umweltbundesamt

AUSTRIA'S INFORMATIVE INVENTORY REPORT (IIR) 2007

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

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Project management

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This report was prepared on behalf of the Austrian *Federal Ministry of Agriculture, Forestry, Environment and Water Management.*

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EXECUTIVE SUMMARY

This report provides a complete and comprehensive description of the methodologies used for the compilation of Austrian's Air Emission Inventory as presented in Austria's 2007 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 Convention Austria is required to annually report data on emissions of air pollutants covered in the Convention and its Protocols: these are the 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 2002 the Executive Body adopted guidelines for estimating and reporting of emission data which are necessary to ensure that the transparency, consistency, comparability, completeness and accuracy of reported emissions are adequate for current CLRTAP requirements (EB.AIR/GE.1/2002/7 and its supporting addendum).

The guidelines offer guidance on how to provide supporting documentation within the new reporting format (Nomenclature For Reporting NFR) and give information on the level of required reporting detail and on minimum and additional reporting obligations. Furthermore they ask parties to provide an Informative Inventory Report (IIR) containing detailed and complete information on the compilation of their emission inventories in order to ensure the transparency of the inventory.

This year, Austria provides the Informative Inventory Report at hand for the forth time. The structure of this report follows closely the structure of Austria's National Inventory Report (NIR) submitted annually under the United Nations Framework Convention on Climate Change (UNFCCC) which includes a complete and comprehensive description of methodologies used for compilation of Austria's greenhouse gas inventory[1].

The first chapter of this report provides general information on the institutional arrangements for inventory preparation, on the inventory preparation process itself and on QA/QC activities. Chapter 2 gives information on reduction or stabilization targets as set out in the Protocols to the Convention compared to actual trends. The third chapter presents major changes to the previous submission (emission data report 2006 under 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.

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1 UMWELTBUNDESAMT (2007): Austria's National Inventory Report 2007 – Submission under the United Nations Framework Convention on Climate Change; Wien.

The annex presents inter alia emission data for all pollutants for the year 2005 in the "New Format for Reporting – NFR" as well as trend tables for these gases and for heavy metals, POPs and particulate matter, as included in "Austria's Annual National Air Emissions Inventory 1980–2005. Submission under the Convention on Long-range Transboundary Air Pollution (CLRTAP)".

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

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

Specific responsibilities for the IIR 2007 have been as follows:

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1 INTRODUCTION

1.1 Institutional Arrangement for Inventory Preparation

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

Umweltbundesamt, as the federal environment agency in Austria, has been designated as single national entity responsible for the preparation of the annual air pollutant inventory by law. The Environmental Control Act[2] regulates responsibilities of environmental control in Austria and lists the tasks of the Umweltbundesamt. One task is to provide technical expertise and the data basis for the fulfilment of the emission related reporting obligations under the UNECE LRTAP Convention. To that end, the Umweltbundesamt prepares and annually updates the Austrian air emissions inventory („Österreichische Luftschadstoff-Inventur – OLI"), which covers greenhouse gases (GHG) and emissions of other air pollutants as stipulated in the reporting obligations further explained in the following chapters.

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

Within the Umweltbundesamt, the department of air emissions is responsible for the preparation of the inventory and all work related to inventory preparation.

Umweltbundesamt is an ISO 17020 accredited inspection body for Greenhouse Gas Inventories (Id. No. 241) in accordance with the Austrian Accreditation Law (AkkG)[3] by decree of the Minister of Economics and Labour (BMWA), issued on 19.01.2006, valid from 23.12.2005.[4] The requirements of EN ISO/IEC 17020 (Type A) are fulfilled.

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)[5]: 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.

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

[3] 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

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

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

- 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).[6] The Austrian implementation of the European NEC-Directive[7] also entails the obligation for a national emissions inventory of the covered air pollutants NO_x, SO_2, NMVOC and NH_3.
- Austria's annual obligations under the European Council Decision 280/2004/EC ("Monitoring Decision"[8]; replacing Decision 389/1992/EEC amended by Decision 296/1999/EEC) concerning a mechanism for monitoring Community greenhouse gas emissions and for implementing the Kyoto Protocol.
- Austria's obligation under the „United Nations Framework Convention on Climate Change (UNFCCC) (1992)[9] and the Kyoto Protocol (1997)[10].
- Obligation under the Austrian "ambient air quality law"[11] 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)[12]. 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.

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

	Tools of UNECE Convention on Long-range Transboundary Air Pollution (LRTAP)	**Parties**	**entered into force**	**signed/ratified by Austria**
1984	Geneva Protocol on Long-term Financing of the Cooperative Programme for Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe (EMEP)	41	28.01.1988	16.12.1982 (r)
1985	Helsinki Protocol on the Reduction of Sulphur Emissions or their Transboundary Fluxes by at least 30 per cent	22	02.09.1987	09.07.1985 04.06.1987
1988	Sofia Protocol concerning the Control of Nitrogen Oxides or their Transboundary Fluxes	28	14.02.1991	01.11.1988 15.01.1990
1991	Geneva Protocol concerning the Control of Emissions of Volatile Organic Compounds or their Transboundary Fluxes	21	29.09.1997	19.11.1991 23.08.1994
1994	Oslo Protocol on Further Reduction of Sulphur Emissions	25	05.08.1998	14.06.1994 27.08.1998

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

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

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

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

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

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

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

	Tools of UNECE Convention on Long-range Transboundary Air Pollution (LRTAP)	Parties	entered into force	signed/ratified by Austria
1998	Aarhus Protocol on Heavy Metals	27	29.12.2003	24.06.1998 17.12.2003
1998	Aarhus Protocol on Persistent Organic Pollutants (POPs)	23	23.10.2003	24.06.1998 27.08.2002
1999	The 1999 Gothenburg Protocol to Abate Acidification, Eutrophication and Ground-level Ozone	18	17.05.2005	01.12.1999 (s)

Abbreviation: signed (s)/ratified (r)

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

1.1.2 National Inventory System Austria (NISA)

Regulations under the UNECE/LRTAP Convention and its Protocols define standards for the preparation of and reporting on national emission inventories. In 2002, the Executive Body adopted new guidelines for estimating and reporting emission data to ensure that the transparency, consistency, comparability, completeness and accuracy of reported emissions are adequate for current CLRTAP needs (EB.AIR/GE.1/2002/7[13] and its supporting addendum).

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

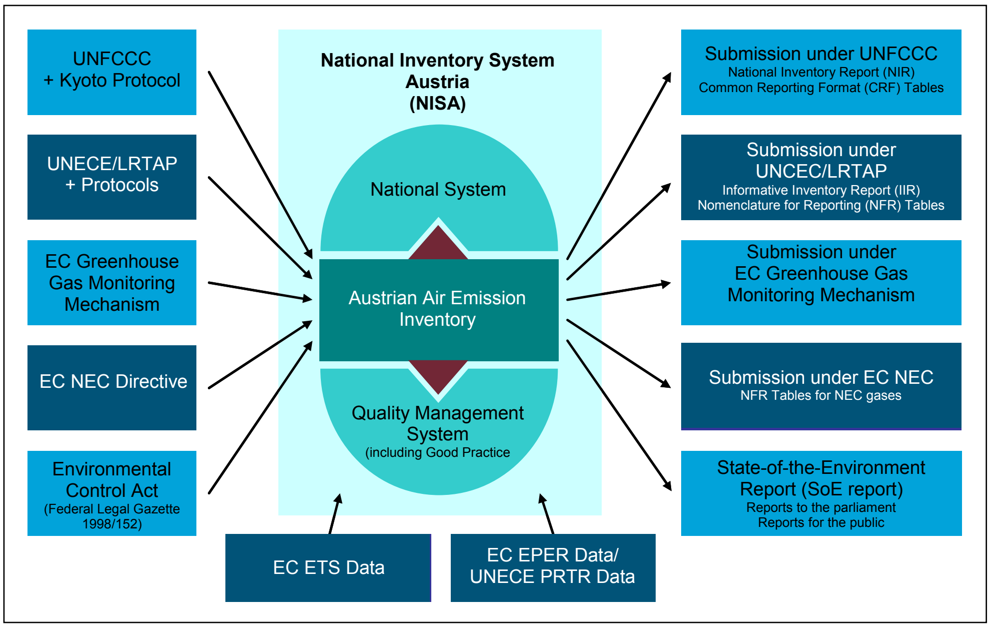
It is designed to comply with the (in general more stringent) standards for national emission inventories under the UNFCCC and the Kyoto Protocol and also meets all the requirements of the LRTAP Convention and other reporting obligations as presented above (chapter 1.1.1).

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

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

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

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



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

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

- Austria established measurements for SO_2 under EMEP in 1978 (Cooperative Programme for Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe) and joined the UNECE in 1983. At that time Austria reported mainly SO_2 emissions.
- As an EFTA country Austria participated in CORINAIR 90, which was an air emission inventory for Europe. It was part of the CORINE[14] work plan set up by the European Council of Ministers in 1985. The aim of CORINAIR 90[15] was to produce a complete, consistent and transparent emission inventory for the pollutants: SO_x as SO_2, NO_x as NO_2, NMVOC, CH_4, CO, CO_2, N_2O and NH_3.
- As a Party to the Convention, Austria signed the UNFCCC on June 8th, 1992 and subsequently submitted its instrument of ratification on February 28th, 1994.[16]
- In 1994 the first so-called Austrian Air Emission Inventory (OLI) was carried out.
- In 1997 emission data were reported for a time period (for each of the years from 1980 to 1995) for the first time.
- In 1998 also emissions of heavy metals, POPs and fluorinated compounds (SF_6, PFCs, HFCs) were included in the inventory.
- Inventory data for particulate matter (PM) were included in the inventory in 2001.

[14] Coordination d'Information Environmentale

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

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

For more details on NISA see the report "NISA – NATIONAL INVENTORY SYSTEM AUSTRIA – Implementation Report" [17] 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)[18].

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

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

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

YEARLY	Components (Minimum and ***additional***)	Reporting years
A. National totals		
1. Main pollutants	SO_x, NO_x, NH_3, NMVOC, CO	from 1980 to 2005
2. Particulate matter	PM2,5, PM10, TSP	for 1990, 1995, and for 1999 to 2005
3. Heavy metals	Pb, Cd, Hg, *As, Cr, Cu, Ni, Se, Zn*	from 1990 to 2005
4. POPs	aldrin, chlordane, chlordecone, DDT, dieldrin, endrin, heptachlor, hexachlorobenzene (HCB), mirex, toxaphene, hexachlor-ocyclohexane (HCH), hexabromobiphenyl, polychlorinated biphenyls (PCBs), dioxins/furans (PCDD/F), polycyclic aromatic hydrocarbons (PAHs), short-chain chlorinated paraffins (SCCP), pentachlorophenol (PCP)	from 1990 to 2005
B. Sector emissions		
1. Main pollutants	SO_x, NO_x, NH_3, NMVOC, CO	from 1980 to 2005
2. Particulate matter	PM2,5, PM10, TSP	for 1990, 1995, and for 1999 to 2005
3. Heavy metals	Pb, Cd, Hg, *As, Cr, Cu, Ni, Se, Zn*	from 1990 to 2005
4. POPs	aldrin, chlordane, chlordecone, DDT, dieldrin, endrin, heptachlor, HCB, mirex, toxaphene, HCH, hexabromobiphenyl, PCBs, PCDD/F, PAHs, SCCP, PCP	from 1990 to 2005

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

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

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

5-YEARLY: MINIMUM REPORTING		
C. Gridded data in the EMEP 50x50 km² grid		
1. National totals	Main pollutants, PM, Pb, Cd, Hg, PAHs, HCB, dioxins/furans	1990, 1995, 2000, 2005 (PM: 2000)
2. Sector emissions		
D. Emissions from large point sources		
	Main pollutants, HM, PCDD/F, PAH, HCB, PM	2000, 2005
E. Historical and Projected activity data and projected national total emissions		
1. National total emissions	See table IV 2A in EB/AIR/GE.1/2002/7	2010, 2015, 2020
2. Energy consumption	See tables IV 2B, 2C in EB.AIR/GE.1/2002/7	1990, 1995, 2000, 2005, 2010, 2015 and 2020
3. Energy consumption for transport sector	See table IV 2D in EB.AIR/GE.1/2002/7	1990, 1995, 2000, 2005, 2010, 2015 and 2020
4. Agricultural activity	See table IV 2E in EB.AIR/GE.1/2002/7	1990, 1995, 2000, 2005, 2010, 2015 and 2020
5-YEARLY: ADDITIONAL REPORTING/FOR REVIEW AND ASSESSMENT PURPOSES		
VOC speciation/Height distribution/Temporal distribution	Parties are encouraged to review the information used for modelling at the Meteorological Synthesizing Centres available for review at http://webdab.emep.int/ and the Additional Reporting Tables	
Land-use data/Mercury breakdown		
% of toxic congeners of PCDD/F emissions		
Pre-1990 emissions of PAHs, HCB, PCDD/F and PCB		
Information on natural emissions		

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

- the EMEP/CORINAIR Emission Inventory Guidebook – 2005, Technical report No 30[19]
- the EEA core set of indicators – Guide, Technical report No 1/2005[20]
- the Recommendations for Revised Data Systems for Air Emission Inventories, Topic report No 12/1996[21]
- the Guidance Report on preliminary assessment under EC air quality directives, Technical report No 11[22].

as well as other internationally applied methodologies and guidelines including:

- Integrated Pollution Prevention and Control (IPPC)[23] and European Pollutant Emission Register (EPER)[24]
- IPPC Best Available Techniques Reference Documents[25]

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[19] and previous editions: EMEP/CORINAIR Emission Inventory Guidebook – 3rd edition October 2002 UPDATE (http://reports.eea.eu.int/EMEPCORINAIR3/en)

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

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

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

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

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

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

- Guidelines for Emission Inventory Reporting from the Large Combustion Plant Directive[26]
- Organization for Economic Co-operation and Development (OECD) and Pollution Release and Transfer Register (PRTR) Guidance[27]
- Revised 1996 Intergovernmental Panel on Climate Change (IPCC) Guidelines for National Greenhouse Gas Inventories[28] and the IPCC Good Practice Guidance[29].

1.2 Inventory Preparation Process

The present Austrian Air Pollutant Inventory for the period 1980 to 2005 was compiled according to the recommendations for inventories as set out by the UN ECE Executive Body in the guidelines mentioned above.

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

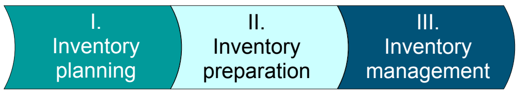

Figure 2: Three stages of inventory preparation.

I. Inventory planning

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

Inventory planning also includes planning of how to distribute available resources, and thus, as resources are limited, also includes a prioritization of planned improvements. Considerations on which part of the inventory (in terms of pollutants and/or sectors) to focus efforts to improve the inventory include political or public awareness due to current environmental problems or emission reduction limits that are hard to meet. A tool to prioritize between sectors within the inventory is the key source analysis, where efforts are focused on important sources/sectors in terms of emissions, trends or concerning the influence on the overall quality of the inventory.

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

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

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

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

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

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

Emissions of air pollutants are estimated together with greenhouse gases in a single data base based on the CORINAIR[30] systematic, which was formerly also used as reporting format under the UNECE. This nomenclature was designed by the ETC/AE (European Topic Centre on Air Emissions) to estimate emissions of all kind of air pollutants as well as greenhouse gases.

The CORINAIR system's nomenclature is called SNAP[31], which may be expanded to adapt to national circumstances by so-called SPLIT codes, and additionally each SNAP/SPLIT category can be extended using a fuel code.

II. Inventory preparation

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

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

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

As mentioned above, the Austrian Inventory is based on the SNAP systematic, and has to be transformed into the current reporting format under the LRTAP Convention – the NFR[32] 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.

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[30] 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)

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

[32] **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

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

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

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

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

Sector	Data Sources for Activity Data	Emission Calculation
Energy	• energy balance[33] from STATISTICS AUSTRIA • steam boiler data base[34] administrated by Umweltbundesamt • data from industry[35] • national studies	Umweltbundesamt, plant operators
Industry	• national production statistics • import/export statistics from STATISTICS AUSTRIA • direct information from industry • direct information from associations of industry	Umweltbundesamt, plant operators
Solvent and Other Product Use	• production statistics • consumption statistics • import/export statistics } from STATISTICS AUSTRIA	Contractors: Forschungsinstitut für Energie u. Umweltplanung, Wirtschaft und Marktanalysen/Institut für industrielle Ökologie (IIÖ)[36]
Agriculture	• national agricultural statistics „Grüner Bericht" from STATISTICS AUSTRIA • national report on water protection „Gewässerschutzbericht" from LEBENSMINISTERIUM[37] • national studies • direct information from agricultural association	Contractors: University of Natural Resources and Applied Life Sciences, Research Center Seibersdorf, Austria
Waste	• database on landfills administrated by Umweltbundesamt • National reports from STATISTICS AUSTRIA • sewage plant inventory administrated by Umweltbundesamt • national report on water protection „Gewässerschutz bericht" from LEBENSMINISTERIUM[37]	Umweltbundesamt

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

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

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

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

[37] www.lebensministerium.at

1.3.1 Main Data Suppliers

STATISTICS AUSTRIA

- The main data supplier for the Austrian air emission inventory is STATISTICS AUSTRIA[38], which provides the underlying energy data. The Austrian energy balances are based on several databases mainly prepared by the Ministry of Economic Affairs and Labour[39], „Bundeslastverteiler" and STATISTICS AUSTRIA. Their methodology follows the International Energy Agency (IEA)[40] and Eurostat[41] conventions. The aggregates of the balances, for example transformation input and output or final energy use, are harmonised with the IEA tables as well as their sectoral breakdown which follows the NACE[42] classification.
- Activity data for some sources is obtained from STATISTICS AUSTRIA which provides statistics on production data[43]. The methodology of the statistics changed in 1996, no data is available for that year and there are some product groups that are not reported anymore in the new statistics.
- Activity data needed for the calculation of non energetic emissions are based on several statistics collected by STATISTICS AUSTRIA and national and international studies.
- Activity data for Solvent and Other Product Use are based on import/export statistics also prepared by STATISTICS AUSTRIA.

INFORMATION FROM INDUSTRY

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

DATABASES

- Operators of steam boilers with more than 50 MW report their NO_x, SO_2, CO and TSP emissions and their activity data directly to the steam boiler data base administrated by the Umweltbundesamt (see Table 4).
- Operators of landfill sites also report their activity data directly to Umweltbundesamt. Emissions for the years 1998–2005 are calculated on the basis of these data.

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[38] www.statistik.at

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

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

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

[42] Classification of Economic Activities in the European Community

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

- EPER: The European Pollutant Emission Register (EPER) is the first Europe-wide register for emissions from industrial facilities both to air and to water. The legal basis of EPER is Article 15 of the IPPC Directive (EPER Decision 2000/479/EG)[44], the scope is to provide information to the public[45].

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

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

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

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

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

LITERATURE

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

Studies on HM, POPs and PM emissions

Emissions of HM and some POPs have already been estimated in the course of CORINAIR 1990 and 1994, respectively[46]. 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.

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

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

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

- (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.

1.3.2 Summary of methodologies applied for estimating emissions

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

The following abbreviations are used:

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

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

Table 5: Summary of methodologies applied for estimating emissions.

		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

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

1.4 Key Source Analysis

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

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

However, quantitative uncertainties for the current inventory have not been assessed (for further information see Chapter 1.6). A simplified approach is to only analyse absolute emission levels, and according to the GPG for GHG inventories this quantitative approach is a so-called Tier 1 analysis, the "level assessment"[47].

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

Level Assessment

For the level assessment the contribution from each source (fraction of total emission) is listed and ranked until 95% of the total emission is accounted for. The analysis was made for the last year of the inventory (2005).

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

Identification of Source Categories

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

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

After an initial analysis at a high level of aggregation further splits were made for categories that contributed significantly to total emissions of one pollutant, but only if the methodologies for the sub-sources are not the same (e.g. Solvent and Other

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

Product Use the methodology for NMVOC emissions uses the same input data for all sub-sources, and the input data are dependant on each other, which is why no further dissaggregation was made).

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

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

1 A Combustion Activities

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

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

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

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

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

Figure 3: Disaggregation used for 1 A Combustion Activities.

1 B Fugitive Emissions

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

2 Industrial Processes

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

3 Solvent and Other Product Use

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

4 Agriculture

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

6 Waste

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

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

Results of the Level Assessment

As the analysis was made for all different pollutants reported to the UNECE and as these pollutants differ in their way of formation, most of the identified categories are key for one pollutant or more: as in last year's analysis, 33 key sources were identified. The results of the analysis are presented in Table 8.

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

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

1.5 Quality Assurance and Quality Control (QA/QC)

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

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

The *Department of Air Emissions* of the Umweltbundesamt has decided to implement a QMS based on the International Standard ISO 17020 *General Criteria for the operation of various types of bodies performing inspections*[48]. 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[49].

The QMS was fully implemented by the end of 2003, and the accreditation audit of the *Department for Air Emissions* as inspection body took place in autumn 2005. In January 2006, the official notification concerning the accreditation for greenhouse gases of the *Department for Air Emissions* was received.[50/51]

QA/QC Activities

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

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

- inventory preparation/data collection (performed by sector experts):
  - checking if applied methodology is applicable or if any comments have been made e.g. by the review team, incorporating last year's planned improvements;
  - transparent and comprehensible documenting and archiving that allows reproduction of the inventory.
- data processing (performed by data manager):
  - electronic checks to screen for incomplete estimates and calculation errors;
  - visual checks to screen for time series consistency.

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

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

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

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

- preparation of inventory report (performed by sector experts):
  - check for transcription errors by comparison of data in reporting format with data/information in the inventory database;
  - check for plausibility of estimates by comparison with previous estimates using automatically produced data sheets showing recalculation differences.

1.6 Uncertainty Assessment

So far, no quantitative uncertainty assessment for any of the pollutants or pollutant groups relevant for this report has been made. For GHGs a comprehensive uncertainty assessment has already been performed.[51]

However, the quality of estimates for all relevant pollutants has been rated using qualitative indicators as suggested in Chapter "GPG for CLRTAP emission inventories" of the EMEP/CORINAIR Guidebook. The definition of the ratings is given in Table 6, the ratings for the emission estimates are presented in Table 9.

Table 6: Definitions of qualitative rating.

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

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

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

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

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

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

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

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

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

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

QI…weighed quality indicator

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

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

Table 7: Variation of total emissions ("uncertainty") of HM and POP emissions.

Uncertainty[52]	**1999**		**2000**		
	Emission [kg]	**Variation**		**Emission [t]**	**Variation**
Dioxin/Furan	0.18	0.08–0.4	Cd	0.97	0.5–2.1
HCB	47	20–130	Hg	0.88	0.5–1.7
PAHs	28 000	10 000–80 000	Pb	12.4	6.0–26

[52] 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 8: Level Assessment for the year 2005.

Level Assessment 2005		SO_2	NO_x	NMVOC	NH_3	CO	Cd	Hg	Pb	PAH	Diox	HCB	TSP	PM10	PM2.5
		[%]													
1 A 1 a	**Public Electricity & Heat Production**	**13.4**	**4.0**	0.8	0.3	0.4	**7.4**	**19.2**	**8.3**	0.1	1.5	0.6	0.9	**1.7**	**2.6**
1 A 1 b	**Petroleum refining**	**12.7**	**1.4**		0.1	0.1	**16.6**	0.9	1.8	0.0	0.0	0.0	0.1	0.2	0.3
1 A 1 c	Manufacture of Solid fuels and Other Energy Industries	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1 A 2 mobile	**Other mobile in industry**	0.1	**5.0**	**1.2**	0.0	**1.8**	**5.6**	**8.0**	**14.3**	1.4	**11.7**	**2.5**	**2.8**	**5.3**	**8.2**
1 A 2 stat (l)	**Manuf. Ind. and Constr. stationary LIQUID**	**11.6**	**2.2**	0.1	0.1	0.6	**6.4**	**5.3**	**4.2**	0.0	0.0	0.1	0.0	0.0	0.0
1 A 2 stat (s)	**Manuf. Ind. and Constr. stationary SOLID**	**17.8**	**2.7**	0.2	0.0	**18.8**	0.2	**7.9**	0.3	0.1	0.0	0.1	0.0	0.0	0.0
1 A 2 stat (g)	**Manuf. Ind. and Constr. stationary GASEOUS**	0.4	**3.4**	0.0	0.2	0.5	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0
1 A 2 stat (b)	**Manuf. Ind. and Constr. stationary BIOMASS**	**2.5**	**1.3**	0.1	0.2	0.3	**4.5**	**3.2**	**3.1**	0.4	0.0	0.4	0.0	0.0	0.0
1 A 2 stat (o)	**Manuf. Ind. and Constr. stationary OTHER**	**2.3**	0.7	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1 A 3 a	Civil Aviation	0.3	0.3	0.2	0.0	0.4	0.0	0.0	0.0				0.1	0.2	0.3
1 A 3 b 1	**R.T., Passenger cars**	0.3	**15.3**	**5.9**	**1.7**	**17.3**	0.3	0.1	0.1	**7.3**	1.0	0.2	**2.1**	**4.2**	**7.4**
1 A 3 b 2	**R.T., Light duty vehicles**	0.0	**2.4**	0.4	0.0	0.7	0.0	0.0	0.0	**1.8**	0.3	0.1	0.8	1.5	**2.6**
1 A 3 b 3	**R.T., Heavy duty vehicles**	0.3	**40.4**	**2.9**	0.1	**2.3**	0.2	0.1	0.0	**8.3**	**1.5**	0.3	**2.3**	**4.5**	**7.9**
1 A 3 b 4	**R.T., Mopeds & Motorcycles**	0.0	0.1	**1.1**	0.0	**1.5**	0.0	0.0	0.0	0.4	0.0	0.0	0.0	0.0	0.0
1 A 3 b 5	**R.T., Gasoline evaporation**			**2.5**											
1 A 3 b 6	**R.T., Automobile tyre& break wear**						**7.1**						**12.3**	**8.2**	**9.3**
1 A 3 c	Railways	0.2	0.6	0.1	0.0	0.1	0.0	0.0	0.0	0.2	0.0	0.0	1.8	1.3	0.8
1 A 3 d	Navigation	0.1	0.3	0.4	0.0	0.4	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.1	0.2
1 A 3 e	Other		0.7	0.0	0.0	0.0						0.0	0.0	0.0	0.0
1 A 4 mob	**Other Sectors – mobile**	0.2	**8.1**	**5.6**	0.0	**5.5**	0.0	0.0	0.0	**1.8**	**74.8**	0.1	**11.7**	**21.6**	**34.5**
1 A 4 stat (l)	**Other Sectors stationary LIQUID BIOMASS**	**17.4**	**2.0**	0.1	0.4	**0.9**	0.2	0.1	0.0	0.3	0.0	0.0	0.0	0.0	0.0

Level Assessment 2005		SO_2	NO_x	NMVOC	NH_3	CO	Cd	Hg	Pb	PAH	Diox	HCB	TSP	PM10	PM2.5
		[%]													
1 A 4 stat (s)	**Other Sectors stationary SOLID**	**11.3**	0.2	**1.2**	0.0	**3.4**	2.3	**6.5**	**3.8**	**3.4**	0.0	**7.4**	0.0	0.0	0.0
1 A 4 stat (g)	**Other Sectors stationary GASEOUS**	0.0	**1.7**	0.0	0.2	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1 A 4 stat (b)	**Other Sectors stationary BIOMASS**	**3.2**	**3.7**	**21.5**	0.6	**40.1**	**27.9**	**15.1**	**15.4**	**69.3**	0.1	**79.4**	0.0	0.0	0.0
1 A 4 stat (o)	Other Sectors stationary OTHER	0.3	0.0	0.0	0.0	0.0	0.4	0.1	0.3	0.2	0.0	0.4	0.0	0.0	0.0
1 A 5	Other	0.1	0.1	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.2
1 B	**FUGITIVE EMISSIONS FROM FUELS**	0.5		**2.0**									0.7	0.6	0.3
2 A	**MINERAL PRODUCTS**					**1.4**							**26.3**	**25.4**	**13.8**
2 B	**CHEMICAL INDUSTRY**	**2.9**	0.3	0.9	0.1	**1.5**	0.1	0.0	0.0				0.5	0.6	0.5
2 C	**METAL PRODUCTION**	1.7	0.0	0.3		0.4	**20.2**	**31.2**	**47.8**	**2.0**	**8.0**	**8.1**	**2.5**	**3.5**	**2.7**
2 D	**OTHER PRODUCTION**		0.3	**1.7**		0.1				0.4	0.3	0.1	0.0	0.0	0.0
2 G	OTHER				0.0										
3	**SOLVENT AND OTHER PRODUCT USE**			**49.2**			0.0		0.2						
4 B 1	**Cattle**				**57.3**										
4 B 3	**Sheep**				**1.3**										
4 B 4	Goats				0.2										
4 B 6	Horses				1.1										
4 B 8	**Swine**				**14.7**										
4 B 9	**Poultry**				**8.1**										
4 B-13	Other				0.2										
4 D	**AGRICULTURAL SOILS**		**2.3**	**1.1**	**11.5**								**30.1**	**12.7**	**5.2**
4 F	**FIELD BURNING OF AGRICULTURAL RESIDUES**	0.0	0.0	0.1	0.1	0.2	0.2	0.0	0.1	**2.3**	0.4	0.1			
4 G	**Agriculture – Other**												**4.7**	**7.9**	**3.0**
6	**WASTE**	0.2	0.0	0.1	**1.6**	**0.9**	0.1	2.1	0.1	0.0	0.4	0.1	0.2	0.2	0.1

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

Table 9: Quality of emission estimates.

