	NE	34	NO	45 583	NE
2006	37 987	37 987	NA	3 762	NE	29	NE	34	NO	41 812	NE
2007	36 618	36 618	NA	3 979	NE	30	NE	34	NO	40 662	NE
2008	36 874	36 874	NA	3 953	NE	27	NE	34	NO	40 889	NE
2009	35 232	35 232	NA	2 964	NE	27	NE	34	NO	38 258	NE

Table A-12:Emission trends for TSP [Mg] 1990–2009 - Submission under UNECE/LRTAP.

	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	30 641	29 994	647	18 522	407	12 738	NE	145	NO	62 453	280
1995	31 296	30 751	545	18 609	421	12 558	NE	159	NO	63 043	416
2000	31 718	31 159	558	18 762	425	12 367	NE	90	NO	63 362	524
2001	32 237	31 651	585	18 102	426	12 376	NE	87	NO	63 228	512
2002	32 016	31 418	599	17 398	428	12 344	NE	110	NO	62 297	462
2003	32 570	31 930	641	17 139	430	12 412	NE	129	NO	62 681	428
2004	32 516	31 915	601	17 826	433	12 441	NE	169	NO	63 385	506
2005	33 809	33 199	611	17 228	436	12 223	NE	189	NO	63 885	594
2006	33 039	32 448	591	16 084	438	12 195	NE	186	NO	61 942	626
2007	33 125	32 593	533	15 713	440	12 086	NE	216	NO	61 580	663
2008	33 010	32 501	509	16 857	442	12 033	NE	179	NO	62 521	662
2009	31 641	31 249	392	15 667	443	12 048	NE	179	NO	59 977	570

Table A-13:Emission trends for PM10 [Mg] 1990–2009 - Submission under UNECE/LRTAP.

	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	22 971	22 666	305	10 435	407	5 809	NE	70	NO	39 691	280
1995	22 911	22 654	257	9 948	421	5 724	NE	75	NO	36 661	416
2000	22 658	22 394	263	9 904	425	5 630	NE	43	NO	38 659	524
2001	23 065	22 789	276	9 586	426	5 640	NE	41	NO	38 758	512
2002	22 764	22 482	282	8 899	428	5 623	NE	52	NO	37 767	462
2003	23 107	22 804	302	8 772	430	5 649	NE	61	NO	38 019	428
2004	22 884	22 601	283	9 063	433	5 688	NE	80	NO	38 148	506
2005	23 786	23 498	288	8 733	436	5 563	NE	89	NO	38 608	594
2006	22 794	22 515	279	8 016	438	5 547	NE	88	NO	36 883	626
2007	22 682	22 430	252	7 693	440	5 499	NE	102	NO	36 415	663
2008	22 460	22 220	241	8 286	442	5 475	NE	85	NO	36 748	662
2009	21 450	21 265	185	7 684	443	5 479	NE	85	NO	35 141	570

Table A-14:Emission trends for PM2.5 [Mg] 1990–2009 - Submission under UNECE/LRTAP.

	NFR-Sectors										
year	1	1 A	1 B	2	3	4	5	6	7		
	ENERGY	FUEL COMBUSTION ACTIVITIES	FUGITIVE EMISSIONS FROM FUELS	INDUSTRIAL PROCESSES	SOLVENT AND OTHER PRODUCT USE	AGRICULTURE	LAND USE CHANGE AND FORESTRY	WASTE	OTHER	NATIONAL TOTAL	International Bunkers
1990	19 052	18 957	95	3 226	407	1 396	NE	23	NO	24 103	280
1995	18 906	18 826	80	2 600	421	1 372	NE	24	NO	23 323	416
2000	18 449	18 367	82	2 386	425	1 341	NE	13	NO	22 613	524
2001	18 798	18 712	86	2 333	426	1 351	NE	13	NO	22 921	512
2002	18 499	18 411	88	1 917	428	1 343	NE	16	NO	22 204	462
2003	18 715	18 621	95	1 893	430	1 342	NE	19	NO	22 401	428
2004	18 435	18 346	89	1 891	433	1 385	NE	25	NO	22 169	506
2005	19 097	19 007	90	1 820	436	1 323	NE	28	NO	22 704	594
2006	18 024	17 936	88	1 568	438	1 315	NE	28	NO	21 372	626
2007	17 796	17 716	80	1 380	440	1 305	NE	32	NO	20 953	663
2008	17 484	17 408	76	1 497	442	1 300	NE	27	NO	20 750	662
2009	16 638	16 580	58	1 373	443	1 297	NE	27	NO	19 779	570

12.3 Austria's emissions for SO_2, NO_x, NMVOC and NH_3 according to the submission under NEC directive

In the following tables Austria's emissions 1990–2009 are listed according to NEC Directive 2001/81/EC. NEC emissions are reported on the basis of **fuel used** (without 'fuel export').

The complete tables of the NFR Format are submitted separately in digital form only (excel files).

Table A-15:Austria's emissions 1990–2009 on the basis of fuel used according to Directive 2001/81/EC, Article 8 (1).

	SO_2 [Gg]	NO_x [Gg]	NMVOC [Gg]	NH_3 [Gg]
1990	73.66	181.36	273.01	65.46
1991	70.48	182.11	260.86	67.63
1992	54.08	173.78	237.66	66.85
1993	52.32	166.93	239.09	68.38
1994	46.80	163.95	224.17	70.44
1995	46.46	162.75	224.03	71.26
1996	43.92	162.58	215.60	69.48
1997	39.77	165.14	201.98	69.66
1998	34.90	163.42	183.93	69.57
1999	33.26	163.90	171.50	67.66
2000	31.09	163.86	175.39	65.11
2001	32.08	164.93	173.87	64.64
2002	30.50	162.60	172.79	63.29
2003	31.25	165.08	169.60	62.91
2004	27.42	163.72	151.31	62.15
2005	27.23	167.93	161.15	62.00
2006	28.21	167.80	170.72	62.00
2007	24.82	164.19	157.76	62.96
2008	22.44	159.41	148.94	62.42
2009	20.57	145.39	121.84	63.21
Ceilings 2010	39.00	103.00	159.00	66.00

Table A-16: Austria's SO_2 emissions 1990–2009 on the basis of fuel used according to Directive 2001/81/EC, Article 8 (1).

SO_x	NFR Sectors according to NEC directive									
	1	1 A	1 B	2	3	4	6	7		
	ENERGY	FUEL COMBUSTION ACTIVITIES	FUGITIVE EMISSIONS FROM FUELS	INDUSTRIAL PROCESSES	SOLVENT AND OTHER PRODUCT USE	AGRICULTURE	WASTE	OTHER	NATIONAL TOTAL	International Bunkers
	Gg									
1990	71.37	69.37	2.00	2.22	NA	0.00	0.07	NO	**73.66**	0.26
1991	68.52	67.22	1.30	1.90	NA	0.00	0.06	NO	**70.48**	0.29
1992	52.37	50.37	2.00	1.67	NA	0.00	0.04	NO	**54.08**	0.31
1993	50.86	48.76	2.10	1.42	NA	0.00	0.04	NO	**52.32**	0.33
1994	45.34	44.06	1.28	1.42	NA	0.00	0.05	NO	**46.80**	0.34
1995	45.04	43.51	1.53	1.37	NA	0.00	0.05	NO	**46.46**	0.38
1996	42.58	41.38	1.20	1.29	NA	0.00	0.05	NO	**43.92**	0.43
1997	38.45	38.38	0.07	1.27	NA	0.00	0.05	NO	**39.77**	0.44
1998	33.67	33.62	0.04	1.18	NA	0.00	0.05	NO	**34.90**	0.46
1999	32.09	31.95	0.14	1.12	NA	0.00	0.06	NO	**33.26**	0.45
2000	29.94	29.80	0.15	1.09	NA	0.00	0.06	NO	**31.09**	0.48
2001	30.81	30.65	0.16	1.21	NA	0.00	0.06	NO	**32.08**	0.47
2002	29.23	29.09	0.14	1.21	NA	0.00	0.06	NO	**30.50**	0.43
2003	29.98	29.83	0.15	1.21	NA	0.00	0.06	NO	**31.25**	0.40
2004	26.15	26.00	0.14	1.22	NA	0.00	0.06	NO	**27.42**	0.47
2005	25.96	25.83	0.13	1.22	NA	0.00	0.06	NO	**27.23**	0.55
2006	26.93	26.77	0.17	1.22	NA	0.00	0.06	NO	**28.21**	0.58
2007	23.54	23.36	0.18	1.22	NA	0.00	0.06	NO	**24.82**	0.61
2008	21.16	21.00	0.16	1.23	NA	0.00	0.06	NO	**22.44**	0.61
2009	19.31	19.07	0.24	1.21	NA	0.00	0.06	NO	**20.57**	0.53