		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

		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 6;
(dark shaded cells indicate that no such emissions arise from this source, light shaded cells (green) indicate that source is a key source for this pollutant)

1.7 Completeness

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

Geographic Coverage

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

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

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

In reports to the UNECE/LRTAP, emissions from mobile sources are reported on the basis of fuel sold. Emissions from 'fuel tourism' are therefore included in the Austrian Total.[53]

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 1980–2005 for the main pollutants, from 1985 onwards for POPs and HMs and for the years 1990, 1995 and from 2000 onwards for PM.

Sources

Notation keys are used according to the Guidelines for Estimating and Reporting Emission Data under LRTAP (UNECE 2003 – see Table 10)[54] to indicate where emissions are not occurring in Austria, where emissions have not been estimated or have been included elsewhere as suggested by EMEP/CORINAIR. The main reason for different allocations to categories are the allocation in national statistics, insufficient information on the national statistics, national methods, and the impossibility to disaggregate emission declarations; explanations for each the case is given in the NFR-Table IV 1 F1–F4.

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

[54] AIR POLLUTION STUDIES No. 15

Table 10: Notation keys used in the NFR.

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

2 TREND IN TOTAL EMISSIONS

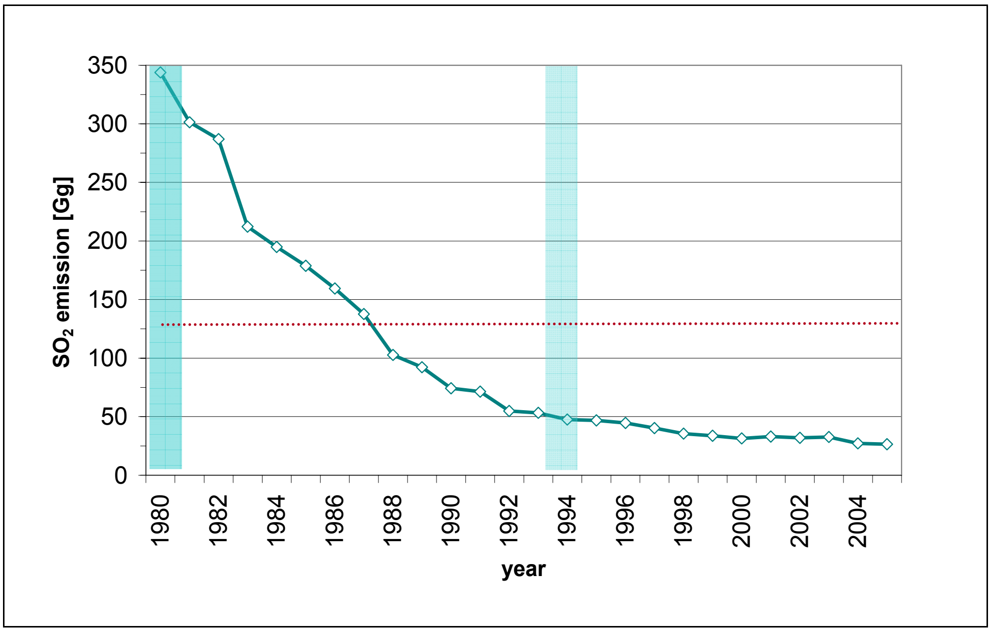
2.1 Emission Targets

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

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

The Protocol to the UNECE/LRTAP Convention on the Reduction of Sulphur Emissions or their Transboundary Fluxes by at least 30 per cent entered into force in 1987. The base year to the protocol was 1980 and the reduction target should have been met by 1993.

Figure 4: SO_2 emissions in Austria 1980–2005.



Twenty-two ECE countries are Parties to this Protocol; all Parties have reached the reduction target. Taken as a whole, the 22 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).

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 2005, SO_2 emissions in Austria amounted to 26 Gg, which is a decrease by 92% compared to 1980. This reduction could be archieved mainly due to lower emissions from residential heating, combustion in industries and energy industries.

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

This Protocol requires freezing emissions of nitrogen oxides or their transboundary fluxes. The general reference year is 1987 (with the exception of the United States that chose to relate its emission target to 1978).

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 (or in the case of the United States 1978) levels or reduced emissions below that level according to the latest emission data reported.

Austria was successful in fulfilling the stabilisation target set out in the Protocol: NO_x emissions decreased steadily from the base year 1987 until the mid-1990s and remained quite stable with only minor fluctuations until 2000. However, since then emissions have been increasing again, in 2003 emissions even slightly exceeded 1987 levels. The main reason for the increase of NO_x emissions are strongly increasing emissions from heavy duty vehicles, which is mainly caused by 'fuel tourism'.

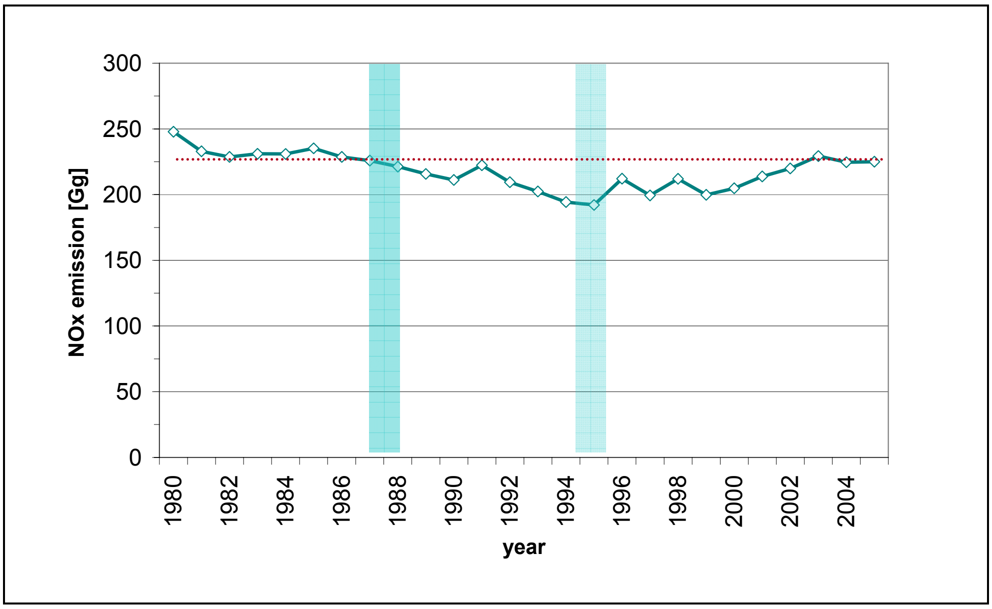


Figure 5: NO_x emissions in Austria 1980–2005.

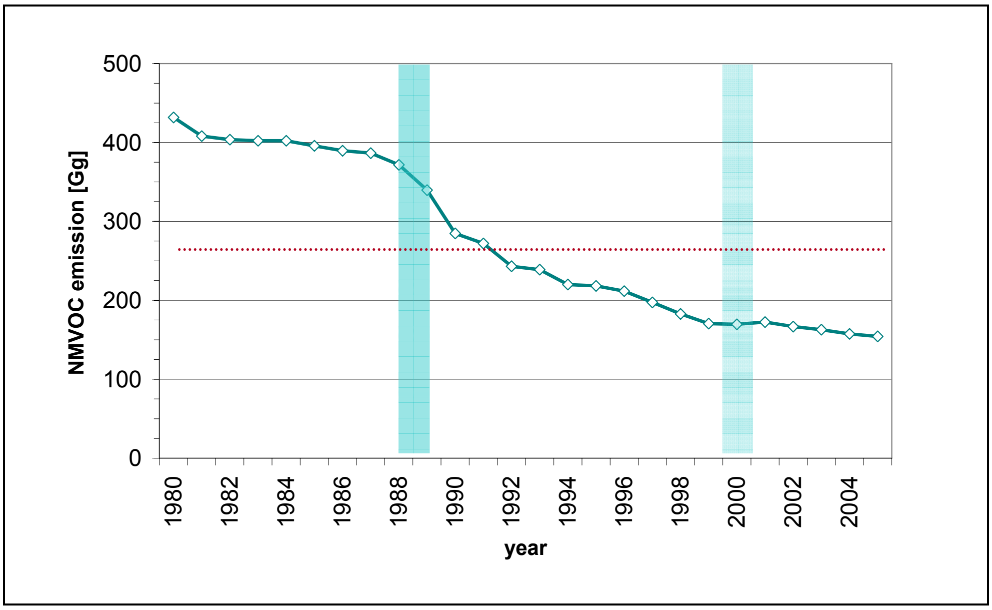
Austrian NO_x emissions in the base year under this Protocol amounted to 226 Gg, by the year 1995 emissions were reduced to 192 Gg corresponding to a reduction of 15%. In 2005, NO_x emissions in Austria amounted to 225 Gg, which is a decrease by 0.4% compared to 1987.[55]

[55] 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 2005 based on fuel used amount to 159 Gg, which is about 29% less (see Chapter 1.7 Completeness for more information regarding 'fuel tourism', Austria's emissions based on fuel used – thus excluding 'fuel tourism' – are presented in Table 1 in the Annex).

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 (other than methane – NMVOC) or their Transboundary Fluxes, the second major air pollutant responsible for the formation of ground level ozone, was adopted. The protocol entered into force on 29th of September 1997.

Figure 6: NMVOC emissions in Austria 1980–2005.



This Protocol specifies three options for emission reduction targets that have to be chosen upon signature or upon ratification. Austria opted for a reduction of its emissions of non-methane volatile organic compounds (NMVOC) by 30% by 1999 using the year 1988 as a basis.

Austria met the reduction target: in the base year NMVOC emissions amounted to 372 Gg, in 1999 emissions were reduced by 54% to 171 Gg. From 1999 to 2005 a further reduction of 10% (154 Gg) can be noted.

2.1.4 The 1998 Aarhus Protocol on Heavy Metals

The Executive Body adopted the Protocol on Heavy Metals on 24th June 1998 in Aarhus (Denmark). 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 24th June 1998 in Aarhus (Denmark). It entered into force on 23rd 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 outright the production and use of some products (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.

The Protocol obliges Parties to reduce their emissions of dioxins, furans, PAHs and HCB below their levels in 1990 or an alternative year between 1985 and 1995. It determines specific upper limits for the incineration of municipal, hazardous and medical waste.

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

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 30th November 1999.

The Protocol sets emission ceilings for 2010 for four pollutants: sulphur, NO_x, NMVOC and ammonia. These ceilings were negotiated on the basis of scientific assessments of pollution effects and abatement options. Parties where emissions have a more severe environmental or health impact and where 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 NMVOC emissions by 40% and its ammonia emissions by 17% compared to 1990.

The Protocol also sets tight limit values for specific emission sources and requires best available techniques to be used to keep emissions down. NMVOC 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.

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

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

Table 11 and Figure 7 show national total emissions and trends (1990–2005) as well as emission targets[56] for air pollutants covered by the Multi-Effect Protocol.

Please note that emissions from mobile sources are calculated based on fuel sold in Austria, thus national total emissions include 'fuel tourism'.[57]

Figure 7: Emission trends and reduction targets for air pollutants covered under the Multi-Effect Protocol and CO.

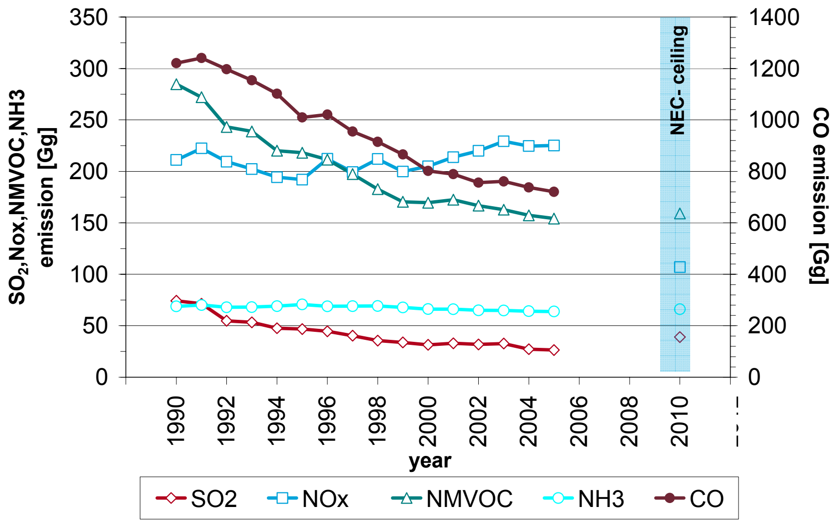


Table 11: National total emissions and trends 1990–2005 as well as emission targets for air pollutants covered by the Multi-Effect Protocol and CO.

Year	Emission [Gg]				
	SO_2	NO_x	NMVOC	NH_3	CO
1990	74.22	211.07	284.74	68.81	1 220.77
1991	71.35	222.34	271.99	70.19	1 241.05
1992	54.91	209.44	243.21	67.91	1 196.97
1993	53.32	202.33	238.79	68.06	1 154.12
1994	47.56	194.36	220.02	69.10	1 101.71
1995	46.81	192.07	218.19	70.68	1 010.05
1996	44.66	212.10	211.50	68.94	1 021.13

[56] 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 CLRTAP Protocol (103 Gg vs. 107 Gg).

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

Year	Emission [Gg]				
	SO_2	NO_x	NMVOC	NH_3	CO
1997	40.35	199.32	197.37	69.10	954.60
1998	35.56	211.98	182.71	69.20	914.85
1999	33.74	199.83	170.47	67.90	865.91
2000	31.41	204.82	169.58	66.24	802.29
2001	33.02	213.78	172.40	66.09	789.35
2002	31.92	219.90	166.68	64.95	755.85
2003	32.63	229.28	162.71	64.90	760.81
2004	27.26	224.63	157.34	64.16	737.35
2005	26.41	225.06	154.14	63.94	720.31
Trend 1990–2005	***-64%***	***7%***	***-46%***	***-7%***	***-41%***
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 2005 emissions were reduced by 64% mainly due to lower emissions from residential heating, combustion in industries and energy industries.

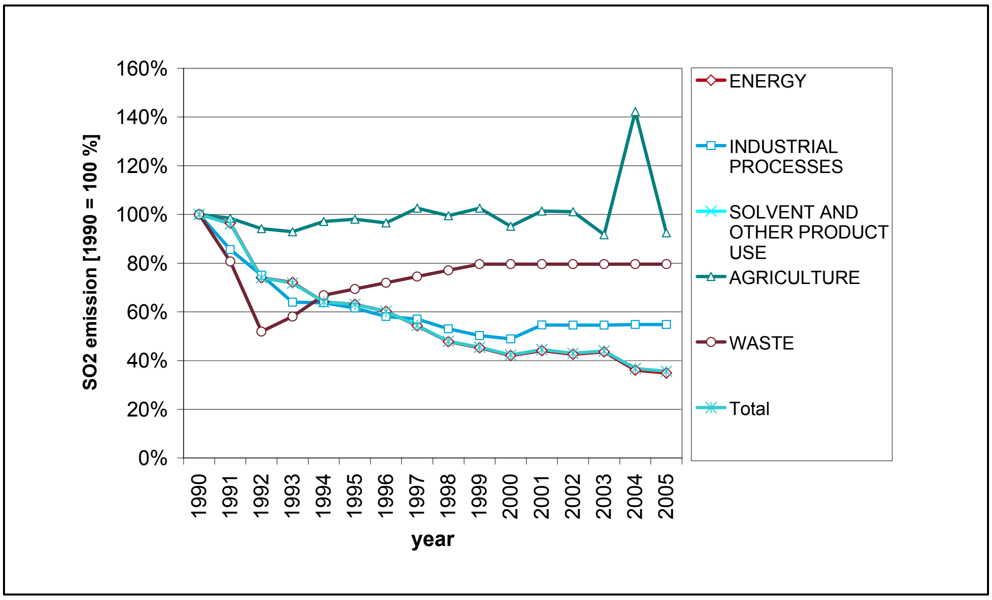


Figure 8: SO_2 emission trend per NFR Category 1990–2005.

As shown in Table 12, the main source for SO_2 emissions in Austria with a share of 94% in 1990 and 95% in 2005 is Category *1 A Fuel Combustion Activities*. Within this source residential heating has the highest contribution to total SO_2 emissions. SO_2 emissions have decreased steadily mainly due to lower emissions from residential heating, combustion in industries and energy industries, mainly caused by a swich from high sulfur fuels (like coal and heavy oil) to fuels with lower sulfur content, and the implementation of desulfurizsation units. The peak of SO_2 emissions in 2004 in Sector *Agriculture* (< 0.01% to national total) is due to a larger area of stubble fields burnt that year.

The 2010 national emission ceiling for SO_2 emissions in Austria as set out in Annex II of the Multi-Effects Protocol is 39 Gg (see Table 11). In 2005 Austrian total SO_2 emissions (26 Gg) were well below the ceiling.

Table 12: SO_2 emissions per NFR Category 1990 and 2005, their trend 1990–2005 and their share in total emissions.

NFR Category		SO_2 Emissions [Gg]		Trend	Share in National Total	
		1990	**2005**	**1990–2005**	**1990**	**2005**
1	Energy	71.92	25.13	-65%	97%	95%
1 A	*Fuel Combustion Activities*	*69.92*	*25.00*	*-64%*	*94%*	*95%*
1 B	*Fugitive Emissions from Fuels*	*2.00*	*0.13*	*-93%*	*3%*	*1%*
2	Industrial Processes	2.22	1.22	-45%	3%	5%
3	Solvent and Other Product Use	NA	NA			
4	Agriculture	< 0.01	< 0.01	-8%	*< 1%*	*< 1%*
6	Waste	0.07	0.06	-20%	*< 1%*	*< 1%*
	National Total	**74.22**	**26.41**	**-64%**	**100%**	**100%**

2.2.2 NO_x Emissions

In 1990, national total NO_x emissions amounted to 212 Gg; emissions were slightly decreasing until the mid-1990 but have been increasing again in the last years: in 2005, they were about 7% above the level of 1990.

As can be seen in Table 13, the main source for NO_x emissions in Austria with a share of 95% in 1990 and 97% in 2005 is *Fuel Combustion Activities.* Within this source *road transport*, with about 60% of national total emissions, has the highest contribution to total NO_x emissions.

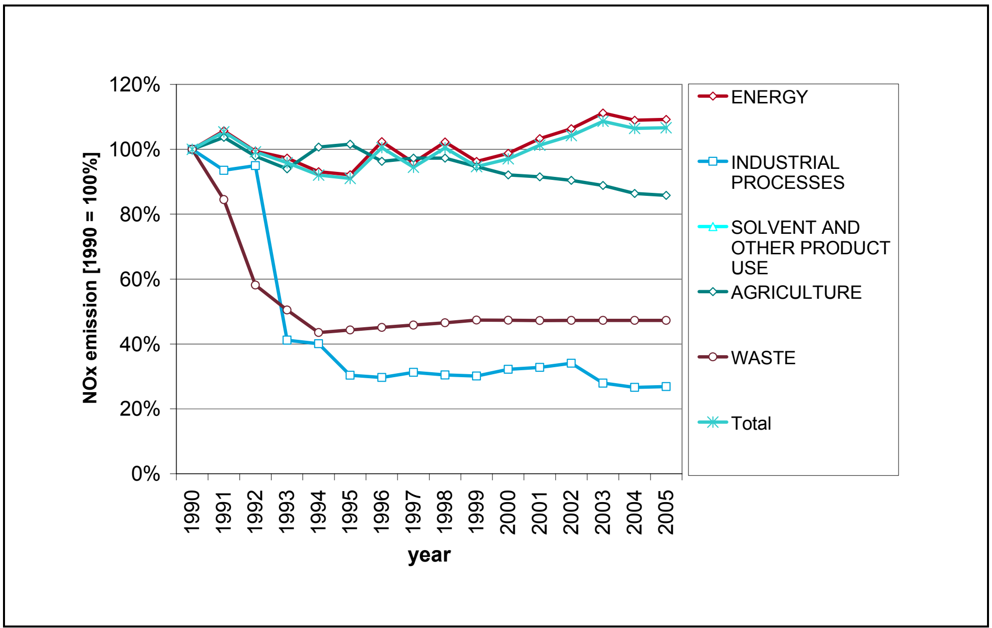


Figure 9: NO_x emission trend per NFR Category 1990–2005.

The 2010 national emission ceiling for NO_x emissions in Austria as set out in Annex II of the Multi-Effects Protocol is 107 Gg (in the European National Emissions Ceiling Directive the national emission ceiling is 103 Gg – see Table 11 and Figure 7). With 225 Gg NO_x emissions in 2005 emissions in Austria are at the moment well above this ceiling.

Please note that emissions from mobile sources are calculated based on fuel sold in Austria, which for the last few years is considerably higher than fuel used: emissions for 2005 based on fuel used amount to 159 Gg, which is about 29% less, but still well above the NEC ceilling.[58]

Table 13: NO_x emissions per NFR Category 1990 and 2005, their trend 1990–2005 and their share in total emissions.

NFR Category		NO_x Emissions [Gg]		Trend	Share in National Total	
		1990	2005	1990–2005	1990	2005
1	Energy	200.09	218.50	9%	95%	97%
1 A	*Fuel Combustion Activities*	*200.09*	*218.50*	*9%*	*95%*	*97%*
1 B	*Fugitive Emissions from Fuels*	*IE*	*IE*			
2	Industrial Processes	4.80	1.29	-73%	2%	1%
3	Solvent and Other Product Use	NA	NA			
4	Agriculture	6.09	5.22	-14%	3%	2%
6	Waste	0.10	0.05	-53%	0%	0%
0	**National Total**	211.07	225.06	7%	100%	100%

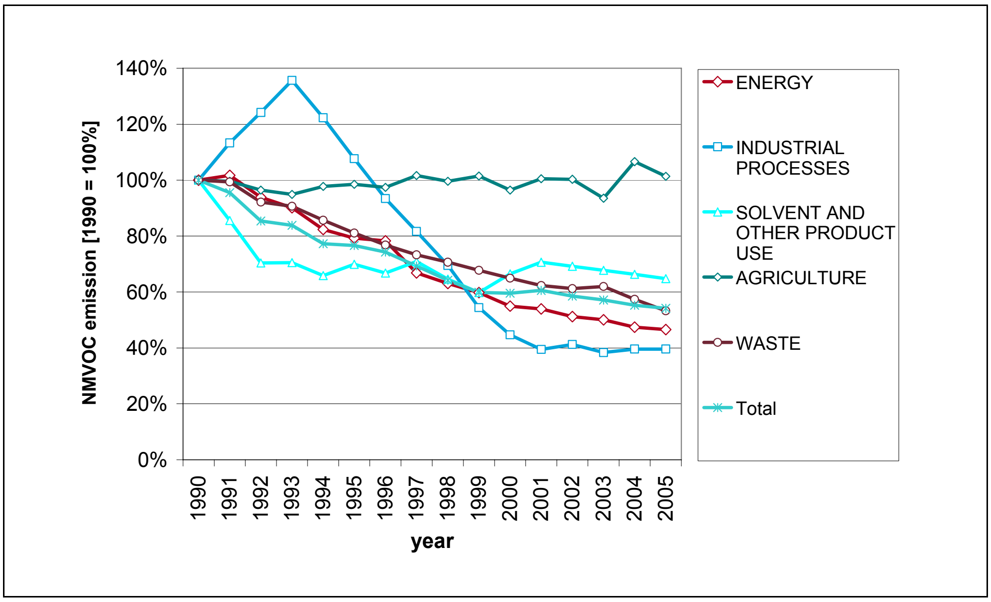
[58] see Chapter 1.7 Completeness for more information regarding 'fuel tourism'; Austria's emissions based on fuel used – thus excluding 'fuel tourism' - are presented in Table 1 in the Annex.

2.2.3 NMVOC Emissions

In 1990 national total NMVOC emissions amounted to 285 Gg; emissions have decreased steadily since then and by the year 2005 emissions were reduced by 46%.

As can be seen in Table 14, the main sources of NMVOC emissions in Austria are *Fuel Combustion Activities* with a share of 50% in 1990 and 45% in 2005, and *Solvent and Other Product Use* with a contribution to the national total of 41% in 1990 and 49% in 2005 respectively.

Figure 10: NMVOC emission trend per NFR Category 1990–2005.



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

The reduction in Sector Solvents is due to legal abatement measures such exhaust systems and aftertreatment.

The national emission ceiling 2010 for NMVOC emissions in Austria as set out in Annex II of the Multi-Effects Protocol is 159 Gg (see Table 11). In 2005 Austria's NMVOC emissions amounted to 154 Gg, and thus were already 3% below this target.

NFR Category		NMVOC Emissions [Gg]		Trend	Share in National Total	
		1990	2005	1990–2005	1990	2005
1	Energy	154.68	72.01	-53%	54%	47%
1 A	*Fuel Combustion Activities*	*142.47*	*68.92*	*-52%*	*50%*	*45%*
1 B	*Fugitive Emissions from Fuels*	*12.22*	*3.09*	*-75%*	*4%*	*2%*
2	Industrial Processes	11.10	4.40	-60%	4%	3%
3	Solvent and Other Product Use	116.95	75.77	-35%	41%	49%
4	Agriculture	1.85	1.87	1%	1%	1%
6	Waste	0.16	0.09	-47%	0%	0%
0	**National Total**	**284.74**	**154.14**	**-46%**	**100%**	**100%**

Table 14: NMVOC emissions per NFR Category 1990 and 2005, their trend 1990–2005 and their share in total emissions.

2.2.4 NH_3 Emissions

In 1990, national total NH_3 emissions amounted to 69 Gg; emissions have slightly decreased over the period from 1990 to 2005, in 2005 emissions were 7% below 1990 levels.