Table A-17: Austria's NO_x emissions 1990–2009 on the basis of fuel used according to Directive 2001/81/EC, Article 8 (1).

NO_x	**NFR Sectors according to NEC directive**									
	1	**1 A**	**1 B**	**2**	**3**	**4**	**6**	**7**		
	ENERGY	**FUEL COMBUSTION ACTIVITIES**	**FUGITIVE EMISSIONS FROM FUELS**	**INDUSTRIAL PROCESSES**	**SOLVENT AND OTHER PRODUCT USE**	**AGRICULTURE**	**WASTE**	**OTHER**	**NATIONAL TOTAL**	**International Bunkers**
	Gg									
1990	169.95	169.95	IE	4.80	NA	6.51	0.10	NO	**181.36**	2.44
1991	170.84	170.84	IE	4.48	NA	6.70	0.09	NO	**182.11**	2.76
1992	162.85	162.85	IE	4.55	NA	6.32	0.06	NO	**173.78**	3.00
1993	158.79	158.79	IE	1.98	NA	6.11	0.05	NO	**166.93**	3.18
1994	155.45	155.45	IE	1.92	NA	6.53	0.04	NO	**163.95**	3.31
1995	154.59	154.59	IE	1.46	NA	6.65	0.05	NO	**162.75**	3.73
1996	154.79	154.79	IE	1.42	NA	6.32	0.05	NO	**162.58**	4.14
1997	157.28	157.28	IE	1.50	NA	6.32	0.05	NO	**165.14**	4.29
1998	155.58	155.58	IE	1.46	NA	6.33	0.05	NO	**163.42**	4.43
1999	156.25	156.25	IE	1.44	NA	6.16	0.05	NO	**163.90**	4.33
2000	156.22	156.22	IE	1.54	NA	6.05	0.05	NO	**163.86**	6.44
2001	157.29	157.29	IE	1.57	NA	6.02	0.05	NO	**164.93**	6.32
2002	154.96	154.96	IE	1.63	NA	5.95	0.05	NO	**162.60**	5.67
2003	157.86	157.86	IE	1.34	NA	5.83	0.05	NO	**165.08**	5.21
2004	156.72	156.72	IE	1.28	NA	5.67	0.05	NO	**163.72**	6.09
2005	160.48	160.48	IE	1.75	NA	5.65	0.05	NO	**167.93**	6.99
2006	160.29	160.29	IE	1.82	NA	5.65	0.05	NO	**167.80**	7.54
2007	156.71	156.71	IE	1.71	NA	5.72	0.05	NO	**164.19**	7.99
2008	151.95	151.95	IE	1.59	NA	5.82	0.05	NO	**159.41**	7.90
2009	138.28	138.28	IE	1.26	NA	5.80	0.05	NO	**145.39**	6.86

Table A-18: Austria's NMVOC emissions 1990–2009 on the basis of fuel used according to Directive 2001/81/EC, Article 8 (1).