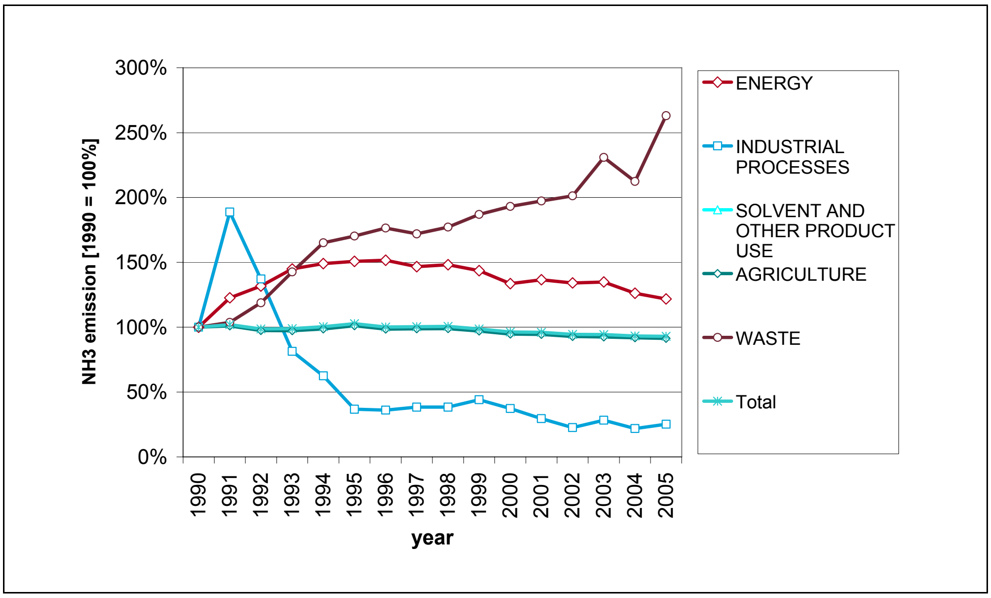


Figure 11: NH_3 emission trend per NFR Category 1990–2005.

As can be seen in Table 15, NH_3 emissions in Austria are almost exclusively emitted by the agricultural sector. The share in national total NH_3 emissions is about 94% for 2005. Within this source manure management – cattle has the highest contribution to total NH_3 emissions: the share in national total emissions of manure management of cattle was 88% in 2005.

The national emission ceiling 2010 for NH_3 emissions in Austria as set out in Annex II of the Multi-Effects Protocol is 66 Gg (see Table 11). In 2005 Austrian total NH_3 emissions (64 Gg) were already below this ceiling.

Table 15: NH_3 emissions per NFR Category 1990 and 2005, their trend 1990–2005 and their share in total emissions.

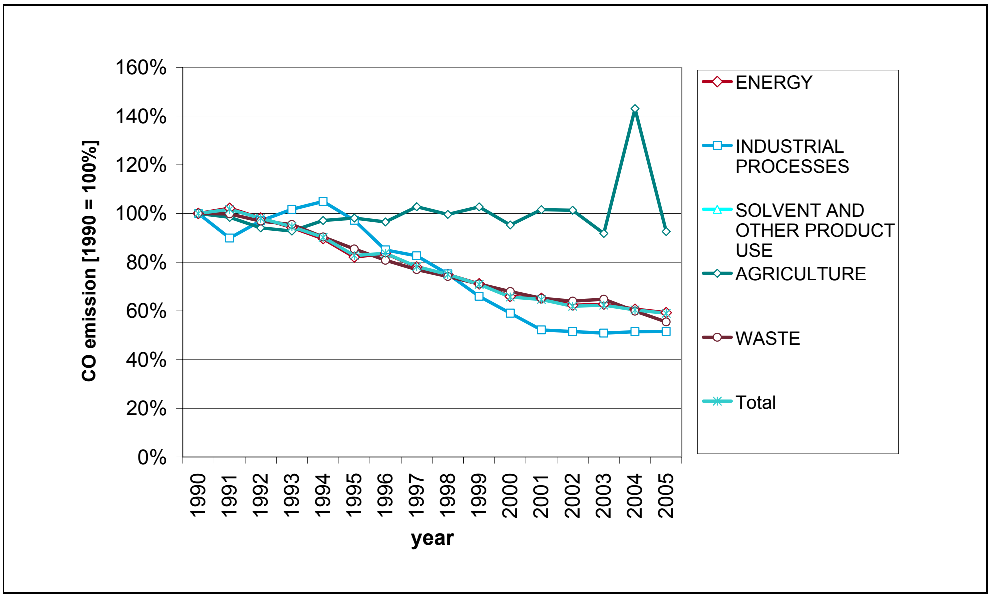
NFR Category		NH_3 Emissions [Gg]		Trend	Share in National Total	
		1990	2005	1990–2005	1990	2005
1	Energy	2.04	2.49	22%	3%	4%
1 A	*Fuel Combustion Activities*	*2.04*	*2.49*	*22%*	*3%*	*4%*
1 B	*Fugitive Emissions from Fuels*	*IE*	*IE*			
2	Industrial Processes	0.27	0.07	-75%	0%	0%
3	Solvent and Other Product Use	NA	NA			
4	Agriculture	66.12	60.39	-9%	96%	94%
6	Waste	0.38	0.99	163%	1%	2%
0	**National Total**	**68.81**	**63.94**	**-7%**	**100%**	**100%**

2.2.5 Carbon monoxide (CO) Emissions

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

In 1990 national total CO emissions amounted to 1 221 Gg; emissions have considerably decreased over the period from 1990 to 2005, in 2005 emissions were 41% below 1990 levels.

Figure 12: CO emission trend per NFR Category 1990–2005



As can be seen in Table 16, CO emissions in Austria are almost exclusively emitted by the energy sector, and more specifically, fuel combustion activities. The share in national total CO emissions is about 96% for 2005. Emissions decreased mainly due to decreasing emissions from road transport and residential heating, which is due to the swich to improved technologies. The peak of CO emissions in 2004 of Sector *Agriculture* (contribution < 0.1% to national total) is due to a larger area of stubble fields burnt that year.

NFR Category		CO Emissions [Gg]		Trend	Share in National Total	
		1990	2005	1990–2005	1990	2005
1	Energy	1161.83	688.99	-41%	95%	96%
1 A	*Fuel Combustion Activities*	*1161.83*	*688.99*	*-41%*	*95%*	*96%*
1 B	*Fugitive Emissions from Fuels*	*IE*	*IE*			
2	Industrial Processes	46.37	23.89	-48%	4%	3%
3	Solvent and Other Product Use	NA	NA			
4	Agriculture	1.20	1.12	-7%	< 0.1%	< 0.1%
6	Waste	11.37	6.31	-45%	1%	1%
0	**National Total**	**1220.77**	**720.31**	**-41%**	**100%**	**100%**

Table 16: CO emissions per NFR Category 1990 and 2005, their trend 1990–2005 and their share in total emissions.

2.3 Emission Trends for Particulate matter (PM)

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

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 13).

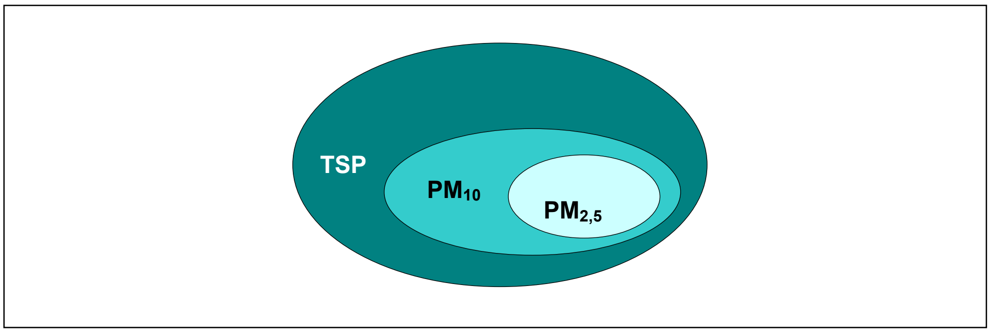
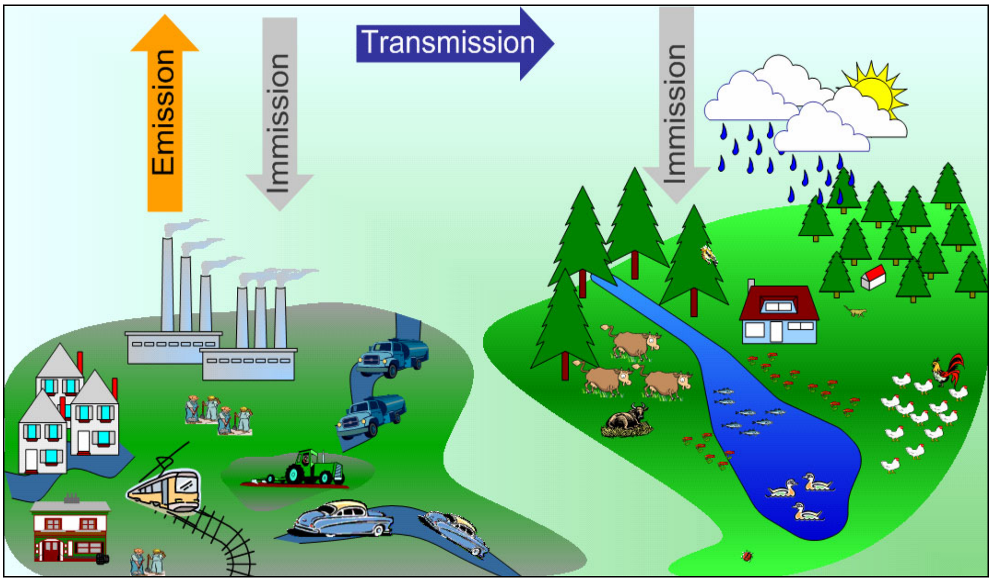


Figure 13: Distribution of TSP, PM10 and PM2,5 (schematic).

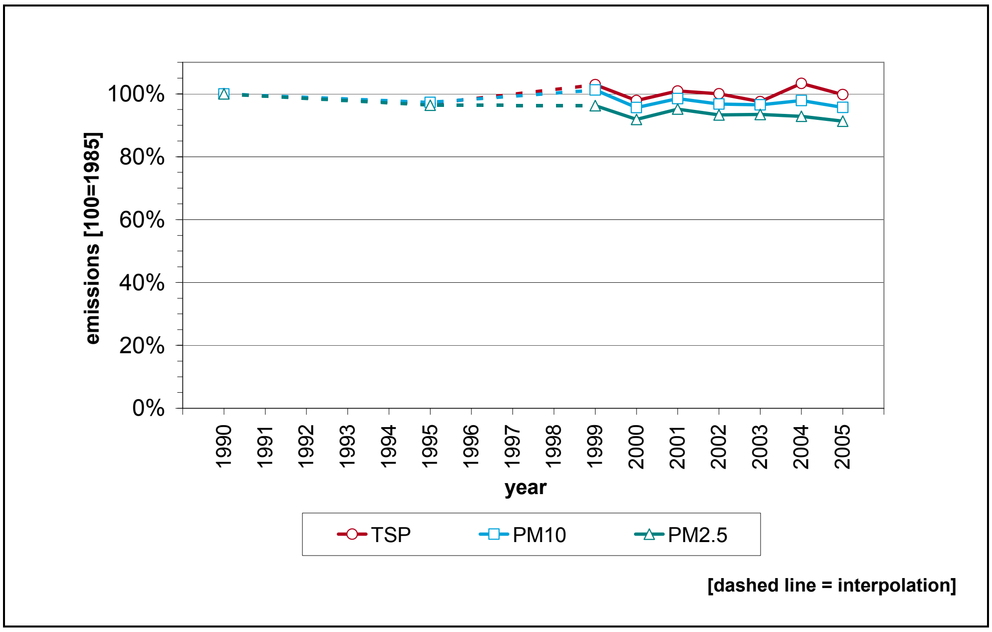
Figure 14: Interrelation of emission, transmission and immission.



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, fine particle 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.

Particulate matter (PM) emissions remained quite stable from the period from 1990 to 2005: TSP emission were on the same level as 1990, PM10 and PM2.5 emissions decreased slightly (by 4% and 9% respectively) over the period 1990 to 2005. Emission trends for particulate matter from 1985 to 2005 are presented in Figure 15 and Table 17 presents emissions of particulate matter relative to 1990. Apart from industry and traffic, private households and the agricultural sector are considerable contributor to emissions of PM. The explanation for these trends is given in the following chapters.

Figure 15: National total emissions for PM 1990–2005.



Year	Emissions [Mg]		
	TSP	PM10	PM2.5
1990	91 572	47 592	28 606
1995	88 636	46 292	27 566
1999	94 255	48 164	27 532
2000	89 616	45 520	26 277
2001	92 398	46 868	27 218
2002	91 611	46 064	26 685
2003	89 303	45 925	26 733
2004	94 619	46 581	26 562
2005	91 336	45 533	26 119
Trend 1990–2005	***-0.3%***	***-4.3%***	***-8.7%***

Table 17: National total emissions and emission trends for particulate matter (PM) 1990–2005.

2.3.1 Total suspended particulate matter (TSP) Emissions

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

TSP emissions and emission trends in Austria

National total TSP emissions amounted to 91.6 Gg in 2005, which is about the same value as in 1990 (emissions in 1990 amounted to 91.3 Gg – see Table 18).

NFR Category		TSP Emissions [Mg]		Trend	Share in National Total	
		1990	2005	1990–2005	1990	2005
1	Energy	32 631.46	32 576.05	< 1%	36%	36%
1 A	*Fuel Combustion Activities*	*31 984.43*	*31 962.22*	*< 1%*	*35%*	*35%*
1 B	*Fugitive Emissions f. Fuels*	*647.03*	*613.83*	*-5%*	*1%*	*1%*
2	Industrial Processes	25 170.41	26 734.31	6%	27%	29%
3	Solvent a. Other Product Use	NA	NA			
4	Agriculture	33 602.55	31 841.48	-5%	37%	35%
6	Waste	167.89	184.04	10%	< 1%	< 1%
	National Total	**91 572.31**	**91 335.88**	**< 1%**	**100%**	**100%**

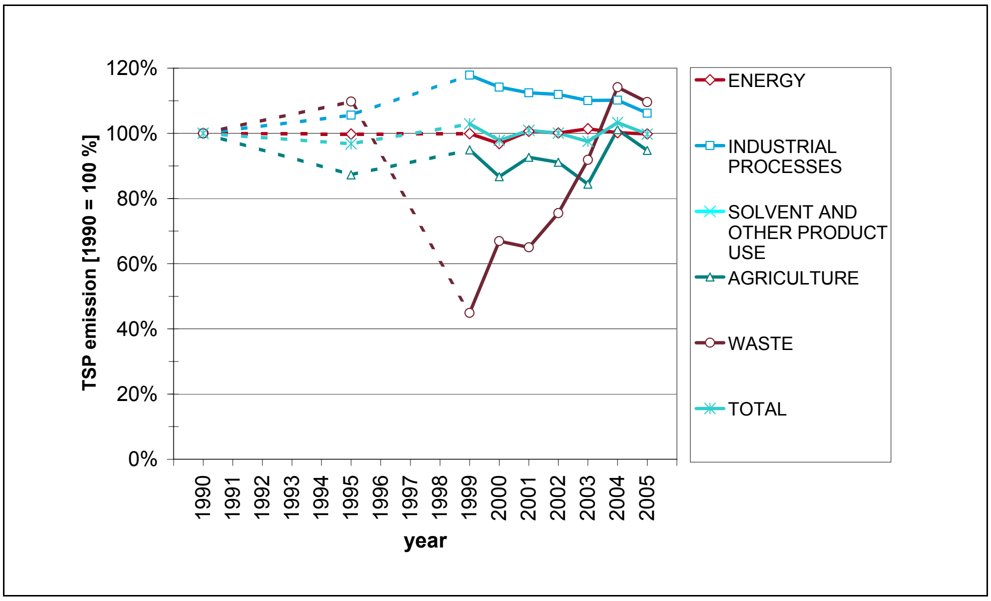
Table 18: TSP emissions per NFR Category 1990 and 2005, their trend 1990–2005 and their share in total emissions.

As shown in Table 18 the main sources for TSP emissions in Austria with a share of 35% each were combustion processes in the energy sector (mainly small combustion plants, oven or stoves fired with wood or coke in households and re-suspended dust from roads.), and agricultural activities (livestock husbandry and cultivation).

The decrease in agricultural production (soil cultivation, harvesting, …) is responsible for the decrease in TSP emissions. The industrial processes sector had a contribution of 29% to the national total emission in 2005.

The increasing emissions from industry are due to intensive activities in mineral production and the construction branch. In the energy sector neither an overall reducing nor an increasing trend could be noted. The emissions within the energy sector are very inhomogeneous: the decrease of TSP emission in especially the manufacturing industries and construction branch, is completely compensated by enormously increasing TSP emission from transportation activities. The increase of the TSP emission in the waste sector resulted from restoring of landfill sites and the reuse of these abandoned hazardous sites as landfills (see Figure 16).

Figure 16: TSP emission trend per NFR Category 1990–2005.



2.3.2 PM10 Emissions

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

PM10 emissions and emission trends in Austria

National total PM10 emissions amounted to 47.6 Gg in 1990 and decreased by about 4% until 2005 (emissions in 2005 amounted to 45.5 Gg – see Table 19).

As shown in Table 19 the main source for PM10 emissions in Austria are combustion processes in the energy sector with a share of 50% in national total emissions in 2005. These emissions are mainly due to transport activities including mechanical abrasion from road surfaces, and re-suspended dust from roads, and on the other hand activities in the energy processing in small combustion plants and households (oven, stove etc.). The industrial processes sector had a share of 30% in national total emissions.

Another important source for PM 10 emissions in Austria with a share of about 21% is the agricultural sector (livestock husbandry and cultivation). The decrease in agricultural production (soil cultivation, harvesting, etc.) is responsible for the slight decrease in PM10 emissions in Sector *Agriculture*.

Table 19: PM10 emissions per NFR Category 1990 and 2005, their trend 1990–2005 and their share in total emissions.

NFR Category		**PM10 Emissions [Mg]**		**Trend**	**Share in National Total**	
		1990	**2005**	**1990–2005**	**1990**	**2005**
1	Energy	24 225.12	22 615.50	-7%	51%	50%
1 A	*Fuel Combustion Activities*	*23 920.41*	*22 325.78*	*-7%*	*50%*	*49%*
1 B	*Fugitive Emissions f. Fuels*	*304.71*	*289.72*	*-5%*	*1%*	*1%*
2	Industrial Processes	13 845.69	13 451.52	-3%	29%	30%
3	Solvent a. Other Product Use	NA	NA			
4	Agriculture	9 440.43	9 378.58	-1%	20%	21%
6	Waste	80.26	87.07	8%	<1%	<1%
	National Total	**47 591.50**	**45 532.66**	**-4%**	**100%**	**100%**

As presented in Figure 17, this overall decrease is mainly due to decreasing emissions in the energy sector. However, the achievements made by installing of flue gas cleaning systems where almost completely compensated by enormous increasing PM10 emission of the transportation sector due to increased transport activities. Decreasing emissions of 3% in the sector industrial processes can be noted, here especially in the iron and steel industry. The decrease of PM10 emission in the mineral production and the construction branch is due to protective enclosure and sprinkling during the activities.

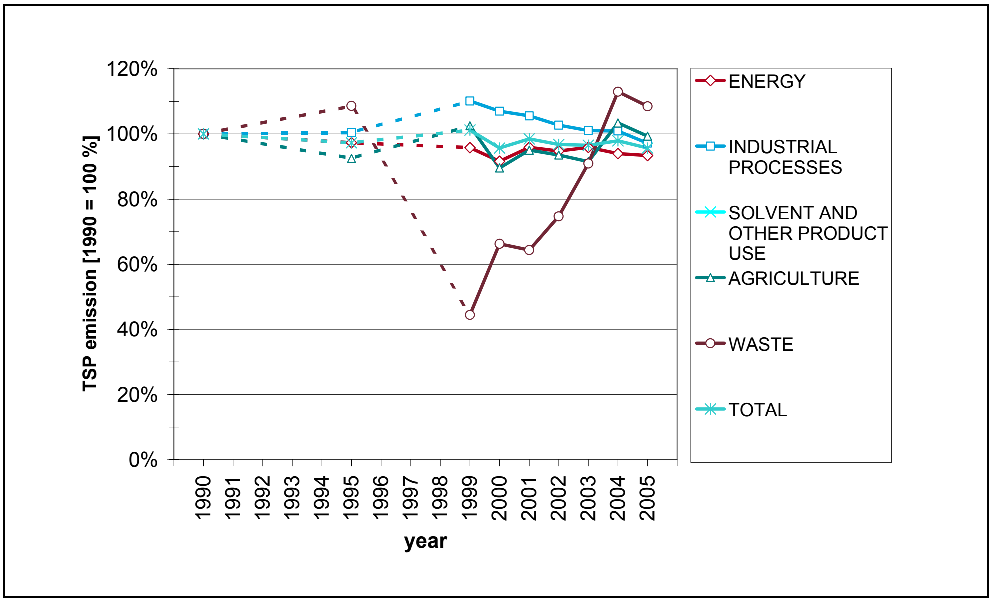


Figure 17: PM10 emission trend per NFR Category 1990–2005.

2.3.3 PM2.5 Emissions

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

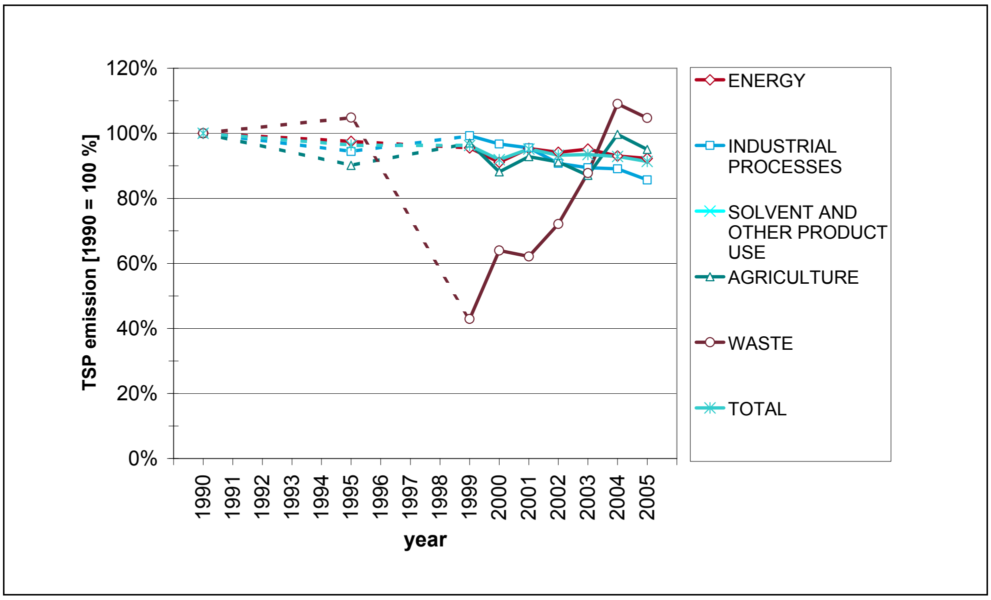
PM2.5 emissions and emission trends in Austria

National total PM2.5 emissions amounted to 28.6 Gg in 1990 and have decreased steadily so that by the year 2005 emissions were reduced by 9% (to 26.1 Gg).

As it is shown in Table 20 PM2.5 emissions in Austria mainly arose from combustion processes in the energy sector with a share of 75% in the total emissions in 2005. Besides the sources already mentioned in the context of TSP and PM10, PM2.5 emissions resulted on a big scale from power plants with flue gas cleaning systems, which filter larger particles. The industrial processes sector had a share of 17% and the agricultural sector had a share of 8% in national total emissions. The decrease in agricultural production (soil cultivation, harvesting, etc.) is responsible for the decrease in PM2.5 emissions in Sector *Agriculture*.

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

Figure 18: PM2.5 emission trend per NFR Category 1990–2005.



NFR Category		PM2.5 Emissions [Mg]		Trend	Share in National Total	
		1990	2005	1990–2005	1990	2005
1	Energy	21 135.60	19 503.85	-8%	74%	75%
1 A	*Fuel Combustion Activities*	*21 040.64*	*19 412.96*	*-8%*	*74%*	*74%*
1 B	*Fugitive Emissions f. Fuels*	*94.96*	*90.89*	*-4%*	*0%*	*0%*
2	Industrial Processes	5 188.60	4 444.15	-14%	18%	17%
3	Solvent a. Other Product Use	NA	NA			
4	Agriculture	2 256.11	2 143.80	-5%	8%	8%
6	Waste	26.17	27.40	5%	0%	0%
	National Total	**28 606.47**	**26 119.19**	**-9%**	**100%**	**100%**

Table 20: PM2.5 emissions per NFR Category 1990 and 2005, their trend 1990–2005 and their share in total emissions.

2.4 Emission Trends for Heavy Metals

In general emissions of heavy metals decreased remarkably from 1985 to 2005. Emission trends for heavy metals from 1985 to 2005 are presented in Table 21. Figure 19 presents emissions of heavy metals relative to 1985. 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.

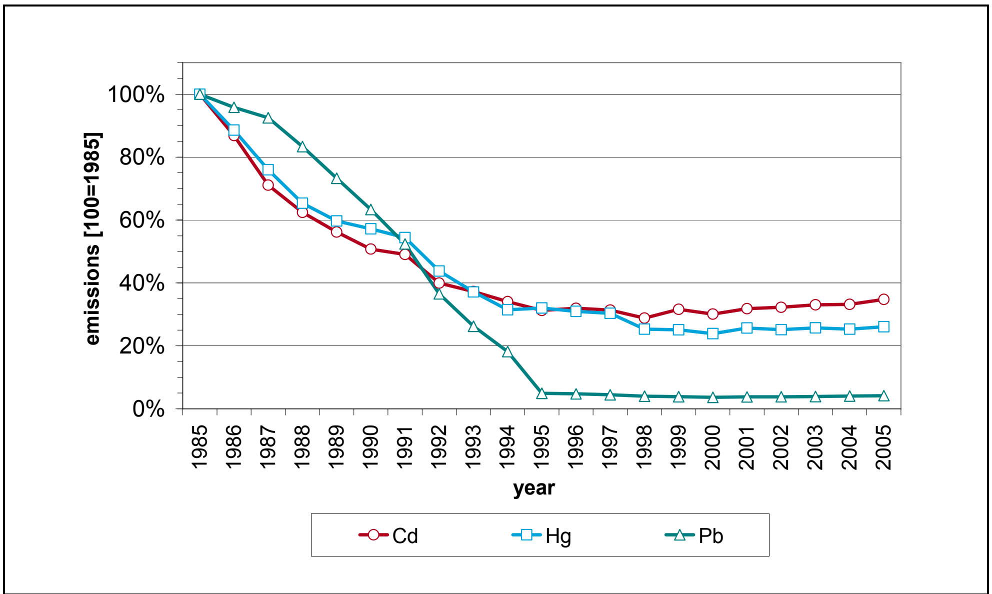


Figure 19: National total emissions for heavy metals 1985–2005.

Table 21: National total emissions and emission trends for heavy metals 1985–2005.

Year	Emissions [Mg]		
	Cd	Hg	Pb
1985	3.10	3.74	326.70
1986	2.70	3.32	312.94
1987	2.21	2.84	302.04
1988	1.94	2.45	272.23
1989	1.74	2.24	239.36
1990	1.57	2.14	206.85
1991	1.52	2.04	171.17
1992	1.24	1.64	119.30
1993	1.16	1.39	85.78
1994	1.06	1.18	59.40
1995	0.97	1.20	16.08
1996	0.99	1.16	15.50
1997	0.97	1.14	14.55
1998	0.89	0.95	12.99
1999	0.98	0.94	12.64
2000	0.93	0.90	11.91
2001	0.99	0.96	12.34
2002	1.00	0.94	12.55
2003	1.03	0.96	12.79
2004	1.03	0.95	13.14
2005	1.08	0.98	13.57
Trend 1985–2005	***-65%***	***-74%***	***-96%***

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.[59] 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.

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

Cadmium emissions and emission trends in Austria

National total Cd emissions amounted to 3.1 Mg in 1985, and amounted to 1.57 Mg in 1990; since then emissions have decreased steadily and by the year 2005 emissions were reduced by 31% (1.05 Mg).

As shown in Table 22 the main source for Cd emissions in Austria with a share of 79% is the energy sector. These emissions mainly arise from combustion of heavy fuel oil, wood and wood waste as well as black liqour. The sub sectors with the highest contribution to Cd emissions from the energy sector are residential plants with 29%, petroleum refining with 21%, road transportation (10%) and pulp, paper and print (10% in 2005). The industrial processes sector contributed about 20% to national total Cd emission.

The overall reduction from 1985 to 2005 is mainly due to decreasing emissions from the industrial processes and energy sector (electricity and heat production) 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.

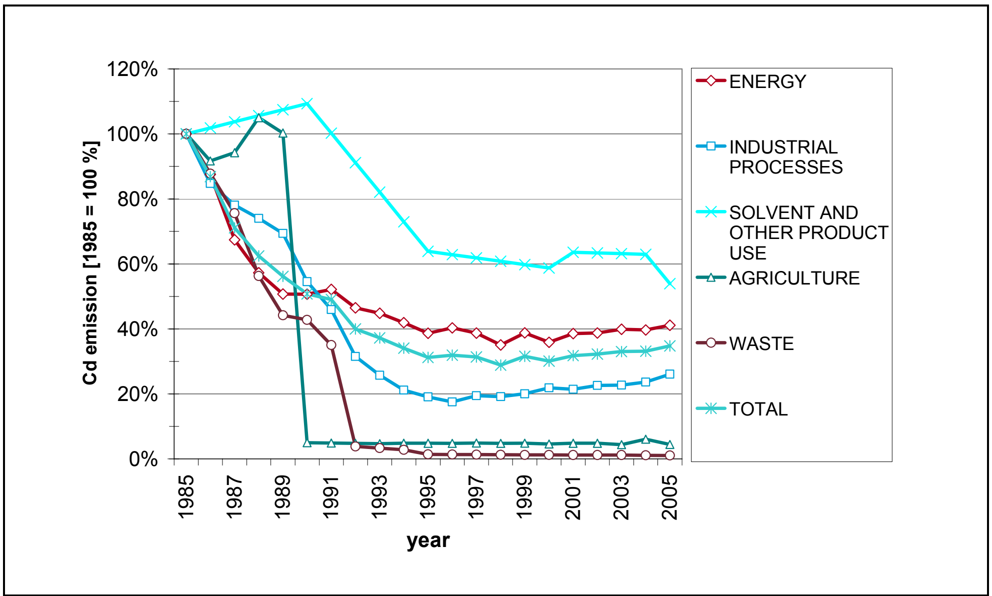


Figure 20: Cd emission trend per NFR Category 1990–2005.

As can be seen in Figure 20, Cd emissions are increasing again in the last few years, which is due to the growing activities in the industrial processes sector and energy sector. The increasing Cd-emission in the energy sector were due increasing use of wood and wooden litter in small combustion plants, the combustion of heavy fuel oil and residues from the petroleum processing in the refinery as well as the thermal utilisation of industrial residues and residential waste. The use of hard coal has increased also. Another reason is the continuously growing activity in the transport sector, especially of heavy duty vehicles.

Table 22: Cd emissions per NFR Category 1985 and 2005, their trend 1985–2005 and their share in total emissions.

NFR Category		Cd Emissions [Mg]			Trend		Share in National Total		
		1985	1990	2005	1985–2005	1990–2005	1985	1990	2005
1	Energy	2.08	1.06	0.86	-59%	-19%	67%	67%	79%
1 A	*Fuel Combustion Activities*	*2.08*	*1.06*	*0.86*	*-59%*	*-19%*	*67%*	*67%*	*79%*
1 B	*Fugitive Emissions f. Fuels*	*NE*	*NE*	*NE*					
2	Industrial Processes	0.84	0.46	0.22	-74%	-52%	27%	29%	20%
3	Solvent a. Other Product Use	0.00	0.00	0.00	-46%	-51%	< 1%	<1%	< 1%
4	Agriculture	0.04	0.00	0.00	-96%	-11%	1%	<1%	< 1%
6	Waste	0.14	0.06	0.00	-99%	-97%	4%	4%	< 1%
	National Total	**3.10**	**1.57**	**1.08**	**-65%**	**-31%**	**100%**	**100%**	**100%**

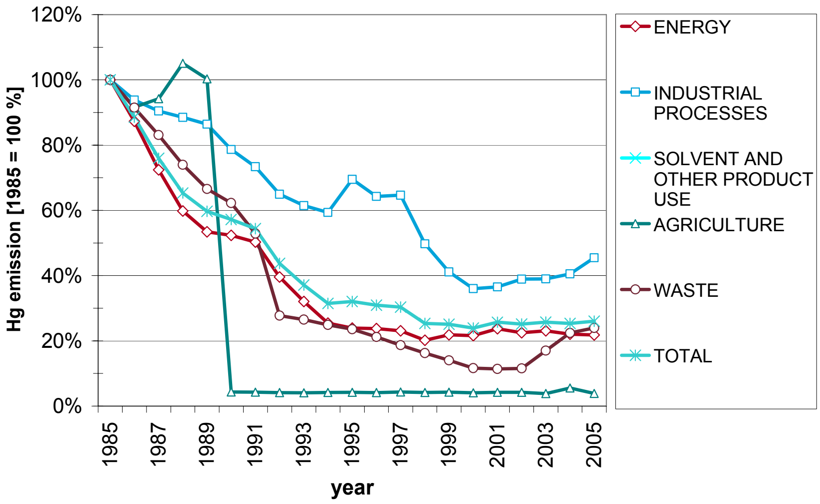
2.4.2 Mercury (Hg) Emissions

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 $4 \cdot 10^{-5}$%.[60] 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 2005 emissions were reduced by 74%.

Figure 21: Hg emission trend per NFR Category 1990–2005.



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

As it is shown in Table 23 Hg emissions mainly arise from the energy sector by combustion processes with a share of 67% of the total emissions in 2005. These emissions are composed of emissions from combustion of coal, heavy fuel oil and waste in manufacturing idustries and construction, the combustion of wood, wood waste and coal in residential plants and combustion of coal and heavy fuel oil in public electricity and heat production.

Process related emissions in the sector industrial processes (especially metal industries) account for about 31% of national total Hg emissions in 2005. Hg emissions mainly arise from the same sub-sectors as Cd emissions, which are residential heating, industry and energy industries.

The overall reduction of about 74% for the period 1985 to 2005 was due to decreasing emissions from the industrial processes sector and residential heating due to a decrease in the use of heavy fuel oil and wood as fuel and also due to improved emission abatement techniques in industry. Several bans in different industrial sub-sectors as well in the agriculture sector lead to the sharp fall of total Hg emission in Austria.

Table 23: Hg emissions per NFR Category 1985 and 2005, their trend 1985–2005 and their share in total emissions.

NFR Category		**Hg Emissions [Mg]**			**Trend**		**Share in National Total**		
		1985	**1990**	**2005**	**1985–2005**	**1990–2005**	**1985**	**1990**	**2005**
1	Energy	2.98	1.56	0.65	-78%	-58%	80%	73%	67%
1 A	*Fuel Combustion Activities*	*2.98*	*1.56*	*0.65*	*-78%*	*-58%*	*80%*	*73%*	*67%*
1 B	*Fugitive Emissions f. Fuels*	*NE*	*NE*	*NE*					
2	Industrial Processes	0.67	0.53	0.30	-55%	-42%	18%	25%	31%
3	Solvent a. Other Product Use	NA	NA	NA					
4	Agriculture	0.01	0.00	0.00	-96%	-10%	< 1%	< 1%	< 1%
6	Waste	0.09	0.05	0.02	-76%	-62%	2%	3%	2%
	National Total	**3.74**	**2.14**	**0.98**	**-74%**	**-54%**	**100%**	**100%**	**100%**

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 326.7 Mg and to 206.9 Mg in 1990; emissions have decreased steadily and by the year 2005 emissions were reduced by 93% (13.6 Mg).

In 1985 the main emission source for Pb emissions with a share of about 79% was the sector energy especially the sub-sector *road transport*. From 1990 to 1995 Pb emissions from this sector decreased by 100% due to prohibition of the addition of lead to petrol. As it is shown in Table 23 today's Pb emissions mainly arise from the energy sector by combustion processes with a share of about 52% of the Austrian Pb emissions.

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.

Figure 22: Pb emission trend per NFR Category 1990–2005.

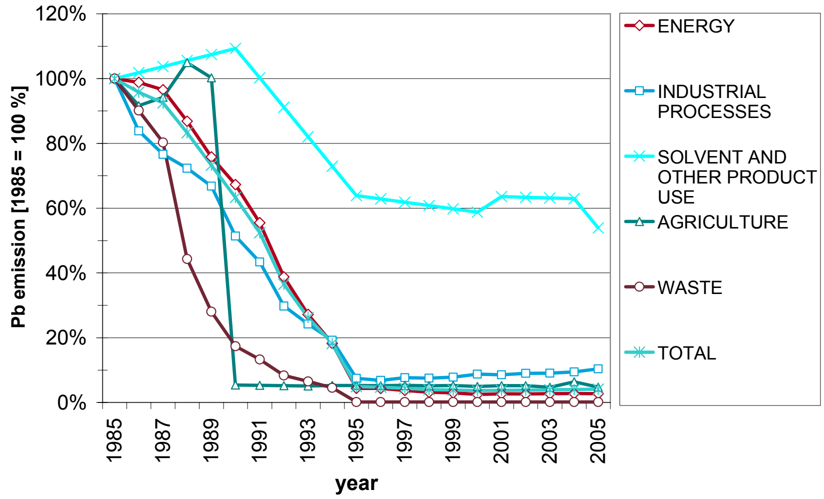


Table 24: Pb emissions per NFR Category 1985 and 2005, their trend 1985–2005 and their share in total emissions.

NFR Category		Pb Emissions [Mg]			Trend		Share in National Total		
		1985	1990	2005	1985–2005	1990–2005	1985	1990	2005
1	Energy	258.11	173.66	7.02	-97%	-96%	79%	84%	52%
1 A	*Fuel Combustion Activities*	*258.11*	*173.66*	*7.02*	*-97%*	*-96%*	*79%*	*84%*	*52%*
1 B	*Fugitive Emissions f. Fuels*	*NE*	*NE*	*NE*					
2	Industrial Processes	62.45	32.09	6.49	-90%	-80%	19%	16%	48%
3	Solvent a. Other Product Use	0.06	0.07	0.03	-46%	-51%	< 1%	< 1%	< 1%
4	Agriculture	0.23	0.01	0.01	-95%	-12%	< 1%	< 1%	< 1%
6	Waste	5.85	1.02	0.01	-100%	-99%	2%	< 1%	< 1%
	National Total	**326.70**	**206.85**	**13.57**	**-96%**	**-93%**	**100%**	**100%**	**100%**

2.5 Emission Trends for POPs

Emissions of Persistent Organic Pollutants (POPs) decreased remarkably from 1985 to 2005. As can be seen in Table 25, emissions for all three POPs are well below their 1985 level, which is the obligation for Austria as a Party to the POPs Protocol (see Chapter 1.1.1).

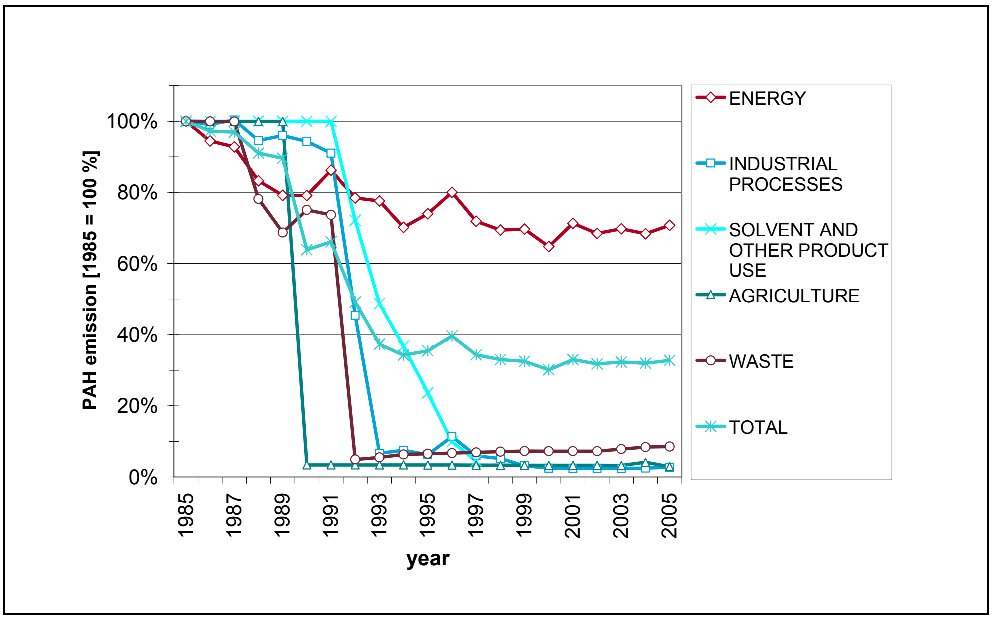


Figure 23: Emission of Persistent Organic Pollutants 1985–2005 relative to 1985 (1985 = 100%).

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. Figure 23 presents emissions of POPs relative to 1985.

Table 25: Emissions and emission trends for POPs 1985–2005.

Year	Emission		
	PAH [Mg]	Dioxin [g]	HCB [kg]
1985	27.04	186.98	106.18
1986	26.31	185.84	103.57
1987	26.21	187.67	106.29
1988	24.61	172.85	97.61
1989	24.23	164.02	94.48
1990	17.27	159.99	91.51
1991	17.86	134.77	84.25
1992	13.30	76.15	69.22
1993	10.10	66.58	63.68
1994	9.26	55.90	51.65
1995	9.60	58.17	52.84
1996	10.71	59.62	55.64

Year	Emission		
	PAH [Mg]	Dioxin [g]	HCB [kg]
1997	9.29	59.55	51.83
1998	8.93	56.12	48.98
1999	8.80	53.86	47.70
2000	8.16	51.60	43.89
2001	8.93	54.84	47.99
2002	8.60	42.32	45.21
2003	8.75	42.25	45.27
2004	8.65	41.34	43.59
2005	8.87	42.62	45.41
Trend 1985–2005	**-67%**	**-77%**	**-57%**

2.5.1 Polycyclic Aromatic Hydrocarbons (PAH) Emissions

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

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

PAH emissions and emission trends in Austria

In 1985 national total PAH emissions amounted to about 27 Mg and amounted to about 17 Mg in 1990; emissions have decreased steadily and by the year 2005 emissions were reduced by about 67% (to 8.9 Mg in 2005).

In 1985 the main emission sources for PAH emissions were the Sectors Energy (44%), Industrial processes (29%) and Agriculture (26%). In 2005 the main source regarding PAH emissions is *Energy* with a share in the national total of 95%. From 1985 to 2005 PAH emissions from Agriculture decreased remarkably by 97% due to prohibition of open field burning, PAH emissions from the sector Industrial processes decreased by 97% due to the shut down of primary aluminium production in Austria, which was a main source for PAH emissions.

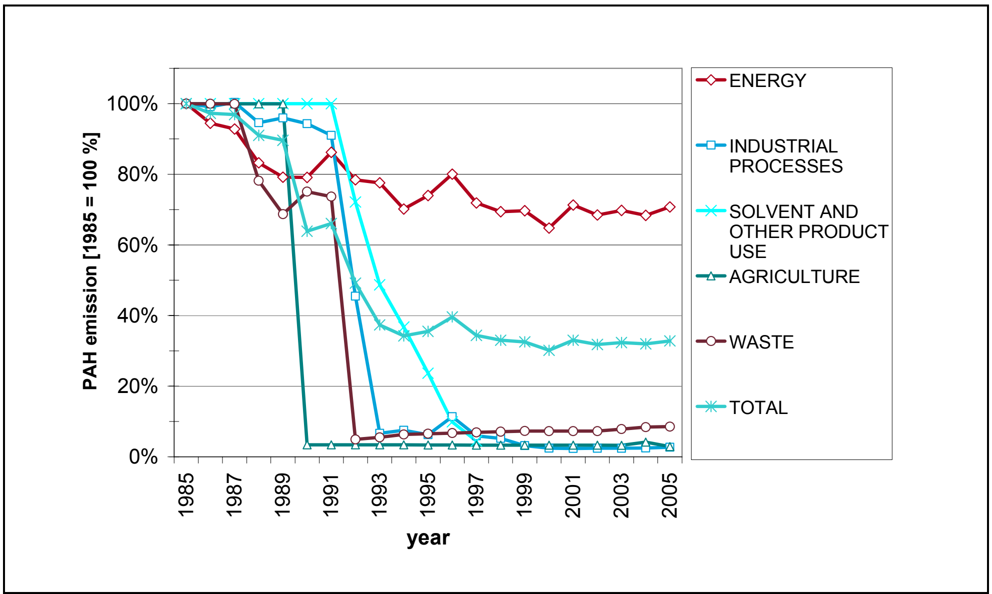


Figure 24: PAH emission trend per NFR Category 1990–2005.

Table 26: PAH emissions per NFR Category 1985 and 2005, their trend 1985–2005 and their share in total emissions.

NFR Category		**PAH Emissions [Mg]**			**Trend**		**Share in National Total**		
		1985	**1990**	**2005**	**1985–2005**	**1990–2005**	**1985**	**1990**	**2005**
1	Energy	11.94	9.44	8.45	-29%	-11%	44%	55%	95%
1 A	*Fuel Combustion Activities*	11.94	9.44	8.45	-29%	-11%	44%	55%	95%
1 B	*Fugitive Emissions from Fuels*								
2	Industrial Processes	7.88	7.44	0.22	-97%	-97%	29%	43%	2%
3	Solvent a. Other Product Use	0.15	0.15		-100%	-100%	1%	1%	
4	Agriculture	7.07	0.24	0.20	-97%	-15%	26%	1%	2%
6	Waste	0.00	0.00	0.00	-91%	-89%	< 1%	< 1%	< 1%
	National Total	**27.04**	**17.27**	**8.87**	**-67%**	**-49%**	**100%**	**100%**	**100%**

2.5.2 Dioxins and Furan

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

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

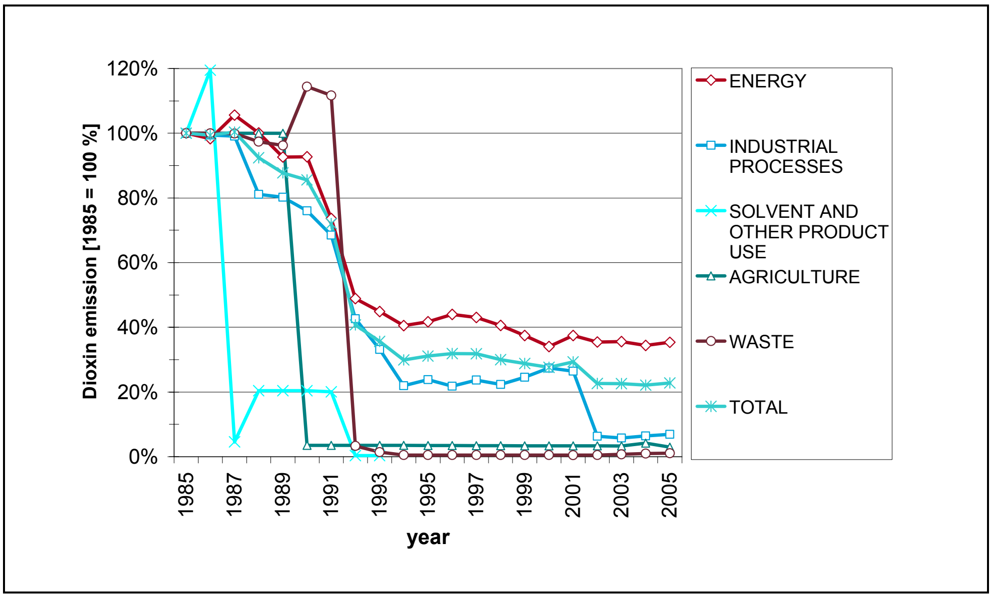
Thanks to stringent legislation and modern technology dioxin emissions due to combustion and incineration as well as due to chemical manufacturing and processes have been reduced dramatically. Nowadays domestic combustion as well as thermal processes in metals extraction and processing have become more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

Dioxin/Furan emissions and emission trends in Austria

In 1985 national total dioxin/furan emissions amounted to about 187 g and amounted to about 160 g in 1990; emissions have decreased steadily and by the year 2005 emissions were reduced by about 77% (to 43 g in 2005).

In 1985 the main sources for dioxin/furan emissions were the Sectors *Energy* (59%) and *Industrial Processes* (especially iron and steel production) (27%). In 2005 the main sector regarding dioxin/furan emissions is *Energy* with a share in National Total of 91%.

Figure 25: Dioxin emission trend per NFR Category 1990–2005.



From 1985 to 2005 PAH emissions from the sectors *Waste* and *Solvents and Other Product Use* decreased by almost 100% due to stringent legislation and modern technology. The dioxin emissions of the sectors *Agriculture* and *Industrial processes* decreased by 93% and 97%, respectivley, due to prohibition of open field burning and improved emission abatement technologies in iron and steel industries.

Table 27: Dioxin emissions per NFR Category 1985 and 2005, their trend 1985–2005 and their share in total emissions.

NFR Category		Dioxin Emissions [g]			Trend		Share in National Total		
		1985	1990	2005	1985–2005	1990–2005	1985	1990	2005
1	Energy	109.55	101.56	38.76	-65%	-62%	59%	63%	91%
1 A	*Fuel Combustion Activities*	109.55	101.56	38.76	-65%	-62%	59%	63%	91%
1 B	*Fugitive Emissions from Fuels*								
2	Industrial Processes	51.30	39.00	3.54	-93%	-91%	27%	24%	8%
3	Solvent & Other Product Use	5.19	1.06		-100%	-100%	3%	1%	
4	Agriculture	5.0526	0.1775	0.1508	-97%	-15%	3%	0%	0%
6	Waste	15.90	18.19	0.17	-99%	-99%	9%	11%	0%
	National Total	**186.98**	**159.99**	**42.62**	**-77%**	**-73%**	**100%**	**100%**	**100%**

2.5.3 Hexachlorobenzene (HCB) Emissions

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

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

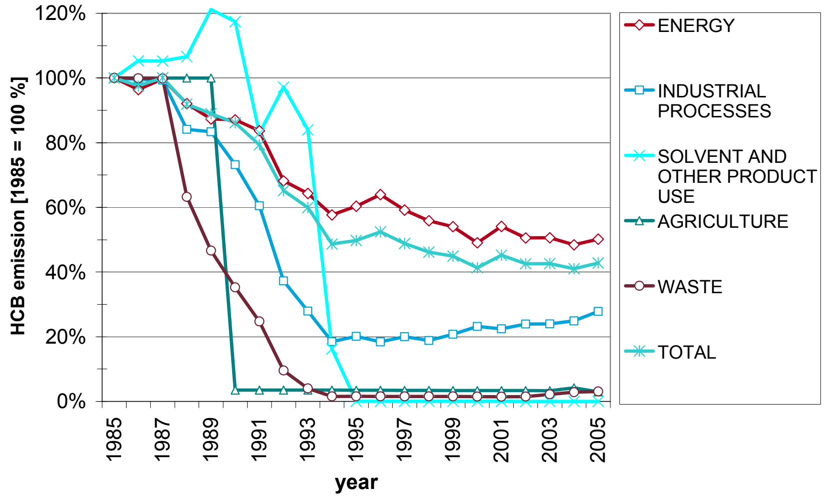
It is released to the environment as an unintentional by-product in chemical industry (production of several chlorinated hydrocarbons such as drugs, pesticides or solvents) and in metal industries and is formed in combustion processes in the presence of chlorine.

HCB emissions and emission trends in Austria

In 1985 national total HCB emissions amounted to about 106 g and amounted to about 92 g in 1990; emissions have decreased steadily and by the year 2005 emissions were reduced by about 57% (to 45 g in 2005).

In 1985 the two main sources for HCB emissions were the sectors *Energy* (78%) and *Industrial processes* (12%). In 2005 the main sector of HCB emissions is *Energy* with a share in National Total of 92%.

Figure 26: HCB emission trend per NFR Category 1990–2005.



From 1985 to 2005 HCB emissions from the sectors *Waste* and *Agriculture* as well as *Solvents and Other Products Use* decreased remarkably by 97% and more due to stringent legislation and modern technology. HCB emissions of the sectors *Industrial processes* and *Energy* decreased by 72% or 50% respectively due to improved dust abatement technologies. National total emissions decreased by 57% in the period from 1985 to 2005.

Table 28: Hexachlorbenzene (HCB) emissions per NFR Category 1985 and 2005, their trend 1985–2005 and their share in total emissions.

NFR Category		**HCB Emissions [g]**			**Trend**		**Share in National Total**		
		1985	**1990**	**2005**	**1985–2005**	**1990–2005**	**1985**	**1990**	**2005**
1	Energy	83.08	72.31	41.65	-50%	-42%	78%	79%	92%
1 A	*Fuel Combustion Activities*	*83.08*	*72.31*	*41.65*	*-50%*	*-42%*	*78%*	*79%*	*92%*
1 B	*Fugitive Emissions from Fuels*								
2	Industrial Processes	13.27	9.71	3.69	-72%	-62%	12%	11%	8%
3	Solvent and Other Product Use	7.71	9.05	NA	-100%	-100%	7%	10%	
4	Agriculture	1.01	0.04	0.03	-97%	-15%	1%	< 1%	< 1%
6	Waste	1.11	0.39	0.03	-97%	-91%	1%	< 1%	< 1%
0	**National Total**	**106.18**	**91.51**	**45.41**	**-57%**	**-50%**	**100%**	**100%**	**100%**

3 MAJOR CHANGES

3.1 Relation to data reported earlier

As a result of the continuous improvement of Austria's National Air Emission Inventory, emissions of some sources have been recalculated based on updated data or revised methodologies, thus emission data for 1990 to 2004 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.

Table 29: Recalculation difference of Austria's NEC gas, CO, PM, HM and POP emissions compared to the previous submission.

	SO_2	NO_x	NMVOC	NH_3	TSP	PM10	PM2.5
1990	0%	0%	0%	0%	2%	2%	0%
2004	-6%	-1%	-9%	0%	0%	0%	-1%
	CO	**Cd**	**Pb**	**Hg**	**PAH**	**Diox**	**HCB**
1990	0%	3%	0%	0%	0%	0%	0%
2004	-1%	-2%	1%	0%	-1%	1%	-1%

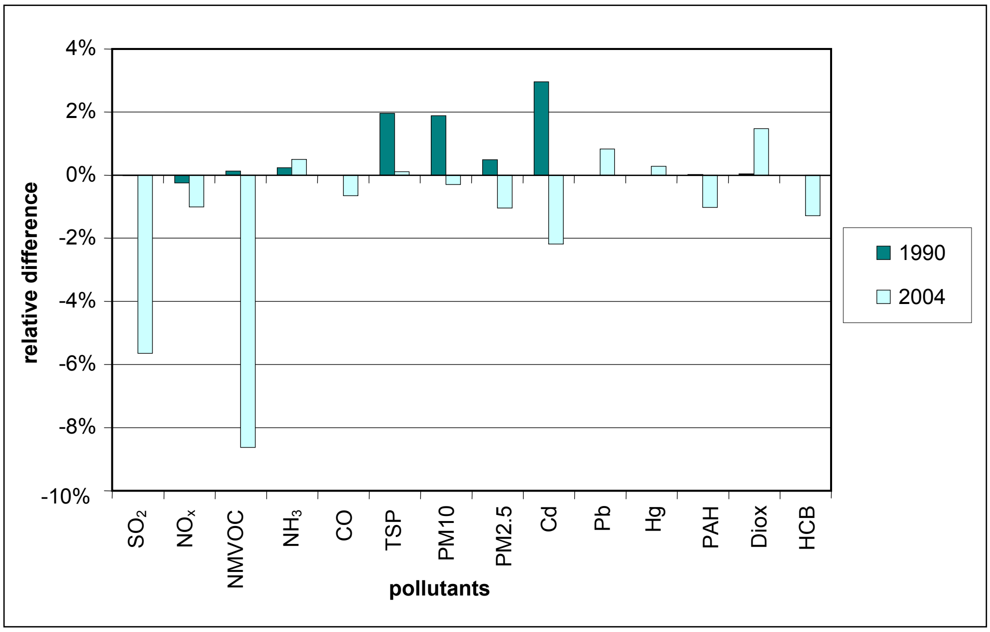


Figure 27: Recalculation difference of Austria's emissions of NEC gas, CO, PM, HM and POP compared to the previous submission.

The 9% decrease of NMVOC emissions for 2004 compared to the previous submission is mainly due to a recalculation of *Category 2 B – Chemical Industry* applying new data reported by the Austrian Association of Chemical Industry. An update of activity data in *Category 3 – Solvent and Other Product Use* led to lower emissions in 2004 too.