NMVOC	NFR Sectors according to NEC directive									
	1	1 A	1 B	2	3	4	6	7		
	ENERGY	FUEL COMBUSTION ACTIVITIES	FUGITIVE EMISSIONS FROM FUELS	INDUSTRIAL PROCESSES	SOLVENT AND OTHER PRODUCT USE	AGRICULTURE	WASTE	OTHER	NATIONAL TOTAL	International Bunkers
	Gg									
1990	145.47	133.34	12.13	11.10	114.43	1.85	0.16	NO	**273.01**	0.18
1991	149.35	136.29	13.06	12.58	96.93	1.85	0.16	NO	**260.86**	0.20
1992	143.40	130.39	13.02	13.78	78.54	1.79	0.15	NO	**237.66**	0.22
1993	142.22	129.49	12.74	15.05	79.91	1.76	0.14	NO	**239.09**	0.24
1994	133.63	123.51	10.13	13.57	75.02	1.81	0.13	NO	**224.17**	0.25
1995	128.86	120.18	8.68	11.95	81.27	1.82	0.13	NO	**224.03**	0.29
1996	125.84	118.09	7.75	10.37	77.47	1.80	0.12	NO	**215.60**	0.34
1997	107.44	100.24	7.21	9.06	83.48	1.88	0.11	NO	**201.98**	0.37
1998	98.80	93.12	5.68	7.71	75.46	1.84	0.11	NO	**183.93**	0.40
1999	94.07	89.11	4.95	6.04	69.41	1.88	0.10	NO	**171.50**	0.39
2000	86.20	81.23	4.97	4.96	82.35	1.79	0.10	NO	**175.39**	0.42
2001	80.64	77.52	3.12	4.38	86.90	1.86	0.10	NO	**173.87**	0.41
2002	73.76	70.49	3.26	4.57	92.50	1.86	0.10	NO	**172.79**	0.37
2003	69.98	66.76	3.22	4.26	93.54	1.73	0.10	NO	**169.60**	0.34
2004	65.32	62.28	3.04	4.40	79.53	1.98	0.09	NO	**151.31**	0.40
2005	65.17	62.32	2.86	4.71	89.31	1.86	0.09	NO	**161.15**	0.47
2006	58.93	56.05	2.88	4.87	105.04	1.79	0.08	NO	**170.72**	0.50
2007	55.30	52.80	2.49	4.89	95.71	1.79	0.08	NO	**157.76**	0.53
2008	53.91	51.66	2.25	4.80	88.21	1.95	0.07	NO	**148.94**	0.52
2009	51.29	49.18	2.11	4.56	64.10	1.83	0.07	NO	**121.84**	0.45

Table A-19: Austria's NH_3 emissions 1990–2009 on the basis of fuel used according to Directive 2001/81/EC, Article 8 (1).

NH_3	NFR Sectors according to NEC directive									
	1	1 A	1 B	2	3	4	6	7		
	ENERGY	FUEL COMBUSTION ACTIVITIES	FUGITIVE EMISSIONS FROM FUELS	INDUSTRIAL PROCESSES	SOLVENT AND OTHER PRODUCT USE	AGRICULTURE	WASTE	OTHER	NATIONAL TOTAL	International Bunkers
	Gg									
1990	4.04	4.04	IE	0.27	NA	60.80	0.36	NO	**65.46**	0.00
1991	5.29	5.29	IE	0.51	NA	61.46	0.37	NO	**67.63**	0.00
1992	6.43	6.43	IE	0.37	NA	59.63	0.42	NO	**66.85**	0.00
1993	7.55	7.55	IE	0.22	NA	60.11	0.50	NO	**68.38**	0.00
1994	8.55	8.55	IE	0.17	NA	61.15	0.57	NO	**70.44**	0.00
1995	8.44	8.44	IE	0.10	NA	62.13	0.58	NO	**71.26**	0.00
1996	8.28	8.28	IE	0.10	NA	60.50	0.60	NO	**69.48**	0.00
1997	7.82	7.82	IE	0.10	NA	61.15	0.59	NO	**69.66**	0.00
1998	7.34	7.34	IE	0.10	NA	61.52	0.60	NO	**69.57**	0.00
1999	6.86	6.86	IE	0.12	NA	60.05	0.64	NO	**67.66**	0.00
2000	6.21	6.21	IE	0.10	NA	58.13	0.66	NO	**65.11**	0.00
2001	5.70	5.70	IE	0.08	NA	58.12	0.74	NO	**64.64**	0.00
2002	5.06	5.06	IE	0.06	NA	57.36	0.81	NO	**63.29**	0.00
2003	4.58	4.58	IE	0.08	NA	57.37	0.88	NO	**62.91**	0.00
2004	4.07	4.07	IE	0.06	NA	56.85	1.17	NO	**62.15**	0.00
2005	3.78	3.78	IE	0.07	NA	56.86	1.29	NO	**62.00**	0.00
2006	3.34	3.34	IE	0.07	NA	57.22	1.35	NO	**62.00**	0.00
2007	3.09	3.09	IE	0.08	NA	58.39	1.40	NO	**62.96**	0.00
2008	2.89	2.89	IE	0.08	NA	58.04	1.41	NO	**62.42**	0.00
2009	2.56	2.56	IE	0.09	NA	59.12	1.44	NO	**63.21**	0.00