The 6% decrease of SO_2 emissions for 2004 is mainly due to the revision of the national energy balance and recalculations in *Category 1 A 3 b Road Transportation*.

The light increase of 1% of dioxin emissions for 2004 compared to the previous submission is due to updating the activity data in Category *1 A 2 b Non-ferrous metals* and *6 C Cremations*. The light decrease of 1% of PAH and HCB emissions for 2004 compared to the previous submission is mainly due to the revision of emission factors (*Category 1 A 2 f Other*) as well as the overall updated activity data.

The light decrease of 2% of Cd emissions for 2004 compared to the previous submission is due to an error correction of solid biomass cadmium emission factor (Category 1 A 4 b Residential). The revision is also the main reason for changes in HM emissions; however, the overall change for HM is only 1% and 2%, respectively.

The slight decrease of reported PM2.5 emissions is due updated emission factor in Category *2 C 1 Iron and steel*.

Explanations per sector are given below.

3.2 Explanations and Justifications for Recalculations

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

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

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

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

3.3 Major Changes by Sector

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

3.3.1 Major Changes SECTOR 1 ENERGY

Fuel Combustion (1A)

Update of activity data

Update of activity data are due to updates of the energy balance compiled by the federal statistics authority Statistik Austria.

1 A 2 b Non-ferrous metals

Update of secondary aluminium activity data from 2001 on.

Update of national energy balance – general improvements

The following improvements affect the years 1999 to 2004 only. It has to be noted that the following recalculations relate to official data published by Statistik Austria („Österreich-Bilanzen") in November 2005.

Integration of 2003/2004 census data for improvement of the residential sector (*NFR 1 A 4 b*). Definition of improved and more detailed fuel classifications for industrial waste and biomass. Integration of 2004 and 2002 sampling data for recalculation of industrial sub categories from 1999 on. Improvement of companies' allocation to NACE sectors. Integration of 2004 material input survey. Model error correction 1999 to 2000 for residual fuel oil. Consideration of coke oven tar and benzene as refinery input from 2004 on. 1999–2004 correction of coal foreign trade statistics and stock changes which affects coal gross consumption. Integration of 2005 CO_2 emission trading system (ETS) data for improvement and validation of industry sectoral data, especially for non traded fuels and in-plant waste. Update of brown coal NCV by means of ETS data. Because most improvements affect intersectoral data without changing gross consumption, category *Commerce and Public Services* is chosen as the "residual category" in most cases. This leads to significant changes of NFR category *1 A 4 a* without enhancement of accuracy.

Update of national energy balance – data harmonisation and consistency

In November 2005 Statistik Austria provided a dataset to emission inventory compilers which was consistent with data submitted to EUROSTAT/IEA but not fully consistent with official data published by Statistik Austria („Österreich-Bilanzen"). Thus the following inventory recalculations prior to 1999 have been performed additionally to gain consistency with the official dataset.

1 A 2 Manufacturing Industries; 1 A 4 Other Sectors

1990 to 1998: a share of residual fuel oil final consumption is shifted from *1 A 4 c Agriculture* to *1 A 2 Manufacturing Industries* sub categories and *1 A 2 a Commercial* (1990: 40 kt). A share of the residual fuel previously considered as low sulphur fuel oil is now considered as high sulphur residual fuel oil and contributes to higher NO_x and SO_2 emissions (1990: 11 kt).

1 A 1 Energy Industries; 1 A 4 Other Sectors

1990 to 1997: o*ther solid biomass* is shifted from *1 A 1* to *1 A 4* (1990: 0.2 PJ).

1 A 3 b Transport – Road

Energy data, particularly biodiesel consumption 2004, has been revised according to the updated national energy balance.

1 A 3 e Transport – Pipeline compressors

Revised 2004 natural gas consumption according to the updated national energy balance has been applied.

1 A 4 Other Sectors – Mobile Sources

Revised energy data for railways (coal, diesel, electricity) up to 2000 according to the updated national energy balance has been applied.

Improvements of methodologies and emission factors

Cross sectoral

From 2005 on ETS activity data (356 PJ) has been used for refining sub categories activity data of *NFR 1 A 1 and 1 A 2* stationary sources (total 490 PJ). Increased accuracy of activity data for glass, cement, lime, bricks & tiles and magnesium & dolomite manufacturing industry significantly increases accuracy of NO_x emission calculation for these branches.

1 A 1 a Public Electricity and Heat Production

For plants > 50 MW_{th} update of SO_2 and NO_x emissions for the year 2004 by means of the steam boiler reporting obligation (LRGK).

For biomass fired boilers ≤ 50 MW update of NO_x emission factors 1990–2004 by means of a sample survey.

For municipal waste incineration in boilers ≤ 50 MW update of NO_x emission factors 1999–2004 by means of actual measurements.

Steam boiler fuel consumption reported as *fuel wood* is now considered as *other solid biomass.*

Update of brown coal and brown coal briquettes cadmium emission factor according to measurements taken from a national study.

1 A 1 b Petroleum Refining

Liquid fuels NH_3 emission factor has been updated (error correction).

Error correction of secondary lead dioxin emission factor.

1 A 2 f Other Industries

Change of PAH emission factor for cement production according to actual measurements.

1 A 4 b Residential

Error correction of solid biomass cadmium emission factor.

Fugitive Emissions (1 B)

No recalculations.

3.3.2 Major Changes SECTOR 2 INDUSTRIAL PROCESSES

Update of activity data

2 A 1 Cement Production

Activity data for 2004 has been updated using plant-specific data provided by the Association of the Austrian Cement Industry.

2 C 1 Iron and Steel

Activity data from iron and steel cast have been updated affecting process-specific Dioxine, PAH, HCB, Cd, Hg and Pb emissions.

2 B 5 Chemical Products – Other (organic chemical industries)

NMVOC Emissions have been updated for the years 1994–2004: From 1999 onwards data reported by the Austrian Association of Chemical Industry has been used; emissions between 1994 and 1998 have been estimated by interpolation. This recalculation results in a decrease of emissions compared to the previous submission, where a constant value was reported from 1993 onwards.

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

Activity data for 2004 has been updated.

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

Activity data for 2004 has been updated.

Improvements emission factors

2 C 1 Iron and Steel

Emission factor for TSP, PM10 and PM2.5 for iron and steel production have been updated.

3.3.3 Major Changes SECTOR 3 SOLVENT USE

Update of activity data

NMVOC emissions from solvent use have been updated from 2002 onwards by using new activity data for 2005 as well as 2001 data of sector-specific technological and economic developments. This resulted in a decrease of total NMVOC emissions from solvent use compared to the previous submission, where emission data were constantly extrapolated from 2002 onwards.

3.3.4 Major Changes SECTOR 4 AGRICULTURE

Update of activity data

4 D 1 Direct Soil Emissions – urea consumption data

Revised urea application data from 2002 to 2004 have been used. In accordance with the other N mineral fertilizer application data, figures now relate to the economic year of the farmers and not to the calendar year.

4 D 1 Direct Soil Emissions – Grazing

Unfertilized grassland area data from 2003 to 2005 has been updated, which resulted in lower NH_3 emissions.

Improvements of methodologies and emission factors

4 B 1 a Dairy

As encouraged in the Draft LRTAP trial Centralized Review 2006, housing systems of dairy cattle have been reviewed: for 2005 a share of dairy cattle held in loose housing systems of 25% and a share of dairy cattle held in tied housing systems of 75% based on expert judgement has been applied, which resulted in higher emissions from dairy cattle.

Expert Judgement was made by the following experts:

- DI Alfred Pöllinger, Agricultural Research and Education Centre Gumpenstein. November 2006.
- Dr. Leopold Kirner, Federal Institute of Agricultural Economics. Expert judgement (November 2006) based on the following study:
  Kirner, L. (2005): Sozioökonomische Aspekte der Milchviehhaltung in Österreich. Studien zu Wettbewerbsfähigkeit, Entwicklungstendenzen und Agrarreform. Schriftenreihe der Bundesanstalt für Agrarwirtschaft Nr. 95. Wien.

4 B 1 b Non-Dairy

Due to quality checks a transcription error of N excretion values from cattle < 1 year has been corrected (25.7 kg instead of 25.3 kg/animal/year). This resulted in slightly higher NH_3 emissions.

3.3.5 Major Changes SECTOR 6 WASTE

Update of activity data

6 A 1 Managed Waste Disposal

The activity data for Residual Waste and Non-residual Waste have been updated, this results in recalculated emissions (according to the Landfill Ordinance the operators of landfill sites have to report their activity data annually. Based on reports received after the due date, there are minor changes of the activity data for the whole time series and a major change for 2004 data compared to the previous submission).

NH_3 and NMVOC recalculations also due to quality checks a calculation error in non-residual waste categories was detected and corrected, the effects on emissions are minor.

6 D Other – Compost production

The changes between 2000 and 2004 are due to updated activity data, which were compiled by looking at the waste management concepts and plans of the federal provinces (Bundesländer). This bottom-up approach led to revised data.

3.4 Recalculations per Gas

The following tables present the implication on emission trends of the methodological changes made as summarized in Chapter 3.3. Changes in the use of notation keys are also shown in the tables[61].

3.4.1 Recalculation difference of air pollutant emissions covered by the Multi-Effect Protocol and of CO emissions with respect to submission 2005

In the following the recalculation difference of air pollutant emissions covered by the Multi-Effect Protocol and of CO emissions with respect to submission 2005 are depicted in the following Table.

Detailed explanations are provided in chapters 3.1 and 3.3.

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

Table 30: Recalculation difference of emissions of air pollutants covered by the Multi-Effect Protocol and of CO with respect to submission 2005.

NFR Category		Absolute difference [Mg]							Relative difference		
		1990	1995	2000	2001	2002	2003	2004	1980 ∆%	1990 ∆%	2004 ∆%
					SO_2 emissions						
1	Energy	-0.01	-0.01	-0.09	0.16	-0.91	-0.75	-1.63	0%	0%	-6%
2	Industrial Processes	0.00	0.00	0.00	0.00	0.00	0.00	0.00	=	=	=
3	Solvent & Other Product Use										
4	Agriculture	0.00	0.00	0.00	0.00	0.00	0.00	0.00	=	=	-1%
6	Waste	0.00	0.00	0.00	0.00	0.00	0.00	0.00	=	=	=
Total Emissions		**-0.01**	**-0.01**	**-0.09**	**0.16**	**-0.91**	**-0.75**	**-1.63**	**0%**	**0%**	**-6%**
					NO_x emissions						
1	Energy	-0.53	-0.51	0.93	0.62	0.19	-0.71	-2.33	0%	0%	-1%
2	Industrial Processes	0.00	0.00	0.00	0.00	0.00	0.00	0.05	=	=	4%
3	Solvent & Other Product Use										
4	Agriculture	0.01	0.00	-0.01	-0.01	-0.01	-0.01	-0.02	0%	0%	0%
6	Waste	0.00	0.00	0.00	0.00	0.00	0.00	0.00	=	=	=
Total Emissions		**-0.52**	**-0.51**	**0.92**	**0.61**	**0.17**	**-0.73**	**-2.29**	**0%**	**0%**	**-1%**
					NMVOC emissions						
1	Energy	0.37	0.67	1.11	1.39	2.82	0.97	-0.03	0%	0%	0%
2	Industrial Processes	0.00	-3.13	-10.67	-11.03	-10.95	-11.06	-10.96	=	=	-71%
3	Solvent & Other Product Use	0.00	0.00	0.00	0.00	-1.28	-2.56	-3.84	=	=	-5%
4	Agriculture	0.00	0.00	0.00	0.00	0.00	-0.03	-0.03	0%	0%	-1%
6	Waste	0.00	0.00	0.00	0.00	0.00	0.00	-0.01	0%	0%	-8%
Total Emissions		**0.37**	**-2.47**	**-9.56**	**-9.64**	**-9.41**	**-12.67**	**-14.86**	**0%**	**0%**	**-9%**
					NH_3 emissions						
1	Energy	0.02	0.02	0.04	0.05	0.06	0.02	0.02	1%	1%	1%
2	Industrial Processes	0.00	0.00	0.00	0.00	0.00	0.00	0.00	=	=	=
3	Solvent & Other Product Use										
4	Agriculture	0.14	0.23	0.59	0.65	0.65	-0.07	0.22	0%	0%	0%
6	Waste	0.00	0.00	0.03	0.05	0.06	0.15	0.08	0%	0%	11%
Total Emissions		**0.16**	**0.25**	**0.66**	**0.74**	**0.77**	**0.10**	**0.32**	**0%**	**0%**	**0%**
					CO emissions						
1	Energy	-1.09	-0.14	4.79	7.58	18.11	-0.76	-4.20	0%	0%	-1%
2	Industrial Processes	0.00	0.00	0.00	0.00	0.00	0.00	0.04	=	=	0%
3	Solvent & Other Product Use										
4	Agriculture	0.00	0.00	0.00	0.00	0.00	-0.02	-0.02	=	=	-1%
6	Waste	0.01	0.01	0.00	0.00	0.00	0.00	-0.63	0%	0%	-9%
Total Emissions		**-1.08**	**-0.14**	**4.79**	**7.58**	**18.11**	**-0.78**	**-4.81**	**0%**	**0%**	**-1%**

3.4.2 Recalculation difference of particle matter emissions with respect to submission 2005

In the following the recalculation difference of particle matter emissions with respect to submission 2005 is depicted in the following Table.

Detailed explanations are provided in chapters 3.1 and 3.3.

Table 31: Recalculation difference of PM emissions in general with respect to submission 2005.

NFR Category	Absolute difference [Mg]							Relative difference		
	1990	1995	2000	2001	2002	2003	2004	1990 Δ%	2000 Δ%	2004 Δ%
					TSP emission					
1 Energy	-0.27	-3.47	130.80	155.85	182.99	518.91	13.46	0%	0%	0%
2 Industrial Processes	1272.94	1488.50	1310.51	1281.58	1285.88	-592.42	-597.91	5%	5%	-2%
3 Solvent & Other Product Use										
4 Agriculture	485.38	629.21	610.74	585.29	588.84	600.09	607.09	1%	2%	2%
6 Waste	0.00	0.00	0.17	-2.32	1.23	1.94	11.59	=	-2%	29%
Total Emissions	**1758.05**	**2114.24**	**2052.21**	**2020.40**	**2058.95**	**528.52**	**34.23**	**2%**	**2%**	**0%**
					PM10 emission					
1 Energy	1.27	-1.25	158.64	191.97	208.53	520.63	62.79	0%	1%	0%
2 Industrial Processes	657.73	1008.61	818.18	798.34	799.30	-441.13	-445.07	5%	6%	-3%
3 Solvent & Other Product Use										
4 Agriculture	220.51	285.85	277.46	265.90	267.51	272.62	275.80	2%	3%	3%
6 Waste	0.00	0.00	0.08	-1.10	0.58	0.92	5.48	=	-2%	29%
Total Emissions	**879.51**	**1293.21**	**1254.36**	**1255.11**	**1275.92**	**353.04**	**-100.99**	**2%**	**3%**	**0%**
					PM2.5 emission					
1 Energy	-0.06	-1.34	139.93	168.78	173.55	459.46	54.69	0%	1%	0%
2 Industrial Processes	121.57	434.19	214.44	206.74	202.84	-289.74	-292.13	2%	4%	-6%
3 Solvent & Other Product Use										
4 Agriculture	17.47	22.65	21.99	21.07	21.20	21.60	21.86	1%	1%	1%
6 Waste	0.00	0.00	0.03	-0.35	0.18	0.29	1.73	=	-2%	29%
Total Emissions	**138.98**	**455.50**	**376.38**	**396.24**	**397.77**	**191.61**	**-213.85**	**0%**	**2%**	**-1%**

3.4.3 Recalculation difference of heavy metal (HM) emissions with respect to submission 2005

In the following the recalculation difference of heavy metal emissions with respect to submission 2005 is depicted in the following Table.

Detailed explanations are provided in chapters 3.1 and 3.3.

Table 32: Recalculation difference of heavy metal emissions in general with respect to submission 2005.

NFR Category		Absolute difference [Mg]							Relative difference		
		1990	1995	2000	2001	2002	2003	2004	1985 Δ%	1990 Δ%	2004 Δ%
Cd emission											
1	Energy	0.05	0.03	0.02	0.03	0.04	0.01	-0.02	4%	4%	-3%
2	Industrial Processes	0.00	0.00	0.00	0.00	0.00	0.00	0.00	=	=	0%
3	Solvent & Other Product Use	0.00	0.00	0.00	0.00	0.00	0.00	0.00	=	=	=
4	Agriculture	0.00	0.00	0.00	0.00	0.00	0.00	0.00	=	=	-2%
6	Waste	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0%	0%	-5%
Total Emissions		**0.05**	**0.03**	**0.02**	**0.03**	**0.04**	**0.01**	**-0.02**	**2%**	**3%**	**-2%**
Hg emission											
1	Energy	0.00	0.00	0.00	0.01	0.01	-0.01	-0.01	0%	0%	-1%
2	Industrial Processes	0.00	0.00	0.00	0.00	0.00	0.00	0.00	=	=	0%
3	Solvent & Other Product Use										
4	Agriculture	0.00	0.00	0.00	0.00	0.00	0.00	0.00	=	=	-2%
6	Waste	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0%	0%	94%
Total Emissions		**0.00**	**0.00**	**0.00**	**0.01**	**0.01**	**-0.01**	**0.00**	**0%**	**0%**	**0%**
Pb emission											
1	Energy	0.02	0.00	-0.03	0.26	0.26	-0.09	0.10	0%	0%	1%
2	Industrial Processes	0.00	0.00	0.01	0.01	0.00	-0.01	0.01	=	=	0%
3	Solvent & Other Product Use	0.00	0.00	0.00	0.00	0.00	0.00	0.00	=	=	=
4	Agriculture	0.00	0.00	0.00	0.00	0.00	0.00	0.00	=	=	-3%
6	Waste	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0%	0%	-1%
Total Emissions		**0.02**	**0.00**	**-0.02**	**0.27**	**0.26**	**-0.10**	**0.11**	**0%**	**0%**	**1%**

3.4.4 Recalculation difference of POP emissions with respect to submission 2005

In the following the recalculation difference of POP emissions with respect to submission 2005 is depicted in the following Tables.

Detailed explanations are provided in chapters 3.1 and 3.3.

Table 33: Recalculation difference of POP emissions in general with respect to submission 2005.

NFR Category	Absolute difference [g]							Relative difference		
	1990	1995	2000	2001	2002	2003	2004	1985 Δ%	1990 Δ%	2004 Δ%
Dioxin emission										
1 Energy	0.13	0.14	1.57	2.55	3.78	1.71	0.52	0%	0%	1%
2 Industrial Processes	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0%	0%	0%
3 Solvent & Other Product Use	0.00	NA=	NA=	NA=	NA=	NA=	NA=	=	=	=
4 Agriculture	0.00	0.00	0.00	0.00	0.00	0.00	0.00	=	=	-2%
6 Waste	0.00	0.00	0.00	0.00	0.00	0.04	0.08	=	=	100%
Total Emissions	**0.14**	**0.15**	**1.57**	**2.56**	**3.78**	**1.75**	**0.60**	**0%**	**0%**	**1%**
HCB emission										
1 Energy	0.11	0.14	1.85	2.45	4.20	1.68	-0.58	0%	0%	-1%
2 Industrial Processes	0.00	0.00	0.00	0.00	0.00	0.00	0.00	=	=	0%
3 Solvent & Other Product Use	0.00	0.00	0.00	0.00	NA=	NA=	NA=	=	=	=
4 Agriculture	0.00	0.00	0.00	0.00	0.00	0.00	0.00	=	=	-2%
6 Waste	0.00	0.00	0.00	0.00	0.00	0.01	0.02	=	=	94%
Total Emissions	**0.11**	**0.14**	**1.85**	**2.45**	**4.20**	**1.68**	**-0.57**	**0%**	**0%**	**-1%**
PAH emission										
1 Energy	0.02	0.02	0.36	0.37	0.63	0.21	-0.09	0%	0%	-1%
2 Industrial Processes	0.00	0.00	0.00	0.00	0.00	0.00	0.00	=	=	0%
3 Solvent & Other Product Use	0.00	0.00	NA=	NA=	NA=	NA=	NA=	=	=	=
4 Agriculture	0.00	0.00	0.00	0.00	0.00	0.00	0.00	=	=	-1%
6 Waste	0.00	0.00	0.00	0.00	0.00	0.00	0.00	=	=	16%
Total Emissions	**0.02**	**0.02**	**0.36**	**0.37**	**0.63**	**0.20**	**-0.09**	**0%**	**0%**	**-1%**

4 ENERGY (NFR SECTOR 1)

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

Sector *1 Energy* considers emissions originating from *fuel combustion activities* (NFR 1 A 1)

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

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

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

4.1 Emission Trends in Energy (NFR Sector 1)

In general in 2005, NFR Category *1 Energy* is the main source of emissions in Austria. Emissions from NFR Sector *1 Energy* and trends for the period from 1990 to 2005 as well as the national share for 1990 and 2005 are presented in Table 35 and Figure 28 to Figure 31.

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

- 95% of in national total SO_2 emissions;
- 96% of in national total CO emissions and
- 97% of in national total NO_x emissions.

The energy sector is – with a share of about 47% of total NMVOC emissions – the second largest emitter of NMVOC in Austria but is – with a contribution of 4% – only minor source regarding NH_3 emissions.

Furthermore Sector *1 Energy* was responsible for more than 91% of each reported POP emissions (PAH, dioxin/furan and HCB).

Whereas only 36% of total TSP emissions resulted from Sector *1 Energy,* the share of PM10 and PM2.5 amount to 50% and 75% respectively. The higher share of finest particles is due to efficient combustion, waste gas treatment and installation of filters, which mainly hold off larger particles.

Sector *Energy* is also an important source for heavy metals emissions; in 2005 the energy sector was responsible for 79% of total Cd emissions, 67% of total Hg emissions, and 52% of total Pb emissions.

Table 34 presents the source categories from the energy sector and their contribution to national total emissions. Furthermore sources which are key sources of the Austrian inventory are highlighted (for details of the key source analysis see Chapter 1.4).

Table 34: Key source in NFR Sector 1 Energy.

Pollutant	Source category					
	1 A 1	1 A 2	1 A 3	1 A 4	1 A 5	1 B
SO_2	26.1%	34.8%	1.1%	32.5%	0.1%	0.5%
NO_x	5.6%	15.4%	60.1%	15.8%	0.1%	
NMVOC	0.8%	2.0%	13.6%	28.4%	0.0%	2.0%
NH_3	0.5%	0.4%	1.8%	1.2%	0.0%	
CO	0.5%	22.0%	22.6%	50.4%	0.1%	
Cd	24.0%	16.7%	7.7%	31.0%	0.0%	
Hg	20.1%	24.4%	0.3%	21.8%	0.0%	
Pb	10.1%	22.0%	0.1%	19.5%	0.0%	
PAH	0.1%	2.0%	18.0%	75.1%	0.0%	
Diox	1.5%	11.7%	2.9%	74.9%	0.0%	
HCB	0.6%	3.2%	0.5%	87.4%	0.0%	
TSP	1.1%	2.8%	19.4%	11.7%	0.0%	0.7%
PM10	2.0%	5.3%	20.1%	21.7%	0.1%	0.6%
PM2.5	2.9%	8.2%	28.5%	34.5%	0.2%	0.3%

Note: grey shaded are key sources

4.1.1 NEC gases and CO Emissions

SO_2 Emissions (key source)

SO_2 emissions from NFR Category 1 Energy were reduced over the period from 1990 to 2005: as can be seen in Table 35 and Figure 28 in 1990 emissions amounted to 72 Gg, in 2005 they were 65% lower (25 Gg).

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

The share of SO_2 emissions from this sector in national total emissions was about 97% in 1990 and about 95% in 2005. Within this source the main sources for SO_2 emissions are NFR 1 A 2 *Manufacture of Solid fuels and Other Energy Industries* and NFR 1 A 4 *Other Sectors* with a contribution of 35% and 32%, respectivley.

NO_x Emissions (key source)

As can be seen in Table 35 and Figure 28 NO_x emissions from the Sector *Energy* increased over the period from 1990 to 2005. In 1990 they amounted to 200 Gg, in the year 2005 they were about 9% above 1990 levels (218 Gg). Even if efforts were made regarding emission control in combustion plants, this was counterbalanced by increasing activity of the transport sector in passenger as well as freight transport (NFR *1 A 3 Transport)*.

The share of NO_x emissions from this sector in national total NO_x emissions amounted to about 95% in 1990 and about 97% in 2005. The main source for NO_x emissions in NFR *1 Energy* with a contribution of 51% in 1990 and 62% in 2005 is *1 A 3 Transport*, here especially road transport. Other important sources are NFR 1 A 2 *Manufacture of Solid fuels and Other Energy Industries* with a contribution of 15% and NFR 1 A 4 *Other Sectors* with a contribution of 16% in national total.

NMVOC Emissions (key source)

In 2005 NFR Category *1 Energy* was the second largest sector regarding NMVOC emissions in Austria. In 1990 the contribution to national total emissions was 54% (155 Gg) compared to 47% (72 Gg) in 2005 due to exhaust-gas limits for vehicles and increasing number of diesel-driven vehicles as well as applied abatement techniques and improved biomass heatings in households.

NMVOC emissions from *1 Energy* are continuously decreasing: in the period from 1990 to 2005 emissions decreased by 53%, mainly due to decreasing emissions from NFR *1 A 3 Transport* and NFR *1 A 4 Other Sectors*, which are the main contributors to NMVOC emissions from the energy sector (see Table 35 and Figure 28).

CO Emissions (key source)

NFR *1 Energy* is the largest sector regarding CO emissions. As can be seen in Table 35 and Figure 28, CO emissions from the *Energy sector* decreased by 41% over the period 1990–2005. CO emissions amounted to about 1162 Gg in 1990 and to about 689 Gg in 2005. The main source for CO emissions of NFR Category *1 Energy* with a contribution of 53% in 2005 was NFR *1 A 4 Other Sectors*, here mainly residential biomass heatings.

The share of CO emissions from this sector in national total emissions even slightly increased from about 95% in 1990 to about 96% in 2005 because efforts regarding abatement techniques and improved combustion efficiency in all sub-sectors of NFR *1 Energy* as well as other sectors were counterbalanced by enormously increased individual transport and freight transport.

NH_3 Emissions (key source)

NH_3 emissions from NFR *1 Energy* is the second largest sector regarding NH_3 emissions but this sector is only a minor source of NH_3 emissions with a contribution to national total NH_3 emissions of 3% in 1990 and 4% in 2005 respectively. However, the sub category *1 A 3 Transport* is a key category of the Austrian inventory – in 2005 it contributed 1.8% to national total emissions.

NH_3 emissions from NFR *1 Energy* are increasing: in 1990 emissions amounted to about 2.0 Gg, in the year 2005 they were about 18% higher than 1990 levels and amounted to about 2.5 Gg.

4.1.2 Particle Matter (PM) Emissions (key source)

The Sector *Energy* is an important source for PM emissions in Austria. All major sub categories are key sources of the Austrian Inventory regarding all three reported fractions of PM. As shown in Table 35 and Figure 29 in the period from 1990 to 2005:

- **TSP** emissions remained stable at about 33 Gg, which is a share of 36% in total TSP emissions in 2005.
- **PM10** emissions decreased by about 7% to 23 Gg, which is a share of 50% in total TSP emissions in 2005.
- **PM2.5** emissions decreasd by about 8% to 20 Gg, which is a share of 75% in total TSP emissions in 2005.

In 2005 within this source NFR *1 A 3 Transport* and *1 A 4 Other Sectors* have the highest contribution to TSP, PM10 and PM2.5 emissions. Whereas 36% of the national TSP emission resulted from Sector *Energy*, the share in PM10 emissions is 50% and in PM2.5 75%. The high share of this sector in total PM2.5 emissions is due to diesel engines and applied abatement techniques which mainly reduce larger particles.

4.1.3 Heavy metal Emissions (key source)

The Sector *Energy* is also an important source for HM emissions in Austria. All major sub categories are key sources of the Austrian Inventory regarding all three reported HM. As shown in shown in Table 35 and Figure 30 in the period from 1990 to 2005

- **Cd** emissions decreased by 19% to 0.9 Mg, which is a share of 79% in national total Cd emission in 2005.

  In 2005 within this source NFR *1 A 1 Energy Industries* and *1 A 4 Other Sectors* have the highest contribution to Cd emissions. 31% of national Cd emission resulted from NFR *1 A 4 Other Sectors*, where biomass is used for space and water heating in the commercial, agricultural and household sector, 24% arise from NFR *1 A 1 Energy Industries* and 17% from NFR *1 A 2 Manufacturing Industries and Construction*.

- **Hg** emissions decreased by 58% to 0.65 Mg, which is a share of 67% in national total Hg emissions in 2005.

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

- **Pb** emissions decreased by about 96% to 7 Mg, which is a share of 52% in national total Pb emission in 2005. The enoumous reduction was achieved by elimination of Pb in motor gasoline but also by different abatement techniqes such as filter installation and wet flue gas treatment. Within this source the sub categories NFR *1 A 2 Manufacturing Industries and Constrution* and *1 A 4 Other Sectors* contribute each about one-fifth to total Pb emissions; NFR *1 A 1 Energy* contributes about 10%.

4.1.4 POP Emissions (key source)

The Sector *Energy* is also an important source for POP emissions in Austria. Several sub categories are key sources of the Austrian Inventory regarding all three reported POP. As shown in Table 35 and Figure 31 in the period from 1990 to 2005

- **PAH** emissions decreased by about 11% to 8 Mg, which is a share of 95% in national total PAH emission in 2005.

  In 2005 within this source NFR *1 A 4 Other Sectors* has the highest contribution (75%) to PAH emissions, where biomass is mainly used for space and water heating in the commercial, agricultural and household sector. Emissions of NFR *1 A 3 Transport* contributes 18% to national PAH emissions.

- **Dioxin/furan** emissions decreased by about 62% to 39 g, which is a share of 91% in national total dioxin/furan emissions in 2005.

As for PAH emissions, within this source NFR *1 A 4 Other Sectors* has the highest contribution (75%) to dioxin/furan emissions due to biomass heatings. Emissions of NFR *1 A 2 Manufacturing Industries and Constrution* amount to 12% of national dioxin/furan emissions.

- **HCB** emissions decreased by about 42% to 42 kg, which is a share of 92% in national total HCB emission in 2005.

  As for PAH and Dioxin/furan emissions, within this source NFR *1 A 4 Other Sectors* has the highest contribution (87%) to HCB emissions. Emissions of the others sub categories NFR *1 A 1*, NFR *1 A 2*, NFR *1 A 3* and NFR *1 A 5* contribute together only 4% of national HCB emissions.

Table 35: Emissions from NFR Sector 1 and trends 1990–2005.

Year	SO_2	NO_x	NMVOC	CO	NH_3	TSP	PM10	PM2.5	Cd	Hg	Pb	PAH	Dioxin	HCB
	[Gg]					[Mg]			[Mg]			[Mg]	[g]	[kg]
1990	71.92	200.09	154.68	1 161.83	2.04	32 631.46	24 225.12	21 135.60	1.06	1.56	173.66	9.44	101.56	72.31
1991	69.39	211.45	157.33	1 186.85	2.50	NR	NR	NR	1.09	1.50	143.23	10.29	80.65	69.52
1992	53.20	198.87	145.16	1 139.85	2.69	NR	NR	NR	0.97	1.18	100.14	9.36	53.54	56.65
1993	51.85	194.58	139.41	1 095.00	2.96	NR	NR	NR	0.93	0.95	70.19	9.26	49.15	53.42
1994	46.09	186.26	127.44	1 041.62	3.04	NR	NR	NR	0.87	0.76	47.05	8.37	44.38	47.90
1995	45.39	184.38	122.55	954.09	3.08	32 548.04	23 574.93	20 608.03	0.80	0.71	11.33	8.83	45.68	50.12
1996	43.31	204.77	121.14	971.34	3.10	NR	NR	NR	0.84	0.71	11.18	9.56	48.19	53.14
1997	39.03	191.86	103.37	906.31	2.99	NR	NR	NR	0.81	0.69	9.69	8.58	47.15	49.12
1998	34.33	204.55	97.50	870.37	3.03	NR	NR	NR	0.73	0.60	8.23	8.28	44.42	46.43
1999	32.56	192.58	92.48	826.02	2.93	32 609.30	23 204.37	20 183.31	0.81	0.65	7.67	8.32	41.01	44.89
2000	30.27	197.62	85.00	766.04	2.73	31 616.11	22 196.27	19 253.86	0.75	0.64	6.38	7.73	37.29	40.76
2001	31.75	206.59	83.44	756.51	2.79	32 844.76	23 230.74	20 150.76	0.80	0.71	6.92	8.51	41.04	44.96
2002	30.65	212.71	79.20	723.48	2.74	32 677.31	22 955.14	19 898.27	0.81	0.67	6.84	8.17	38.83	41.99
2003	31.36	222.48	77.35	728.75	2.76	33 077.75	23 223.56	20 106.24	0.83	0.69	7.05	8.33	38.98	42.03
2004	25.98	218.04	73.29	704.96	2.58	32 698.99	22 760.91	19 662.62	0.83	0.66	7.18	8.16	37.67	40.22
2005	25.13	218.50	72.01	688.99	2.49	32 576.05	22 615.50	19 503.85	0.86	0.65	7.02	8.45	38.76	41.65
Trend														
1990–2005	*-65.1%*	*9.2%*	*-53.4%*	*-40.7%*	*21.8%*	*-0.2%*	*-6.6%*	*-7.7%*	*-18.8%*	*-58.4%*	*-96.0%*	*-10.5%*	*-61.8%*	*-42.4%*
2004–2005	*-3.3%*	*0.2%*	*-1.7%*	*-2.3%*	*-3.4%*	*-0.4%*	*-0.6%*	*-0.8%*	*3.7%*	*-1.0%*	*-2.2%*	*3.5%*	*2.9%*	*3.6%*
National Share														
1990	*96.9%*	*94.8%*	*54.3%*	*95.2%*	*3.0%*	*35.6%*	*50.9%*	*73.9%*	*67.1%*	*72.8%*	*84.0%*	*54.7%*	*63.5%*	*79.0%*
2005	*95.2%*	*97.1%*	*46.7%*	*95.7%*	*3.9%*	*35.7%*	*49.7%*	*74.7%*	*79.4%*	*66.6%*	*51.7%*	*95.3%*	*90.9%*	*91.7%*

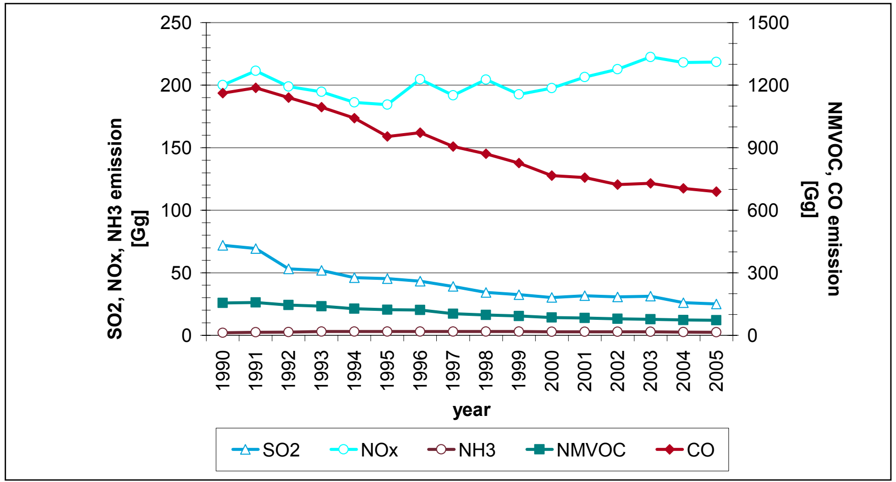


Figure 28: NEC gas emissions and CO emission from NFR Sector 1 Energy 1990–2005.

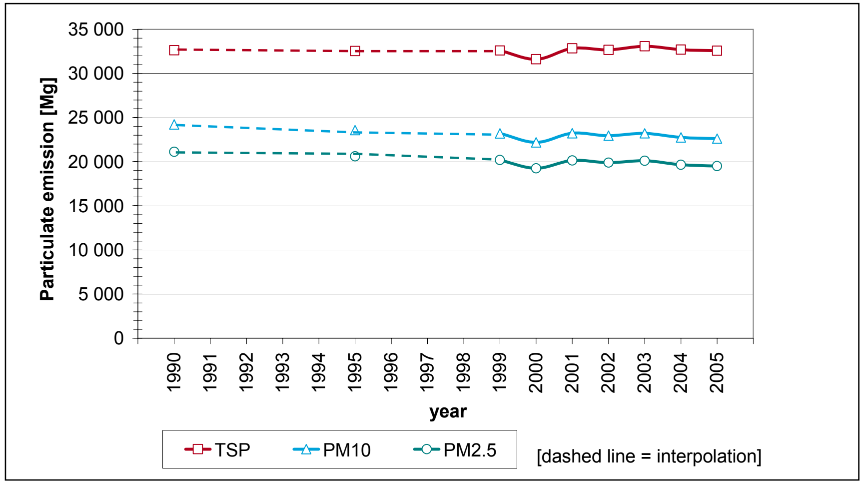


Figure 29: PM emissions from NFR Sector 1 Energy 1990–2005.

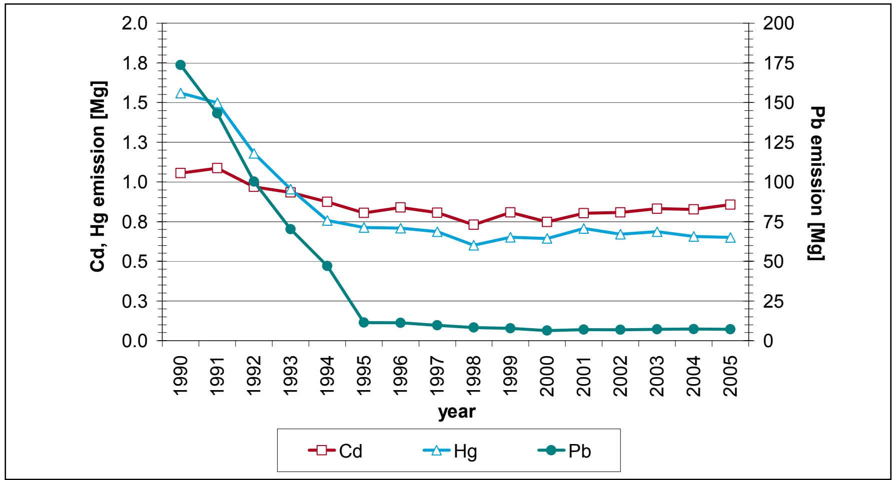


Figure 30: Heavy metal emissions from NFR Sector 1 Energy 1990–2005.

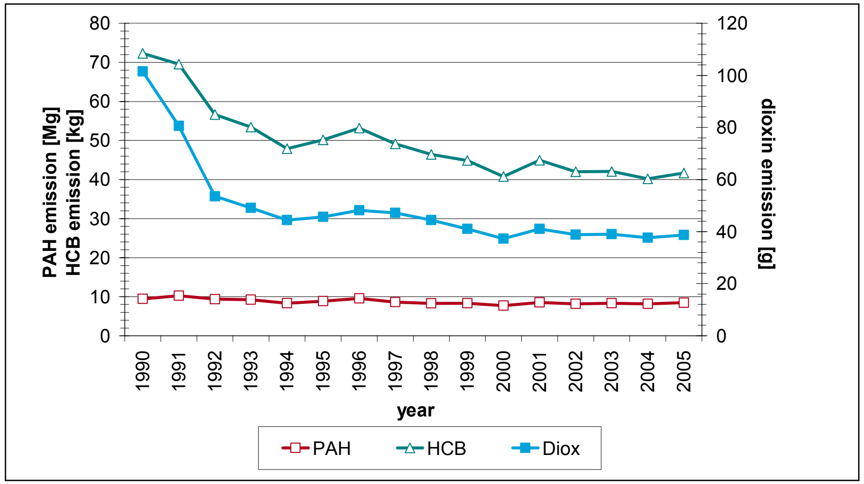


Figure 31: POP emissions from NFR Sector 1 Energy 1990–2005.

4.2 NFR 1 A Stationary Fuel Combustion Activities

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

4.2.1 Gerneral discription

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

Information is also provided in the Austrian National Inventory Report 2007 (UMWELTBUNDESAMT 2007a) which is part of the submission under the UNFCCC.

- Additionally to information provided in this document, Annex 2 of (UMWELTBUNDESAMT 2007a) 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 2007a).

Completeness

Table 36 provides information on the status of emission estimates of all sub categories. A "✓" indicates that emissions from this sub category have been estimated.

Table 36: 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	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

NFR Category	NO_x	CO	NMVOC	SO_x	NH_3	TSP	PM10	PM2.5	Pb	Cd	Hg	DIOX	PAH	HCB
1 A 2 e Food Processing, Beverages and Tobacco	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
1 A 2 f Other	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
1 A 3 e i Pipeline compressors	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	NE (6)	NA (7)	✓
1 A 4 a Commer-cial/Institutional	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
1 A 4 b i Residential plants	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
1 A 4 c i Agriculture/ Forestry/Fishing, Stationary	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
1 A 5 a Other, Stationary (including Military)	IE(2)	IE(2)	IE(2)	IE(2)	IE(2)	IE(2)	IE(2)	IE(2)	IE(2)	IE(2)	IE(2)	IE(2)	IE(2)	IE(2)

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

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

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

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

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

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

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

Table 37 shows the correspondence of NFR and SNAP categories.

Table 37: NFR and SNAP categories of "1 A Stationary Fuel Combustion Activities".

NFR Category	SNAP
1 A 1 a Public Electricity and Heat Production	0101 Public power 0102 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	010503 Oil/Gas Extraction plants
1 A 2 a Iron and Steel	0301 Comb. In boilers, gas turbines and stationary engines (Iron and Steel Industry) 030302 Reheating furnaces steel and iron 030326 Processes with Contact-Other(Iron and Steel Industry)
1 A 2 b Non-ferrous Metals	0301 Comb. In boilers, gas turbines and stationary engines (Non-ferrous Metals Industry) 030307 Secondary lead production 030309 Secondary copper production 030310 Secondary aluminium production 030324 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)

NFR Category	SNAP
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 Other	0301 Comb. in boilers, gas turbines and stationary engines (Other Industry) 030311 Cement 030317 Glass 030312 Lime 030319 Bricks and Tiles 030323 Magnesium production (dolomite treatment)
1 A 3 e Other	010506 Pipeline Compressors
1 A 4 a Commercial/Institutional	0201 Commercial and institutional plants
1 A 4 b Residential	0202 Residential plants
1 A 4 c Agriculture/Forestry/ Fisheries	0203 Plants in agriculture, forestry and aquaculture

4.2.2 Methodological issues

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

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

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

Emission factors

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

Emission factors may vary over time for the following reasons:

- The chemical characteristics of a fuel category varies, e.g. sulphur content in residual oil.
- The mix of fuels of a fuel category changes over time. If the different fuels of a fuel category have different calorific values and their share in the fuel category changes, the calorific value of the fuel category might change over time. If emission factors are in the unit kg/t the transformation to kg/TJ induces a different emission factor due to varying net calorific values.
- The 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 the national studies only emission factors for VOC are cited. NMVOC emissions are calculated by subtracting 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 sulpur content higher than 1% is limited to special power plants ≥ 50 MW and the oil refinery. Heating fuel oil is mainy 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 38: Limited sulphur content of oil product classes according to the Austrian standard „ÖNORM".

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

Activity data

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

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

- Emissions from international bunker fuels are not included in the National Total but reported separately as *Memo Item*.

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

Measured emissions

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

4.2.3 NFR 1 A 1 Energy Industries

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

Emission Trend

While total fuel consumption increased by 31% from 186 PJ in 1990 to 247 PJ in 2005,

- a decrease in emission due to fuel switches and the implementation of abatement techniques could be noted for
  - SO_2 emissions (-51%); Between 2000 to 2004 SO_2 emissions increased due to rising coal consumption of public power plants.
  - NO_x emissions (-26%)
  - CO emissions (-44%)
  - TSP, PM10, PM2.5 emissions (-2%, -4%, -4%)
  - Hg emissions (-41%)
  - dioxin/furan emissions (-20%).
- an increase in emissions mainly driven by the increase of coal, biomass and natural gas consumption could be noted for
  - NMVOC emissions (+55%)
  - NH_3 emissions (+52%)
  - Cd and Pb emissions (+32% and +24%)
  - PAH and HCB emissions (+133% and +33%).

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

Table 39: SO_2 and NO_x emissions and trends from Sector 1 A 1 Energy Industries and source categories 1990–2005.

Year	SO_2 [Gg]	1	1 A	1 A 1	1 A 1 a	1 A 1 b	1 A 1 c	NO_x [Gg]	1	1 A	1 A 1	1 A 1 a	1 A 1 b	1 A 1 c
1990		71.92	69.92	14.04	11.79	2.25	0.00		200.09	200.09	17.23	12.09	4.32	0.83
1991		69.39	68.09	15.42	13.31	2.11	0.00		211.45	211.45	16.56	11.40	4.32	0.84
1992		53.20	51.20	8.58	5.74	2.85	0.00		198.87	198.87	14.09	9.10	4.19	0.79
1993		51.85	49.75	10.06	6.64	3.42	0.00		194.58	194.58	11.79	7.55	3.40	0.84
1994		46.09	44.81	7.72	4.69	3.03	0.00		186.26	186.26	10.68	6.45	3.41	0.82
1995		45.39	43.86	8.92	5.93	2.98	0.00		184.38	184.38	11.94	7.66	3.38	0.89
1996		43.31	42.11	7.80	4.31	3.49			204.77	204.77	10.84	6.84	3.48	0.52
1997		39.03	38.97	9.08	5.42	3.66			191.86	191.86	11.80	7.69	3.47	0.64
1998		34.33	34.29	7.33	3.53	3.80			204.55	204.55	10.45	6.54	3.36	0.55
1999		32.56	32.42	7.38	3.83	3.55			192.58	192.58	10.30	6.67	3.25	0.38
2000		30.27	30.12	7.13	3.69	3.44			197.62	197.62	10.55	6.94	3.07	0.54
2001		31.75	31.59	7.96	4.35	3.62			206.59	206.59	12.10	8.29	3.30	0.51
2002		30.65	30.51	7.66	3.97	3.69			212.71	212.71	11.86	7.95	3.44	0.47
2003		31.36	31.21	7.97	4.25	3.68			222.48	222.48	13.81	9.78	3.34	0.69
2004		25.98	25.84	7.64	3.80	3.84			218.04	218.04	13.94	9.81	3.44	0.70
2005		25.13	25.00	6.90	3.55	3.35			218.50	218.50	12.69	8.90	3.05	0.74
Trend														
1990–2005		*-65%*	*-64%*	*-51%*	*-70%*	*49%*	*-100%*		*9.2%*	*9.2%*	*-26.4%*	*-26.3%*	*-29.3%*	*-11.0%*
2004–2005		*-3%*	*-3%*	*-10%*	*-7%*	*-13%*			*0.2%*	*0.2%*	*-9.0%*	*-9.2%*	*-11.2%*	*5.4%*
Share in Sector 1 A 1 Energy Industries														
1990			*97%*	*20%*	*16%*	*3%*	*< 0.1%*			*100.0%*	*8.6%*	*6.0%*	*2.2%*	*0.4%*
2005			*99%*	*27%*	*14%*	*13%*				*100.0%*	*5.8%*	*4.1%*	*1.4%*	*0.3%*
Share in National Total														
1990		*97%*	*94%*	*19%*	*16%*	*3%*	*<0.1%*		*94.8%*	*94.8%*	*8.2%*	*5.7%*	*2.0%*	*0.4%*
2005		*95%*	*95%*	*26%*	*13%*	*13%*			*97.1%*	*97.1%*	*5.6%*	*4.0%*	*1.4%*	*0.3%*

Table 40: NMVOC and CO emissions and trends from Sector 1 A 1 Energy Industries and source categories 1990–2005.

Year	NMVOC [Gg] 1	1 A	1 A 1	1 A 1 a	1 A 1 b	1 A 1 c	CO [Gg] 1	1 A	1 A 1	1 A 1 a	1 A 1 b	1 A 1 c
1990	154.68	142.47	0.77	0.77	IE	0.00	1 161.83	1 161.83	6.06	1.36	4.65	0.06
1991	157.33	144.16	0.83	0.83	IE	0.00	1 186.85	1 186.85	2.50	1.64	0.80	0.06
1992	145.16	132.04	0.73	0.72	IE	0.00	1 139.85	1 139.85	1.84	1.34	0.45	0.05
1993	139.41	126.55	0.75	0.74	IE	0.00	1 095.00	1 095.00	1.50	0.99	0.46	0.06
1994	127.44	117.19	0.74	0.74	IE	0.00	1 041.62	1 041.62	1.69	1.12	0.52	0.05
1995	122.55	113.73	0.74	0.73	IE	0.00	954.09	954.09	2.32	1.71	0.55	0.06
1996	121.14	113.24	0.81	0.81	IE	0.00	971.34	971.34	2.25	1.78	0.44	0.03
1997	103.37	96.01	0.68	0.68	IE	0.00	906.31	906.31	2.45	1.67	0.74	0.04
1998	97.50	91.65	0.75	0.75	IE	0.00	870.37	870.37	1.88	1.49	0.35	0.04
1999	92.48	87.35	0.75	0.75	IE	0.00	826.02	826.02	2.53	2.04	0.46	0.03
2000	85.00	79.83	0.67	0.67	IE	0.00	766.04	766.04	2.72	2.10	0.58	0.04
2001	83.44	80.13	0.79	0.79	IE	0.00	756.51	756.51	3.13	2.60	0.49	0.03
2002	79.20	75.73	0.77	0.77	IE	0.00	723.48	723.48	3.30	2.54	0.72	0.03
2003	77.35	73.91	0.86	0.86	IE	0.00	728.75	728.75	4.00	3.08	0.87	0.05
2004	73.29	70.02	0.88	0.88	IE	0.00	704.96	704.96	4.08	3.16	0.87	0.05
2005	72.01	68.92	1.19	1.19	IE	0.00	688.99	688.99	3.38	2.91	0.42	0.05
Trend												
1990–2005	*-53%*	*-52%*	*55%*	*55%*		*-12%*	*-40.7%*	*-40.7%*	*-44.2%*	*114.5%*	*-90.9%*	*-11.7%*
2004–2005	*-2%*	*-2%*	*35%*	*35%*		*5%*	*-2.3%*	*-2.3%*	*-17.1%*	*-8.0%*	*-51.3%*	*5.4%*
Share in Sector 1 A 1 Energy Industries												
1990		*92%*	*0%*	*0%*		*< 0.1%*		*100.0%*	*0.5%*	*0.1%*	*0.4%*	*< 0.1%*
2005		*96%*	*2%*	*2%*		*< 0.1%*		*100.0%*	*0.5%*	*0.4%*	*0.1%*	*< 0.1%*
Share in National Total												
1990	*54%*	*50%*	*0%*	*0%*		*< 0.1%*	*95.2%*	*95.2%*	*0.5%*	*0.1%*	*0.4%*	*< 0.1%*
2005	*47%*	*45%*	*1%*	*1%*		*< 0.1%*	*95.7%*	*95.7%*	*0.5%*	*0.4%*	*0.1%*	*< 0.1%*

Table 41: NH_3 emissions and trends from Sector 1 A 1 Energy Industries and source categories 1990–2005.

Year	NH_3 [Gg] 1	1 A	1 A 1	1 A 1 a	1 A 1 b	1 A 1 c
1990	2.042	2.042	0.201	0.109	0.086	0.006
1991	2.504	2.504	0.210	0.121	0.083	0.006
1992	2.689	2.689	0.205	0.117	0.083	0.005
1993	2.959	2.959	0.236	0.138	0.093	0.006
1994	3.044	3.044	0.240	0.138	0.096	0.005
1995	3.078	3.078	0.227	0.133	0.088	0.006
1996	3.096	3.096	0.254	0.159	0.091	0.003
1997	2.995	2.995	0.256	0.160	0.091	0.004
1998	3.026	3.026	0.274	0.179	0.091	0.004
1999	2.933	2.933	0.258	0.174	0.082	0.003
2000	2.728	2.728	0.228	0.143	0.081	0.004
2001	2.789	2.789	0.251	0.164	0.083	0.003
2002	2.740	2.740	0.252	0.163	0.086	0.003
2003	2.755	2.755	0.283	0.193	0.085	0.005
2004	2.576	2.576	0.304	0.208	0.091	0.005
2005	2.488	2.488	0.305	0.218	0.083	0.005
Trend						
1990–2005	*21.8%*	*21.8%*	*52.2%*	*99.6%*	*-3.8%*	*-13.3%*
2004–2005	*-3.4%*	*-3.4%*	*0.5%*	*4.5%*	*-8.9%*	*5.4%*
Share in Sector 1 A 1 Energy Industries						
1990		*100.0%*	*9.8%*	*5.3%*	*4.2%*	*0.3%*
2005		*100.0%*	*12.3%*	*8.8%*	*3.3%*	*0.2%*
Share in National Total						
1990	*3.0%*	*3.0%*	*0.3%*	*0.2%*	*0.1%*	*0.0%*
2005	*3.9%*	*3.9%*	*0.5%*	*0.3%*	*0.1%*	*0.0%*

Table 42: *Cd and Hg emissions and trends from Sector 1 A 1 Energy Industries and source categories 1990–2005.*

Year	Cd [Mg]	1	1 A	1 A 1	1 A 1 a	1 A 1 b	1 A 1 c	Hg [Mg]	1	1 A	1 A 1	1 A 1 a	1 A 1 b	1 A 1 c
1990		1.0560	1.0560	0.1970	0.1064	0.0906			1.5595	1.5595	0.3350	0.3281	0.0069	
1991		1.0864	1.0864	0.2152	0.1142	0.1011			1.4990	1.4990	0.3487	0.3410	0.0077	
1992		0.9685	0.9685	0.1782	0.0793	0.0989			1.1796	1.1796	0.2337	0.2262	0.0075	
1993		0.9337	0.9337	0.1957	0.0717	0.1240			0.9550	0.9550	0.1959	0.1865	0.0095	
1994		0.8737	0.8737	0.1869	0.0597	0.1272			0.7578	0.7578	0.1805	0.1708	0.0097	
1995		0.8050	0.8050	0.1701	0.0598	0.1103			0.7125	0.7125	0.1961	0.1876	0.0085	
1996		0.8397	0.8397	0.1930	0.0604	0.1326			0.7087	0.7087	0.1942	0.1842	0.0100	
1997		0.8059	0.8059	0.1963	0.0578	0.1385			0.6865	0.6865	0.1954	0.1849	0.0105	
1998		0.7304	0.7304	0.1858	0.0520	0.1338			0.6008	0.6008	0.1565	0.1464	0.0101	
1999		0.8083	0.8083	0.2134	0.0699	0.1435			0.6513	0.6513	0.1861	0.1753	0.0108	
2000		0.7473	0.7473	0.2000	0.0649	0.1350			0.6434	0.6434	0.2077	0.1975	0.0102	
2001		0.8034	0.8034	0.2294	0.0783	0.1511			0.7064	0.7064	0.2301	0.2188	0.0113	
2002		0.8072	0.8072	0.2513	0.0775	0.1738			0.6700	0.6700	0.2118	0.1988	0.0130	
2003		0.8312	0.8312	0.2560	0.0886	0.1673			0.6869	0.6869	0.2332	0.2206	0.0126	
2004		0.8267	0.8267	0.2476	0.0824	0.1652			0.6559	0.6559	0.2146	0.1998	0.0148	
2005		0.8572	0.8572	0.2593	0.0800	0.1793			0.6495	0.6495	0.1964	0.1872	0.0092	
Trend														
1990–2005		*-18.8%*	*-18.8%*	*31.6%*	*-24.9%*	*97.9%*			*-58.4%*	*-58.4%*	*-41.4%*	*-42.9%*	*34.0%*	
2004–2005		*3.7%*	*3.7%*	*4.7%*	*-3.0%*	*8.6%*			*-1.0%*	*-1.0%*	*-8.5%*	*-6.3%*	*-37.9%*	
Share in Sector 1 A 1 Energy Industries														
1990			*100.0%*	*18.7%*	*10.1%*	*8.6%*				*100.0%*	*21.5%*	*21.0%*	*0.4%*	
2005			*100.0%*	*30.3%*	*9.3%*	*20.9%*				*100.0%*	*30.2%*	*28.8%*	*1.4%*	
Share in National Total														
1990		*67.1%*	*67.1%*	*12.5%*	*6.8%*	*5.8%*			*72.8%*	*72.8%*	*15.6%*	*15.3%*	*0.3%*	
2005		*79.4%*	*79.4%*	*24.0%*	*7.4%*	*16.6%*			*66.6%*	*66.6%*	*20.1%*	*19.2%*	*0.9%*	

Table 43: Pb and PAH emissions and trends from Sector 1 A 1 Energy Industries and source categories 1990–2005.