12.4 Extracts from Austrian Legislation

Extracts from Austrian legislation, which regulate monitoring, reporting and verification of emissions at plant level

Cement production

BGBl 1993/ 63 Verordnung für Anlagen zur Zementerzeugung

§ 5. Der Betriebsanlageninhaber hat

1. kontinuierliche Messungen der Emissionskonzentrationen an Gesamtstaub, SO_2 und Stickstoffoxiden (berechnet als NO_2) der Ofenanlage entsprechend der Z 1 der Anlage zu dieser Verordnung durchzuführen ...

Zur Durchführung der Messungen gemäß Z 2 und 3 sind Anstalten des Bundes oder eines Bundeslandes, staatlich autorisierte Anstalten, Ziviltechniker oder Gewerbebetreibende, jeweils im Rahmen ihrer Befugnisse, heranzuziehen.

§ 6 Die Ergebnisse der Messungen gemäß § 5 sind in einem Messbericht festzuhalten, welcher

1. bei Messungen gemäß § 5 Z 1 die Messwerte in Form von Aufzeichnungen eines kontinuierlich registrierenden Messgerätes und die gemäß § 4 Abs. 1 zu führenden Aufzeichnungen über Grenzwertüberschreitungen, zu enthalten hat. Der Messbericht ist mindestens fünf Jahre in der Betriebsanlage derart aufzubewahren, dass er den behördlichen Organen jederzeit zur Einsicht vorgewiesen werden kann.

Anlage

(§ 5)

Emissionsmessungen

1. Kontinuierliche Messungen

a) Die Datenaufzeichnung hat durch automatisch registrierende Messgeräte in Form von Halbstundenmittelwerten unter Angabe von Datum, Uhrzeit und Messstelle zu erfolgen. Die Verfügbarkeit der Daten hat mindestens 90 % zu betragen. Als Bezugszeitraum gilt ein Monat.

b) Registrierende Emissionsmessgeräte sind im Abnahmeversuch und alle drei Jahre durch einen Sachverständigen aus dem im § 5 letzter Satz angeführten Personenkreis zu kalibrieren.

c) Jährlich ist eine Funktionskontrolle an registrierenden Emissionsmessgeräten durch Sachverständige aus dem im § 5 letzter Satz angeführten Personenkreis vorzunehmen.

Foundries

BGBl 1994/ 447 Verordnung für Gießereien

§ 5 (1) Der Betriebsanlageninhaber hat Einzelmessungen der Emissionskonzentration der im § 3 Abs. 1 angeführten Stoffe entsprechend der Z 1 lit. A bis c der Anlage 2 dieser Verordnung in regelmäßigen, drei Jahre nicht übersteigenden Zeitabständen durchführen zu lassen (wiederkehrende Emissionsmessungen).

(2) Der Betriebsanlageninhaber hat kontinuierliche Messungen der Emissionskonzentrationen ... entsprechend der Z2 der Anlage 2 zu dieser Verordnung durchzuführen.

(3) Zur Durchführung der Messungen gemäß Abs. 1 sowie zur Funktionskontrolle und Kalibrierung von Messgeräten für Messungen gemäß Abs. 2 sind Anstalten des Bundes oder eines Bundeslandes, staatlich autorisierte Anstalten, Ziviltechniker oder Gewerbebetreibende, jeweils im Rahmen ihrer Befugnisse, oder akkreditierte Stellen im Rahmen des fachlichen Umfangs ihrer Akkreditierung (§ 11 Abs. 2 des Akkreditierungsgesetzes, BGBl Nr 468/ 1992) heranzuziehen.

§ 6 Die Ergebnisse der Messungen gemäß § 5 sind in einem Messbericht festzuhalten, welcher

1. bei Messungen gemäß § 5 Abs. 1 die Messwerte und die Betriebsbedingungen während der Messungen (Betriebszustand, Verbrauch an Brennstoff, Rohmaterial und Zuschlagstoffen),

2. bei Messungen gemäß § 5 Abs. 2 die Messwerte in Form von Aufzeichnungen eines kontinuierlich registrierenden Messgerätes und die gemäß § 4 Abs. 2 zu führenden Aufzeichnungen über Grenzwertüberschreitungen, zu enthalten hat. Der Messbericht ist mindestens drei Jahre, bei Messungen gemäß § 5 Abs. 1 jedenfalls bis zur jeweils nächsten Messung, in der Betriebsanlage derart aufzubewahren, dass er den behördlichen Organen jederzeit zur Einsicht vorgewiesen werden kann.

<u>Anlage 2</u>
(§ 5)

Emissionsmessungen

1. Einzelmessungen

a) Einzelmessungen sind für alle im § 3 Abs. 1 angeführten Stoffe bei jenem Betriebzustand durchzuführen, in dem nachweislich die Anlagen vorwiegende betrieben werden. Die Durchführung der Messungen hat nach den Regeln der Technik zu erfolgen.

c) Die Abgasmessungen sind an einer repräsentativen Entnahmestelle im Kanalquerschnitt, die vor Aufnahme der Messungen zu bestimmen ist, vorzunehmen. Es sind innerhalb eines Zeitraumes von drei Stunden drei Messwerte als Halbstundenmittelwerte zu bilden, deren einzelne Ergebnisse zu beurteilen sind.

2. Kontinuierliche Messungen

a) Die Datenaufzeichnung hat durch automatisch registrierende Messgeräte in Form von Halbstundenmittelwerte unter Angabe von Datum, Uhrzeit und Messstelle zu erfolgen. Die Verfügbarkeit der Daten hat mindestens 90 % zu betragen. Als Bezugszeitraum gilt ein Monat.

b) Registrierende Emissionsmessgeräte sind im Abnahmeversuch und alle drei Jahre durch einen Sachverständigen aus dem im § 5 Abs. 3 angeführten Personenkreis zu kalibrieren.

c) Jährlich ist eine Funktionskontrolle an registrierenden Emissionsmessgeräten durch Sachverständige aus dem im § 5 Abs. 3 angeführten Personenkreis vorzunehmen.

Glass production

<u>BGBl 1994/ 498 Verordnung für Anlagen zur Glaserzeugung</u>

§ 5 (2) Zur Kontrolle der Einhaltung der im § 3 festgelegten Emissionsgrenzwerte sind unter Beachtung des § 4 jeweils mindestens drei Messwerte als Halbstundenmittelwerte zu bestimmen.

(4) Die Durchführung der Emissionsmessungen hat nach den Regeln der Technik (z.B. nach den vom Verein deutscher Ingenieure herausgegebenen und beim Österreichischen 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.

<u>Anlage</u>

(§ 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

<u>BGBl II 1997/ 163 Verordnung für Anlagen zum Sintern von Eisenerzen</u>

§ 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.

Umweltbundesamt GmbH
Spittelauer Lände 5
1090 Wien/Österreich

Tel.: +43-(0)1-313 04
Fax: +43-(0)1-313 04/5400

office@umweltbundesamt.at
www.umweltbundesamt.at

In the Informative Inventory Report (IIR) 2011 the Umweltbundesamt presents a comprehensive and detailed method description of the Austrian air emission inventory (Österreichische Luftschadstoff-Inventur – 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) and
- particulate matter (TSP, PM10, PM2.5)

The Austrian air emission inventory covers also air pollutant groups such as

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

With the Informative Inventory Report 2011, Austria provides documentation as required for reporting under the UNECE Convention on Long-range Transboundary Air Pollution (LRTAP).

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