Year	Pb [Mg]	1	1 A	1 A 1	1 A 1 a	1 A 1 b	1 A 1 c	PAH [Mg]	1	1 A	1 A 1	1 A 1 a	1 A 1 b	1 A 1 c
1990		173.66	173.66	1.10	0.93	0.18			9.441	9.441	0.006	0.004	0.002	0.000
1991		143.23	143.23	1.17	0.97	0.20			10.294	10.294	0.006	0.004	0.002	0.000
1992		100.14	100.14	0.97	0.78	0.19			9.363	9.363	0.007	0.005	0.002	0.000
1993		70.19	70.19	0.85	0.61	0.24			9.259	9.259	0.009	0.006	0.003	0.000
1994		47.05	47.05	0.79	0.54	0.25			8.373	8.373	0.009	0.006	0.003	0.000
1995		11.33	11.33	0.75	0.54	0.22			8.833	8.833	0.008	0.006	0.003	0.000
1996		11.18	11.18	0.91	0.64	0.26			9.557	9.557	0.009	0.006	0.002	
1997		9.69	9.69	0.97	0.69	0.28			8.582	8.582	0.010	0.007	0.003	
1998		8.23	8.23	0.89	0.62	0.27			8.285	8.285	0.011	0.008	0.003	
1999		7.67	7.67	0.95	0.67	0.29			8.319	8.319	0.011	0.009	0.002	
2000		6.38	6.38	1.12	0.85	0.27			7.731	7.731	0.011	0.008	0.002	
2001		6.92	6.92	1.32	1.02	0.30			8.511	8.511	0.013	0.010	0.002	
2002		6.84	6.84	1.39	1.04	0.35			8.175	8.175	0.013	0.010	0.003	
2003		7.05	7.05	1.61	1.27	0.33			8.329	8.329	0.015	0.012	0.003	
2004		7.18	7.18	1.67	1.28	0.39			8.161	8.161	0.015	0.012	0.003	
2005		7.02	7.02	1.37	1.13	0.24			8.447	8.447	0.013	0.011	0.002	
Trend														
1990–2005		*-96.0%*	*-96.0%*	*24.4%*	*21.9%*	*37.4%*			*-10.5%*	*-10.5%*	*133.1%*	*200.5%*	*9.3%*	*-100.0%*
2004–2005		*-2.2%*	*-2.2%*	*-18.1%*	*-11.9%*	*-38.4%*			*3.5%*	*3.5%*	*-15.3%*	*-10.4%*	*-33.9%*	
Share in Sector 1 A 1 Energy Industries														
1990			*100.0%*	*0.6%*	*0.5%*	*0.1%*				*100.0%*	*0.1%*	*<0.1%*	*<0.1%*	*< 0.1%*
2005			*100.0%*	*19.5%*	*16.1%*	*3.5%*				*100.0%*	*0.2%*	*0.1%*	*<0.1%*	
Share in National Total														
1990		*84.0%*	*84.0%*	*0.5%*	*0.4%*	*0.1%*			*54.7%*	*54.7%*	*0.0%*	*<0.1%*	*<0.1%*	*< 0.1%*
2005		*51.7%*	*51.7%*	*10.1%*	*8.3%*	*1.8%*			*95.3%*	*95.3%*	*0.1%*	*0.1%*	*<0.1%*	

Table 44: Dioxin and HCB emissions and trends from Sector 1 A 1 Energy Industries and source categories 1990–2005.

Year	Dioxin [g]	1	1 A	1 A 1	1 A 1 a	1 A 1 b	1 A 1 c	HCB [kg]	1	1 A	1 A 1	1 A 1 a	1 A 1 b	1 A 1 c
1990		101.557	101.557	0.822	0.801	0.020	0.001		72.313	72.313	0.207	0.204	0.002	0.000
1991		80.645	80.645	0.853	0.832	0.019	0.001		69.519	69.519	0.227	0.224	0.003	0.000
1992		53.535	53.535	1.045	1.024	0.019	0.001		56.647	56.647	0.246	0.244	0.002	0.000
1993		49.153	49.153	0.268	0.246	0.020	0.001		53.421	53.421	0.184	0.181	0.003	0.000
1994		44.384	44.384	0.286	0.265	0.020	0.001		47.895	47.895	0.194	0.191	0.003	0.000
1995		45.681	45.681	0.326	0.306	0.019	0.001		50.119	50.119	0.204	0.201	0.003	0.000
1996		48.191	48.191	0.368	0.347	0.020	0.001		53.142	53.142	0.211	0.209	0.003	0.000
1997		47.149	47.149	0.389	0.368	0.020	0.001		49.121	49.121	0.218	0.216	0.003	0.000
1998		44.420	44.420	0.397	0.376	0.020	0.001		46.429	46.429	0.214	0.212	0.003	0.000
1999		41.011	41.011	0.452	0.434	0.018	0.001		44.891	44.891	0.261	0.259	0.002	0.000
2000		37.295	37.295	0.550	0.532	0.017	0.001		40.763	40.763	0.270	0.267	0.002	0.000
2001		41.039	41.039	0.595	0.576	0.018	0.001		44.959	44.959	0.272	0.269	0.002	0.000
2002		38.830	38.830	0.630	0.611	0.018	0.001		41.992	41.992	0.280	0.277	0.003	0.000
2003		38.983	38.983	0.735	0.716	0.018	0.001		42.032	42.032	0.289	0.286	0.003	0.000
2004		37.667	37.667	0.724	0.705	0.019	0.001		40.218	40.218	0.289	0.287	0.003	0.000
2005		38.760	38.760	0.655	0.635	0.019	0.001		41.655	41.655	0.275	0.272	0.003	0.000
Trend														
1990–2005		*-96.0%*	*-96.0%*	*24.4%*	*21.9%*	*37.4%*			*-42.4%*	*-42.4%*	*32.8%*	*33.1%*	*10.2%*	*-14.1%*
2004–2005		*-2.2%*	*-2.2%*	*-18.1%*	*-11.9%*	*-38.4%*			*3.6%*	*3.6%*	*-5.1%*	*-5.2%*	*2.4%*	*5.4%*
Share in Sector 1 A 1 Energy Industries														
1990			*100.0%*	*0.6%*	*0.5%*	*0.1%*				*100.0%*	*0.3%*	*0.3%*	*< 0.1%*	*< 0.1%*
2005			*100.0%*	*19.5%*	*16.1%*	*3.5%*				*100.0%*	*0.7%*	*0.7%*	*< 0.1%*	*< 0.1%*
Share in National Total														
1990		*84.0%*	*84.0%*	*0.5%*	*0.4%*	*0.1%*			*79.0%*	*79.0%*	*0.2%*	*0.2%*	*< 0.1%*	*< 0.1%*
2005		*51.7%*	*51.7%*	*10.1%*	*8.3%*	*1.8%*			*91.7%*	*91.7%*	*0.6%*	*0.6%*	*< 0.1%*	*< 0.1%*

Table 45: TSP and PM10 emissions and trends from Sector 1 A 1 Energy Industries and source categories 1990–2005.

Year	TSP [Mg]	1	1 A	1 A 1	1 A 1 a	1 A 1 b	1 A 1 c	PM10 [Mg]	1	1 A	1 A 1	1 A 1 a	1 A 1 b	1 A 1 c
1990		32 631.46	31 984.43	982.48	829.12	150.58	2.78		24 225.12	23 920.41	926.37	780.82	143.05	2.50
1991		NR	NR	NR	NR	NR	NR		NR	NR	NR	NR	NR	NR
1992		NR	NR	NR	NR	NR	NR		NR	NR	NR	NR	NR	NR
1993		NR	NR	NR	NR	NR	NR		NR	NR	NR	NR	NR	NR
1994		NR	NR	NR	NR	NR	NR		NR	NR	NR	NR	NR	NR
1995		32 548.04	32 003.00	830.06	730.83	96.25	2.98		23 574.93	23 318.02	769.58	675.46	91.44	2.68
1996		NR	NR	NR	NR	NR	NR		NR	NR	NR	NR	NR	NR
1997		NR	NR	NR	NR	NR	NR		NR	NR	NR	NR	NR	NR
1998		NR	NR	NR	NR	NR	NR		NR	NR	NR	NR	NR	NR
1999		32 609.30	32 109.66	735.55	613.87	120.42	1.26		23 204.37	22 968.83	683.37	567.84	114.40	1.13
2000		31 616.11	31 059.65	668.50	557.94	108.77	1.78		22 196.27	21 933.77	618.97	514.03	103.33	1.61
2001		32 844.76	32 257.62	854.93	734.03	119.21	1.69		23 230.74	22 953.90	790.56	675.79	113.25	1.52
2002		32 677.31	32 079.32	803.35	689.04	112.75	1.56		22 955.14	22 673.10	745.57	637.05	107.11	1.41
2003		33 077.75	32 422.55	1 011.16	902.39	104.75	4.02		23 223.56	22 914.54	942.53	839.39	99.52	3.62
2004		32 698.99	32 089.96	1 140.10	1 033.02	104.75	2.33		22 760.91	22 473.50	1 054.54	952.93	99.52	2.09
2005		32 576.05	31 962.22	963.54	856.34	104.75	2.45		22 615.50	22 325.78	892.85	791.12	99.52	2.21
Trend														
1990–2005		*-0.2%*	*-0.1%*	*-1.9%*	*3.3%*	*-30.4%*	*-11.7%*		*-6.6%*	*-6.7%*	*-3.6%*	*1.3%*	*-30.4%*	*-11.7%*
2004–2005		*-0.4%*	*-0.4%*	*-15.5%*	*-17.1%*	*0.0%*	*5.4%*		*-0.6%*	*-0.7%*	*-15.3%*	*-17.0%*	*0.0%*	*5.4%*
Share in Sector 1 A 1 Energy Industries														
1990			*98.0%*	*3.0%*	*2.5%*	*0.5%*	*< 0.1%*			*98.7%*	*3.8%*	*3.2%*	*0.6%*	*0.0%*
2005			*98.1%*	*3.0%*	*2.6%*	*0.3%*	*< 0.1%*			*98.7%*	*3.9%*	*3.5%*	*0.4%*	*0.0%*
Share in National Total														
1990		*35.6%*	*34.9%*	*1.1%*	*0.9%*	*0.2%*	*< 0.1%*		*50.9%*	*50.3%*	*1.9%*	*1.6%*	*0.3%*	*0.0%*
2005		*35.7%*	*35.0%*	*1.1%*	*0.9%*	*0.1%*	*< 0.1%*		*49.7%*	*49.0%*	*2.0%*	*1.7%*	*0.2%*	*0.0%*

Table 46: PM2.5 emissions and trends from Sector 1 A 1 Energy Industries and source categories 1990–2005.

Year	PM 2.5 [Mg] 1	1 A	1 A 1	1 A 1 a	1 A 1 b	1 A 1 c
1990	21 135.60	21 040.64	779.51	656.97	120.46	2.08
1991	NR	NR	NR	NR	NR	NR
1992	NR	NR	NR	NR	NR	NR
1993	NR	NR	NR	NR	NR	NR
1994	NR	NR	NR	NR	NR	NR
1995	20 608.03	20 527.76	652.66	573.42	77.00	2.24
1996	NR	NR	NR	NR	NR	NR
1997	NR	NR	NR	NR	NR	NR
1998	NR	NR	NR	NR	NR	NR
1999	20 183.31	20 109.69	579.02	481.74	96.34	0.94
2000	19 253.86	19 171.64	520.65	432.30	87.02	1.34
2001	20 150.76	20 064.17	666.07	569.43	95.37	1.26
2002	19 898.27	19 809.98	627.39	536.02	90.20	1.17
2003	20 106.24	20 009.50	791.55	704.64	83.80	3.11
2004	19 662.62	19 572.48	885.85	800.30	83.80	1.74
2005	19 503.85	19 412.96	751.97	666.33	83.80	1.84
Trend						
1990–2005	*-7.7%*	*-7.7%*	*-3.5%*	*1.4%*	*-30.4%*	*-11.8%*
2004–2005	*-0.8%*	*-0.8%*	*-15.1%*	*-16.7%*	*0.0%*	*5.4%*
Share in Sector 1 A 1 Energy Industries						
1990		*99.6%*	*3.7%*	*3.1%*	*0.6%*	*< 0.1%*
2005		*99.5%*	*3.9%*	*3.4%*	*0.4%*	*< 0.1%*
Share in National Total						
1990	*73.9%*	*73.6%*	*2.7%*	*2.3%*	*0.4%*	*< 0.1%*
2005	*74.7%*	*74.3%*	*2.9%*	*2.6%*	*0.3%*	*< 0.1%*

General Methodology

The following Table 47 gives an overview of methodologies and data sources of sub category *1 A 1 Energy Industries*.

Table 47: Overview of 1 A 1 methodologies for main pollutants.

	Activity data	Reported/measured emissions	Emission factors
1 A 1 a boilers ≥ 50 MW_{th} (42 plants)	Reporting Obligation: fuel consumption (monthly). 2005: ETS data	Reporting Obligation: NO_x, SO_2, TSP, CO (monthly)	NMVOC, NH_3: national studies
1 A 1 a boilers < 50 MW_{th}	Energy balance 2005: 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: ETS data	Reported by plant operator: SO_2, NO_x, CO, NMVOC (yearly)	NH_3: national study
1 A 1 c	Energy balance 2005: ETS data		All pollutants: national studies

For 2005 activity data from the emission trading system (ETS) has been considered. ETS data fully covers caegory *1 A 1 b*, covers about 90% of category *1 A 1 a* and partly covers category *1 A 1 c*. For the year 2005 ETS activity data has been used for a brakedown to *1 A 1 a* boiler size classes. It has turned out that the link from ETS activity data to DKDB activity data end emissions has to be improved (planned for submission 2008).

NFR 1 A 1 a Public Electricity

In this category large point sources are considered. The Umweltbundesamt operates a database called „Dampfkesseldatenbank" (DKDB) which stores plant specific monthly fuel consumption as well as measured CO, NO_x, SO_x and TSP emissions from boilers with a thermal capacity greater than 3 MW_{th} from 1990 on. These data are used to generate a sectoral split of the categories *Public Power* and *District Heating* into the two categories ≥ *300* MW_{th} and ≥ *50* MW_{th} *to 300* MW_{th}. Currently 42 plants 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 2006). 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.

Table 48 shows measured and calculated emission data of category 1 A 1 a for the year 2004.

Table 48: 1 A 1 a measured and calculated emission data for the year 2004.

	Fuel consumption [TJ]	NO_x [Gg]	CO [Gg]	SO_2 [Gg]	TSP [Gg]
≥ 50 MW_{th} Measured	132 336	6.61	1.08	2.82	0.42
< 50 MW_{th} Calculated	60 881	3.20	2.08	0.98	0.61
Total 1 A 1 a	**193 218**	**9.81**	**3.16**	**3.80**	**1.03**

Boilers and gas turbines ≥ 50 MW_{th}

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

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

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

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

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

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

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

In the approach above different coal types and residuel fuel classifications are considered. Table 49 shows some selected aggregated results for 2004. 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 1.08 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 49: 1 A 1 a $\geq$ 50 MW_{th} selected aggregated emission factors, fuel consumption and emissions ratios for the year 2004.

	Fuel consumption [TJ]	NO_x [kg/TJ]		CO [kg/TJ]		SO_2 [kg/TJ]	
		Default	Derived	Default	Derived	Default	Derived
1 A 1 a $\geq$ 50 MWt_h		1.08(1)		0,62(1)		0.50(1)	
SNAP 010101		1.09(1)		3.07(1)		0.59(1)	
Coal	47 490	55.3	60.4	2.2	6.7	63.2	37.1
Oil	6 708	26.0	28.4	3.0	9.2	50.0	29.4
Natural gas	32 655	30.0	32.8	4.0	12.3	NA	NA
Sewage sludge	67	100.0	109.4	200.0	614.7	NA	NA
SNAP 010102		2.08(1)		1.59(1)		0.29(1)	
Coal	6 376	50.5	105.1	1.1	1.8	57.6	17.0
Oil	140	26.0	54.1	3.0	4.8	50.0	14.7
Natural gas	3 349	30.0	62.4	4.0	6.3	NA	NA
Biomass	217	94.0	195.6	72.0	114.1	11.0	3.2
SNAP 010201		0.89(1)		0.82(1)		0.46(1)	
Coal	12 769	62.0	54.9	3.0	2.5	40.0	18.5
Oil	23	88.5	78.4	3.6	3.0	118.3	54.7
Natural gas	641	25.0	22.1	4.0	3.3	NA	NA
SNAP 010202			0.77(1)		0.12(1)		0.36(1)
Coal	15	77.0	59.4	10.0	1.2	89.0	32.0
Oil	4 417	100.0	77.1	4.0	0.5	127.0	45.6
Natural gas	10 761	25.0	19.3	4.0	0.5	NA	NA
Waste	5 918	46.9	36.2	200.0	24.1	130.0	46.7
Sewage Sludge	714	100.0	77.1	200.0	24.1	130.0	46.7

(1) Emission ratio of calculated emissions and measured emissions.

Boilers and gas turbines < 50 MWth

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

Fuel	Activity [TJ]	NO_x [kg/TJ]	CO [kg/TJ]	NMVOC [kg/TJ]	SO_2 [kg/TJ]	NH_3 [kg/TJ]
Light Fuel Oil	91	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	3 249	317.4	3/15[(1)]	8.0	398	2.7
Gasoil	179	65	10	4.8	45	2.7
Diesel oil	1	700	15	0.8	18.8	2.7
Liquified Petroleum Gas	14	150	5	0.5	6	1
Natural Gas/power and CHP	8 477	30	4	0.5	NA	1
Natural Gas/district heating	2 705	41	5	0.5	NA	1
Wood Waste	16 480	94	72	5.0	11	5
Biogas, Sewage Sludge Gas, Landfill Gas	420	150	4	0.5	NA	1
Municipal Solid $Waste_{wet}$	2 781	30	200	38.0	130	0.02
Industrial Waste	0	100	200	38.0	130	0.02

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

Table 50: 1 A 1 a < 50 MW_{th} main pollutant emission factors and fuel consumption for the year 2005.

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.

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

	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%

Table 51: Share of NMVOC emissions in VOC emissions for 1 A 1 a.

NFR 1 A 1 b Petroleum Refining

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

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

Sources of emission factors

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

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

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

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

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 2005

Table 52 summarizes the selected emission factors for main pollutants and activity data for the year 2005. It is assumed that emissions are uncontrolled.

Table 52: 1 A 1 c main pollutant emission factors and fuel consumption for the year 2004.

Fuel	Source of NO_x, CO, NMVOC, SO_2 emission factors[(1)]	Activity [TJ]	NO_x [kg/TJ]	CO [kg/TJ]	NMVOC [kg/TJ]	SO_2 [kg/TJ]	NH_3 [kg/TJ]
Natural Gas/Oil gas extraction and Gasworks	(BMWA 1990)	4 903	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).

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/m^3 (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 53). It is assumed that imported oil products have a similar metal content.

Table 53: 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 54: Cd emission factors for Sector 1 A 1 Energy Industries.

Cadmium EF [mg/GJ]	1985	1990	1995	2005
Coal				
102A Hard coal	0.1548	0.1140	0.073	0.073
105A Brown coal	2.13			
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)			

Table 55: Cd emission factors for waste for Sector 1 A 1 Energy Industries.

Cadmium EF [mg/t Waste]	1985	1990	1995	2005
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

Mercury EF [mg/GJ]	1985	1990	1995	2005
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)			

Table 56: Hg emission factors for Sector 1 A 1 Energy Industries.

Mercury EF [mg/t Waste]	1985	1990	1995	2005
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 57: Hg emission factors for waste for Sector 1 A 1 Energy Industries.

Lead EF [mg/GJ]	1985	1990	1995	2005
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)			

Table 58: Pb emission factors for Sector 1 A 1 Energy Industries.

Lead EF [mg/t Waste]	1985	1990	1995	2005
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

Table 59: Pb emission factors for waste for Sector 1 A 1 Energy Industries.

Emission factors for POPs used in NFR 1 A 1

Fossil fuels

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

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

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

Other fuels

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

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

Gasworks

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

Table 60: POP emission factors for Sector 1 A 1 Energy Industries.

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

Waste emissions factors are expressed as per ton of dry substance and derived from plant specific measurements. Comma separated values indicate plant specific emissions factors.

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

Table 61: POP emission factors for Sector 1 A 1 Energy Industries.

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 42 plants 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 62.

The emission factors for the fuel type **wood waste** were taken from (UMWELTBUNDESAMT 2006c). These emission factors are valid for the whole time series.

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

	TSP IEF [g/GJ]				%PM10	%PM2.5
	1990	1995	2000	2004	[%]	[%]
Public Power (0101)[(1)]	5.51	3.34	2.69	4.38	95	80
District Heating (0102) [(1)]	3.89	1.41	0.74	0.98	95	80
Petroleum Refining (010301)[(2)]	4.39	3.06	3.35	2.81	95	80
Wood waste (116A)	22				90	75

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

[(2)] Used fuels: Refinery gas (308A), Other oil products (224A) and Natural gas (301A)

Table 62: PM implied emission factors (IEF) for LPS in NFR 1 A1 Energy Industries.

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/Nm^3, 60 mg/Nm^3 and 50 mg/Nm^3) (UMWELT-BUNDESAMT 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. [62]

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. 20019, 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 63: 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

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

4.2.4 NFR 1 A 2 Manufacturing Industry and Combustion

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

- iron and steel (NFR 1 A 2 a),
- non-ferrous metals (NFR 1 A 2 b),
- chemicals (NFR 1 A 2 c),
- pulp, paper and print (NFR 1 A 2 d),
- food processing, beverages and tobacco (NFR 1 A 2 e),
- other (NFR 1 A 2 f)
  - other-mobile in industry (NFR 1 A 2 f 1)[63]
  - other-stationary in industry (NFR 1 A 2 f 2).

While on the one hand total fuel consumption increased by 22% from 211 PJ in 1990 to 264 PJ in 2005, total output in industrial production increased over this period.

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

- SO_2 emissions (-50%)
- NO_x emissions (-22%)
- NMVOC emissions (-27%)
- CO emissions (-33%)
- TSP, PM10, PM2.5 emissions (-34%, -35%, -36%)
- Cd, Pb and Hg emissions (-53%, -70%, -70%)
- dioxin/furan emissions (-90%)
- HCB emissions (-92%).

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

- NH_3 emissions (+21%)
- PAH emissions (+36%).

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

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

Table 64: SO_2 emissions and trends from Sector 1 A 2 Manufacturing Industry and Combustion and source categories 1990–2005.

Year	SO_2 [Gg] 1	1 A	1 A 2	1 A 2 a	1 A 2 b	1 A 2 c	1 A 2 d	1 A 2 e	1 A 2 f	1 A 2 f 1	1 A 2 f 2
1990	71.92	69.92	18.52	6.73	0.15	0.80	4.30	1.65	4.90	0.82	4.08
1991	69.39	68.09	17.78	5.35	0.13	0.83	4.91	1.92	4.64	0.85	3.78
1992	53.20	51.20	11.23	3.48	0.06	0.62	2.60	0.90	3.57	0.86	2.70
1993	51.85	49.75	11.81	3.94	0.12	0.59	2.25	0.78	4.13	0.83	3.29
1994	46.09	44.81	11.46	4.24	0.12	0.64	2.21	0.88	3.37	0.73	2.64
1995	45.39	43.86	10.77	4.21	0.09	0.55	1.97	0.73	3.21	0.26	2.95
1996	43.31	42.11	12.23	4.76	0.13	0.67	1.96	0.52	4.19	0.25	3.94
1997	39.03	38.97	14.09	4.75	0.18	0.74	2.02	0.58	5.80	0.26	5.54
1998	34.33	34.29	11.85	4.70	0.16	0.66	1.71	0.48	4.14	0.26	3.88
1999	32.56	32.42	10.42	4.74	0.17	0.82	1.30	0.39	3.01	0.23	2.78
2000	30.27	30.12	9.83	4.47	0.16	0.66	1.22	0.55	2.77	0.23	2.53
2001	31.75	31.59	10.15	4.83	0.11	0.61	1.10	0.44	3.05	0.24	2.82
2002	30.65	30.51	10.09	4.90	0.16	0.69	1.31	0.58	2.44	0.24	2.20
2003	31.36	31.21	10.19	5.04	0.13	0.76	1.17	0.42	2.67	0.24	2.43
2004	25.98	25.84	9.12	4.71	0.11	0.75	1.17	0.29	2.09	0.04	2.06
2005	25.13	25.00	9.19	4.43	0.16	0.67	1.17	0.30	2.46	0.04	2.43
Trend											
1990–2005	*-65.1%*	*-64.2%*	*-50.4%*	*-34.1%*	*7.6%*	*-16.5%*	*-72.7%*	*-81.8%*	*-49.7%*	*-95.5%*	*-40.5%*
2004–2005	*-3.3%*	*-3.2%*	*0.8%*	*-5.9%*	*46.8%*	*-10.9%*	*0.0%*	*4.0%*	*17.7%*	*1.5%*	*18.0%*
Share in Sector 1 A 2 Manufacturing Industry and Combustion											
1990		*97.2%*	*25.8%*	*9.4%*	*0.2%*	*1.1%*	*6.0%*	*2.3%*	*6.8%*	*1.1%*	*5.7%*
2005		*99.5%*	*36.6%*	*17.6%*	*0.6%*	*2.7%*	*4.7%*	*1.2%*	*9.8%*	*0.1%*	*9.7%*
Share in National Total											
1990	*96.9%*	*94.2%*	*25.0%*	*9.1%*	*0.2%*	*1.1%*	*5.8%*	*2.2%*	*6.6%*	*1.1%*	*5.5%*
2005	*95.2%*	*94.7%*	*34.8%*	*16.8%*	*0.6%*	*2.5%*	*4.4%*	*1.1%*	*9.3%*	*0.1%*	*9.2%*

Table 65: NO_x emissions and trends from Sector 1 A 2 Manufacturing Industry and Combustion and source categories 1990–2005.

Year	NO_x [Gg]	1	1 A	1 A 2	1 A 2 a	1 A 2 b	1 A 2 c	1 A 2 d	1 A 2 e	1 A 2 f	1 A 2 f 1	1 A 2 f 2
1990		200.09	200.09	44.41	5.41	0.25	1.74	7.07	1.74	28.20	14.59	13.60
1991		211.45	211.45	45.31	5.44	0.21	1.56	7.67	1.77	28.66	15.18	13.49
1992		198.87	198.87	42.08	4.50	0.19	1.51	6.40	1.46	28.01	15.33	12.68
1993		194.58	194.58	42.09	4.90	0.22	1.40	6.54	1.32	27.71	14.84	12.87
1994		186.26	186.26	42.32	4.56	0.29	1.19	6.93	1.26	28.09	15.72	12.37
1995		184.38	184.38	40.11	4.86	0.16	1.02	6.12	1.09	26.85	15.36	11.49
1996		204.77	204.77	39.56	4.75	0.18	1.17	5.36	0.93	27.16	15.08	12.08
1997		191.86	191.86	42.62	4.90	0.24	1.31	6.56	1.08	28.53	15.70	12.83
1998		204.55	204.55	40.66	4.95	0.22	1.17	5.84	0.95	27.52	16.18	11.35
1999		192.58	192.58	38.56	4.70	0.20	1.64	5.26	1.03	25.72	15.00	10.72
2000		197.62	197.62	37.44	4.66	0.20	1.44	4.86	1.09	25.18	14.47	10.71
2001		206.59	206.59	36.95	4.37	0.19	1.33	4.67	1.02	25.36	14.03	11.33
2002		212.71	212.71	36.76	4.65	0.21	1.43	4.42	1.20	24.84	13.61	11.23
2003		222.48	222.48	35.81	4.66	0.21	1.45	4.63	0.99	23.87	12.45	11.42
2004		218.04	218.04	34.15	4.38	0.20	1.47	4.71	0.88	22.51	11.63	10.88
2005		218.50	218.50	34.73	5.02	1.17	1.29	5.23	0.76	21.27	11.22	10.04
Trend												
1990–2005		*9.2%*	*9.2%*	*-21.8%*	*-7.2%*	*360.3%*	*-26.1%*	*-26.0%*	*-56.6%*	*-24.6%*	*-23.1%*	*-26.2%*
2004–2005		*0.2%*	*0.2%*	*1.7%*	*14.6%*	*488.8%*	*-12.4%*	*11.0%*	*-14.2%*	*-5.5%*	*-3.5%*	*-7.7%*
Share in Sector 1 A 2 Manufacturing Industry and Combustion												
1990			*100.0%*	*22.2%*	*2.7%*	*0.1%*	*0.9%*	*3.5%*	*0.9%*	*14.1%*	*7.3%*	*6.8%*
2005			*100.0%*	*15.9%*	*2.3%*	*0.5%*	*0.6%*	*2.4%*	*0.3%*	*9.7%*	*5.1%*	*4.6%*
Share in National Total												
1990		*94.8%*	*94.8%*	*21.0%*	*2.6%*	*0.1%*	*0.8%*	*3.3%*	*0.8%*	*13.4%*	*6.9%*	*6.4%*
2005		*97.1%*	*97.1%*	*15.4%*	*2.2%*	*0.5%*	*0.6%*	*2.3%*	*0.3%*	*9.4%*	*5.0%*	*4.5%*

Table 66: NMVOC emissions and trends from Sector 1 A 2 Manufacturing Industry and Combustion and source categories 1990–2005.

Year	NMVOC [Gg]	1	1 A	1 A 2	1 A 2 a	1 A 2 b	1 A 2 c	1 A 2 d	1 A 2 e	1 A 2 f	1 A 2 f 1	1 A 2 f 2
1990		154.68	142.47	4.140	0.075	0.003	0.123	0.754	0.021	3.165	2.872	0.293
1991		157.33	144.16	4.275	0.063	0.003	0.139	0.743	0.026	3.302	2.993	0.309
1992		145.16	132.04	4.255	0.053	0.002	0.171	0.663	0.020	3.346	3.035	0.311
1993		139.41	126.55	4.101	0.063	0.003	0.122	0.632	0.016	3.265	2.945	0.321
1994		127.44	117.19	4.009	0.074	0.004	0.122	0.601	0.020	3.189	2.911	0.278
1995		122.55	113.73	3.868	0.073	0.003	0.132	0.562	0.017	3.082	2.834	0.248
1996		121.14	113.24	3.737	0.073	0.003	0.143	0.479	0.014	3.025	2.723	0.303
1997		103.37	96.01	3.764	0.080	0.004	0.135	0.441	0.015	3.088	2.683	0.405
1998		97.50	91.65	3.568	0.077	0.004	0.121	0.369	0.014	2.983	2.663	0.320
1999		92.48	87.35	3.343	0.076	0.004	0.157	0.292	0.020	2.795	2.453	0.341
2000		85.00	79.83	3.129	0.101	0.004	0.109	0.225	0.020	2.670	2.344	0.326
2001		83.44	80.13	3.139	0.098	0.004	0.144	0.214	0.019	2.660	2.250	0.410
2002		79.20	75.73	3.046	0.097	0.005	0.188	0.220	0.024	2.512	2.160	0.352
2003		77.35	73.91	3.048	0.229	0.004	0.199	0.224	0.018	2.375	2.033	0.342
2004		73.29	70.02	3.054	0.240	0.003	0.256	0.236	0.014	2.305	1.964	0.340
2005		72.01	68.92	3.025	0.254	0.009	0.216	0.255	0.014	2.276	1.908	0.369
Trend												
1990–2005		*-53.4%*	*-51.6%*	*-26.9%*	*238.6%*	*228.4%*	*75.8%*	*-66.2%*	*-32.4%*	*-28.1%*	*-33.6%*	*25.9%*
2004–2005		*-1.7%*	*-1.6%*	*-0.9%*	*6.0%*	*192.4%*	*-15.7%*	*8.1%*	*3.2%*	*-1.2%*	*-2.9%*	*8.3%*
Share in Sector 1 A 2 Manufacturing Industry and Combustion												
1990			*92.1%*	*2.7%*	*0.0%*	*0.0%*	*0.1%*	*0.5%*	*0.0%*	*2.0%*	*1.9%*	*0.2%*
2005			*95.7%*	*4.2%*	*0.4%*	*0.0%*	*0.3%*	*0.4%*	*0.0%*	*3.2%*	*2.6%*	*0.5%*
Share in National Total												
1990		*54.3%*	*50.0%*	*1.5%*	*0.0%*	*0.0%*	*0.0%*	*0.3%*	*0.0%*	*1.1%*	*1.0%*	*0.1%*
2005		*46.7%*	*44.7%*	*2.0%*	*0.2%*	*0.0%*	*0.1%*	*0.2%*	*0.0%*	*1.5%*	*1.2%*	*0.2%*

Table 67: CO emissions and trends from Sector 1 A 2 Manufacturing Industry and Combustion and source categories 1990–2005.

Year	CO [Gg]	1	1 A	1 A 2	1 A 2 a	1 A 2 b	1 A 2 c	1 A 2 d	1 A 2 e	1 A 2 f	1 A 2 f 1	1 A 2 f 2
1990		1 161.83	1 161.83	236.60	210.72	0.05	0.92	4.16	0.20	20.56	8.78	11.78
1991		1 186.85	1 186.85	212.71	185.44	0.04	1.02	4.14	0.20	21.87	9.18	12.69
1992		1 139.85	1 139.85	253.95	226.94	0.03	1.23	3.81	0.16	21.78	9.36	12.43
1993		1 095.00	1 095.00	263.19	237.42	0.04	0.94	3.76	0.19	20.84	9.11	11.73
1994		1 041.62	1 041.62	275.39	250.64	0.05	0.88	3.62	0.17	20.05	8.86	11.19
1995		954.09	954.09	203.73	182.16	0.03	0.91	3.43	0.15	17.05	8.63	8.42
1996		971.34	971.34	228.22	206.70	0.04	1.05	2.93	0.12	17.38	8.26	9.11
1997		906.31	906.31	232.84	211.64	0.05	1.08	2.91	0.13	17.02	8.08	8.94
1998		870.37	870.37	217.90	197.84	0.04	0.96	2.39	0.12	16.54	7.98	8.56
1999		826.02	826.02	197.38	176.62	0.05	1.33	2.02	0.21	17.14	7.62	9.51
2000		766.04	766.04	183.59	164.53	0.05	0.99	1.63	0.20	16.19	7.43	8.76
2001		756.51	756.51	160.42	140.83	0.03	1.06	1.56	0.17	16.77	7.27	9.50
2002		723.48	723.48	153.65	134.42	0.04	1.31	1.65	0.20	16.02	7.12	8.91
2003		728.75	728.75	167.47	147.24	0.04	1.36	1.69	0.17	16.97	6.90	10.07
2004		704.96	704.96	173.65	153.17	0.04	1.67	1.82	0.15	16.80	6.89	9.91
2005		688.99	688.99	158.83	138.44	0.14	1.40	1.98	0.13	16.75	6.82	9.93
Trend												
1990–2005		*-40.7%*	*-40.7%*	*-32.9%*	*-34.3%*	*192.0%*	*51.3%*	*-52.3%*	*-36.3%*	*-18.5%*	*-22.3%*	*-15.7%*
2004–2005		*-2.3%*	*-2.3%*	*-8.5%*	*-9.6%*	*223.0%*	*-16.2%*	*9.0%*	*-13.4%*	*-0.3%*	*-1.0%*	*0.2%*
Share in Sector 1 A 2 Manufacturing Industry and Combustion												
1990			*100.0%*	*20.4%*	*18.1%*	*0.0%*	*0.1%*	*0.4%*	*0.0%*	*1.8%*	*0.8%*	*1.0%*
2005			*100.0%*	*23.1%*	*20.1%*	*0.0%*	*0.2%*	*0.3%*	*0.0%*	*2.4%*	*1.0%*	*1.4%*
Share in National Total												
1990		*95.2%*	*95.2%*	*19.4%*	*17.3%*	*0.0%*	*0.1%*	*0.3%*	*0.0%*	*1.7%*	*0.7%*	*1.0%*
2005		*95.7%*	*95.7%*	*22.0%*	*19.2%*	*0.0%*	*0.2%*	*0.3%*	*0.0%*	*2.3%*	*0.9%*	*1.4%*

Table 68: NH_3 emissions and trends from Sector 1 A 2 Manufacturing Industry and Combustion and source categories 1990–2005.

Year	NH_3 [Gg]	1	1 A	1 A 2	1 A 2 a	1 A 2 b	1 A 2 c	1 A 2 d	1 A 2 e	1 A 2 f	1 A 2 f 1	1 A 2 f 2
1990		2.042	2.042	0.225	0.027	0.002	0.027	0.067	0.021	0.080	0.004	0.076
1991		2.504	2.504	0.240	0.028	0.002	0.026	0.077	0.023	0.084	0.004	0.079
1992		2.689	2.689	0.220	0.026	0.002	0.028	0.066	0.021	0.076	0.004	0.072
1993		2.959	2.959	0.247	0.027	0.003	0.025	0.083	0.022	0.088	0.004	0.084
1994		3.044	3.044	0.263	0.029	0.005	0.022	0.095	0.022	0.090	0.004	0.085
1995		3.078	3.078	0.253	0.033	0.003	0.022	0.085	0.023	0.087	0.004	0.083
1996		3.096	3.096	0.247	0.032	0.003	0.027	0.066	0.020	0.098	0.004	0.094
1997		2.995	2.995	0.294	0.037	0.005	0.030	0.094	0.024	0.105	0.004	0.101
1998		3.026	3.026	0.250	0.042	0.004	0.025	0.072	0.021	0.087	0.004	0.083
1999		2.933	2.933	0.284	0.041	0.004	0.042	0.069	0.026	0.102	0.004	0.099
2000		2.728	2.728	0.262	0.046	0.004	0.037	0.055	0.023	0.098	0.004	0.094
2001		2.789	2.789	0.285	0.048	0.004	0.026	0.057	0.024	0.127	0.004	0.123
2002		2.740	2.740	0.269	0.041	0.004	0.028	0.057	0.026	0.112	0.004	0.109
2003		2.755	2.755	0.272	0.038	0.004	0.027	0.065	0.022	0.116	0.003	0.113
2004		2.576	2.576	0.260	0.042	0.004	0.028	0.066	0.020	0.099	0.003	0.096
2005		2.488	2.488	0.273	0.045	0.007	0.027	0.073	0.017	0.104	0.003	0.101
Trend												
1990–2005		*21.8%*	*21.8%*	*21.2%*	*67.4%*	*212.6%*	*-0.3%*	*7.8%*	*-19.4%*	*29.9%*	*-23.6%*	*32.8%*
2004–2005		*-3.4%*	*-3.4%*	*5.0%*	*7.6%*	*66.9%*	*-5.3%*	*10.8%*	*-15.2%*	*4.7%*	*-1.8%*	*4.9%*
Share in Sector 1 A 2 Manufacturing Industry and Combustion												
1990			*100.0%*	*11.0%*	*1.3%*	*0.1%*	*1.3%*	*3.3%*	*1.1%*	*3.9%*	*0.2%*	*3.7%*
2005			*100.0%*	*11.0%*	*1.8%*	*0.3%*	*1.1%*	*2.9%*	*0.7%*	*4.2%*	*0.1%*	*4.1%*
Share in National Total												
1990		*3.0%*	*3.0%*	*0.3%*	*0.0%*	*0.0%*	*0.0%*	*0.1%*	*0.0%*	*0.1%*	*0.0%*	*0.1%*
2005		*3.9%*	*3.9%*	*0.4%*	*0.1%*	*0.0%*	*0.0%*	*0.1%*	*0.0%*	*0.2%*	*0.0%*	*0.2%*

Table 69: Cd emissions and trends from Sector 1 A 2 Manufacturing Industry and Combustion and source categories 1990–2005.

Year	Cd [Mg]	1	1 A	1 A 2	1 A 2 a	1 A 2 b	1 A 2 c	1 A 2 d	1 A 2 e	1 A 2 f	1 A 2 f 1	1 A 2 f 2
1990		1.0560	1.0560	0.0061	0.0842	0.0319	0.1466	0.0020	0.1169	0.0003	0.1166	0.0061
1991		1.0864	1.0864	0.0056	0.0672	0.0299	0.1321	0.0022	0.1319	0.0003	0.1316	0.0056
1992		0.9685	0.9685	0.0045	0.0443	0.0301	0.1169	0.0015	0.1287	0.0003	0.1284	0.0045
1993		0.9337	0.9337	0.0038	0.0322	0.0169	0.1144	0.0013	0.1330	0.0003	0.1327	0.0038
1994		0.8737	0.8737	0.0039	0.0291	0.0132	0.0993	0.0012	0.1376	0.0003	0.1373	0.0039
1995		0.8050	0.8050	0.0039	0.0294	0.0101	0.0784	0.0009	0.1000	0.0003	0.0997	0.0039
1996		0.8397	0.8397	0.0039	0.0251	0.0124	0.0703	0.0005	0.0924	0.0003	0.0922	0.0039
1997		0.8059	0.8059	0.0036	0.0229	0.0119	0.0776	0.0005	0.0807	0.0003	0.0805	0.0036
1998		0.7304	0.7304	0.0039	0.0207	0.0096	0.0719	0.0004	0.0461	0.0003	0.0458	0.0039
1999		0.8083	0.8083	0.0038	0.0185	0.0169	0.0766	0.0038	0.0621	0.0003	0.0618	0.0038
2000		0.7473	0.7473	0.0042	0.0164	0.0122	0.0715	0.0009	0.0562	0.0003	0.0559	0.0042
2001		0.8034	0.8034	0.0041	0.0163	0.0090	0.0710	0.0009	0.0616	0.0003	0.0613	0.0041
2002		0.8072	0.8072	0.0037	0.0164	0.0132	0.0708	0.0011	0.0533	0.0003	0.0530	0.0037
2003		0.8312	0.8312	0.0036	0.0163	0.0131	0.0741	0.0007	0.0610	0.0003	0.0607	0.0036
2004		0.8267	0.8267	0.0040	0.0163	0.0174	0.0788	0.0003	0.0545	0.0003	0.0542	0.0040
2005		0.8572	0.8572	0.0041	0.0165	0.0167	0.0858	0.0009	0.0566	0.0003	0.0563	0.0041
Trend												
1990–2005		*-18.8%*	*-18.8%*	*-32.3%*	*-80.4%*	*-47.7%*	*-41.5%*	*-53.6%*	*-51.6%*	*16.6%*	*-51.7%*	*-32.3%*
2004–2005		*3.7%*	*3.7%*	*3.7%*	*1.0%*	*-4.3%*	*8.8%*	*192.3%*	*3.9%*	*3.1%*	*3.9%*	*3.7%*
Share in Sector 1 A 2 Manufacturing Industry and Combustion												
1990			*100.0%*	*0.6%*	*8.0%*	*3.0%*	*13.9%*	*0.2%*	*11.1%*	*< 0.1%*	*11.0%*	*0.6%*
2005			*100.0%*	*0.5%*	*1.9%*	*1.9%*	*10.0%*	*0.1%*	*6.6%*	*< 0.1%*	*6.6%*	*0.5%*
Share in National Total												
1990		*67.1%*	*67.1%*	*0.4%*	*5.3%*	*2.0%*	*9.3%*	*0.1%*	*7.4%*	*< 0.1%*	*7.4%*	*0.4%*
2005		*79.4%*	*79.4%*	*0.4%*	*1.5%*	*1.5%*	*7.9%*	*0.1%*	*5.2%*	*< 0.1%*	*5.2%*	*0.4%*

Table 70: Hg emissions and trends from Sector 1 A 2 Manufacturing Industry and Combustion and source categories 1990–2005.

Year	**Hg [Mg]**	**1**	**1 A**	**1 A 2**	**1 A 2 a**	**1 A 2 b**	**1 A 2 c**	**1 A 2 d**	**1 A 2 e**	**1 A 2 f**	**1 A 2 f 1**	**1 A 2 f 2**
1990		1.5595	1.5595	0.7979	0.0003	0.0073	0.0128	0.0671	0.0010	0.7095	0.0001	0.7094
1991		1.4990	1.4990	0.6801	0.0001	0.0067	0.0139	0.0693	0.0011	0.5891	0.0001	0.5890
1992		1.1796	1.1796	0.5296	0.0000	0.0060	0.0166	0.0649	0.0006	0.4415	0.0001	0.4414
1993		0.9550	0.9550	0.3907	0.0006	0.0058	0.0121	0.0709	0.0009	0.3004	0.0001	0.3003
1994		0.7578	0.7578	0.2436	0.0006	0.0063	0.0106	0.0710	0.0007	0.1545	0.0001	0.1544
1995		0.7125	0.7125	0.1854	0.0006	0.0062	0.0079	0.0658	0.0004	0.1045	0.0001	0.1044
1996		0.7087	0.7087	0.1774	0.0005	0.0081	0.0100	0.0582	0.0003	0.1002	0.0001	0.1001
1997		0.6865	0.6865	0.2031	0.0005	0.0082	0.0107	0.0619	0.0003	0.1215	0.0001	0.1214
1998		0.6008	0.6008	0.1798	0.0004	0.0082	0.0094	0.0597	0.0003	0.1019	0.0001	0.1018
1999		0.6513	0.6513	0.2055	0.0002	0.0082	0.0143	0.0623	0.0021	0.1185	0.0001	0.1184
2000		0.6434	0.6434	0.2007	0.0002	0.0082	0.0108	0.0613	0.0011	0.1190	0.0001	0.1189
2001		0.7064	0.7064	0.2303	0.0002	0.0080	0.0092	0.0593	0.0008	0.1528	0.0001	0.1527
2002		0.6700	0.6700	0.2309	0.0002	0.0082	0.0113	0.0601	0.0009	0.1503	0.0001	0.1502
2003		0.6869	0.6869	0.2298	0.0002	0.0081	0.0113	0.0610	0.0008	0.1484	0.0001	0.1483
2004		0.6559	0.6559	0.2325	0.0002	0.0081	0.0134	0.0651	0.0006	0.1451	0.0001	0.1450
2005		0.6495	0.6495	0.2379	0.0005	0.0091	0.0114	0.0702	0.0006	0.1460	0.0001	0.1459
Trend												
1990–2005		*-58.4%*	*-58.4%*	*-70.2%*	*72.0%*	*24.8%*	*-10.4%*	*4.7%*	*-34.9%*	*-79.4%*	*16.6%*	*-79.4%*
2004–2005		*-1.0%*	*-1.0%*	*2.3%*	*154.0%*	*11.7%*	*-14.4%*	*7.8%*	*16.4%*	*0.6%*	*3.1%*	*0.6%*
Share in Sector 1 A 2 Manufacturing Industry and Combustion												
1990			*100.0%*	*51.2%*	*0.0%*	*0.5%*	*0.8%*	*4.3%*	*0.1%*	*45.5%*	*0.0%*	*45.5%*
2005			*100.0%*	*36.6%*	*0.1%*	*1.4%*	*1.8%*	*10.8%*	*0.1%*	*22.5%*	*0.0%*	*22.5%*
Share in National Total												
1990		*72.8%*	*72.8%*	*37.3%*	*0.0%*	*0.3%*	*0.6%*	*3.1%*	*0.0%*	*33.1%*	*0.0%*	*33.1%*
2005		*66.6%*	*66.6%*	*24.4%*	*0.0%*	*0.9%*	*1.2%*	*7.2%*	*0.1%*	*15.0%*	*0.0%*	*15.0%*

Table 71: Pb emissions and trends from Sector 1 A 2 Manufacturing Industry and Combustion and source categories 1990–2005.

Year	Pb [Mg] 1	1 A	1 A 2	1 A 2 a	1 A 2 b	1 A 2 c	1 A 2 d	1 A 2 e	1 A 2 f	1 A 2 f 1	1 A 2 f 2
1990	173.66	173.66	9.784	0.265	4.082	0.250	0.651	0.005	4.531	0.173	4.359
1991	143.23	143.23	9.682	0.243	3.788	0.270	0.633	0.005	4.743	0.151	4.592
1992	100.14	100.14	8.083	0.199	2.986	0.319	0.641	0.003	3.934	0.123	3.811
1993	70.19	70.19	7.422	0.158	2.801	0.210	0.687	0.005	3.561	0.090	3.471
1994	47.05	47.05	7.110	0.165	2.654	0.208	0.692	0.004	3.388	0.057	3.331
1995	11.33	11.33	7.134	0.167	3.111	0.223	0.693	0.003	2.936	0.000	2.936
1996	11.18	11.18	6.668	0.158	3.112	0.249	0.644	0.002	2.502	0.000	2.502
1997	9.69	9.69	5.585	0.161	2.614	0.222	0.674	0.002	1.912	0.000	1.912
1998	8.23	8.23	4.442	0.179	2.089	0.188	0.623	0.002	1.362	0.000	1.362
1999	7.67	7.67	3.748	0.171	1.564	0.276	0.672	0.034	1.031	0.000	1.031
2000	6.38	6.38	2.559	0.180	1.039	0.184	0.631	0.008	0.518	0.000	0.518
2001	6.92	6.92	2.753	0.181	1.052	0.214	0.623	0.007	0.676	0.000	0.676
2002	6.84	6.84	2.786	0.170	1.053	0.306	0.625	0.007	0.625	0.000	0.624
2003	7.05	7.05	2.777	0.165	1.053	0.324	0.656	0.006	0.574	0.000	0.574
2004	7.18	7.18	2.924	0.182	1.053	0.440	0.703	0.003	0.541	0.000	0.541
2005	7.02	7.02	2.983	0.185	1.057	0.392	0.764	0.008	0.578	0.000	0.577
Trend											
1990–2005	*-96.0%*	*-96.0%*	*-69.5%*	*-30.2%*	*-74.1%*	*56.9%*	*17.4%*	*44.2%*	*-87.2%*	*-99.8%*	*-86.8%*
2004–2005	*-2.2%*	*-2.2%*	*2.0%*	*1.5%*	*0.4%*	*-11.0%*	*8.6%*	*119.3%*	*6.7%*	*3.1%*	*6.7%*
Share in Sector 1 A 2 Manufacturing Industry and Combustion											
1990		*100.0%*	*5.6%*	*0.2%*	*2.4%*	*0.1%*	*0.4%*	*0.0%*	*2.6%*	*0.1%*	*2.5%*
2005		*100.0%*	*42.5%*	*2.6%*	*15.0%*	*5.6%*	*10.9%*	*0.1%*	*8.2%*	*0.0%*	*8.2%*
Share in National Total											
1990	*84.0%*	*84.0%*	*4.7%*	*0.1%*	*2.0%*	*0.1%*	*0.3%*	*0.0%*	*2.2%*	*0.1%*	*2.1%*
2005	*51.7%*	*51.7%*	*22.0%*	*1.4%*	*7.8%*	*2.9%*	*5.6%*	*0.1%*	*4.3%*	*0.0%*	*4.3%*

Table 72: PAH emissions and trends from Sector 1 A 2 Manufacturing Industry and Combustion and source categories 1990–2005.

Year	PAH [Mg]	1	1 A	1 A 2	1 A 2 a	1 A 2 b	1 A 2 c	1 A 2 d	1 A 2 e	1 A 2 f	1 A 2 f 1	1 A 2 f 2
1990		9.441	9.441	0.131	0.000	0.000	0.020	0.003	0.002	0.106	0.089	0.017
1991		10.294	10.294	0.139	0.000	0.000	0.021	0.003	0.002	0.112	0.093	0.019
1992		9.363	9.363	0.141	0.000	0.000	0.025	0.003	0.001	0.111	0.094	0.017
1993		9.259	9.259	0.132	0.001	0.000	0.018	0.003	0.002	0.108	0.091	0.017
1994		8.373	8.373	0.133	0.001	0.000	0.017	0.004	0.002	0.109	0.093	0.016
1995		8.833	8.833	0.128	0.001	0.000	0.017	0.004	0.001	0.104	0.091	0.013
1996		9.557	9.557	0.135	0.001	0.000	0.021	0.003	0.001	0.108	0.089	0.019
1997		8.582	8.582	0.143	0.001	0.001	0.022	0.004	0.001	0.114	0.090	0.024
1998		8.285	8.285	0.134	0.001	0.000	0.019	0.004	0.001	0.109	0.091	0.018
1999		8.319	8.319	0.171	0.000	0.001	0.030	0.004	0.006	0.131	0.092	0.039
2000		7.731	7.731	0.156	0.000	0.000	0.022	0.003	0.002	0.128	0.093	0.034
2001		8.511	8.511	0.171	0.000	0.000	0.018	0.003	0.002	0.148	0.095	0.053
2002		8.175	8.175	0.172	0.000	0.000	0.023	0.003	0.002	0.143	0.095	0.048
2003		8.329	8.329	0.172	0.000	0.000	0.023	0.003	0.002	0.143	0.096	0.047
2004		8.161	8.161	0.174	0.000	0.000	0.029	0.003	0.001	0.139	0.101	0.039
2005		8.447	8.447	0.178	0.001	0.002	0.026	0.004	0.002	0.144	0.104	0.040
Trend												
1990–2005		*-10.5%*	*-10.5%*	*-32.3%*	*35.7%*	*57.1%*	*237.9%*	*34.6%*	*30.3%*	*-7.5%*	*35.8%*	*16.6%*
2004–2005		*3.5%*	*3.5%*	*3.7%*	*2.4%*	*104.9%*	*297.6%*	*-9.7%*	*13.0%*	*33.0%*	*3.3%*	*3.1%*
Share in Sector 1 A 2 Manufacturing Industry and Combustion												
1990			*100.0%*	*0.6%*	*1.4%*	*0.0%*	*0.0%*	*0.2%*	*0.0%*	*0.0%*	*1.1%*	*0.9%*
2005			*100.0%*	*0.5%*	*2.1%*	*0.0%*	*0.0%*	*0.3%*	*0.0%*	*0.0%*	*1.7%*	*1.2%*
Share in National Total												
1990		*54.7%*	*54.7%*	*0.4%*	*0.8%*	*0.0%*	*0.0%*	*0.1%*	*0.0%*	*0.0%*	*0.6%*	*0.5%*
2005		*95.3%*	*95.3%*	*0.4%*	*2.0%*	*0.0%*	*0.0%*	*0.3%*	*0.0%*	*0.0%*	*1.6%*	*1.2%*

Table 73: Dioxin emissions and trends from Sector 1 A 2 Manufacturing Industry and Combustion and source categories 1990–2005.

Year	Dioxin [g]	1	1 A	1 A 2	1 A 2 a	1 A 2 b	1 A 2 c	1 A 2 d	1 A 2 e	1 A 2 f	1 A 2 f 1	1 A 2 f 2
1990		101.557	101.557	52.069	0.034	50.336	0.487	0.493	0.029	0.689	0.079	0.611
1991		80.645	80.645	26.788	0.028	24.922	0.524	0.532	0.031	0.751	0.082	0.669
1992		53.535	53.535	4.610	0.023	2.739	0.621	0.501	0.022	0.704	0.083	0.621
1993		49.153	49.153	3.841	0.033	2.126	0.443	0.512	0.033	0.695	0.081	0.615
1994		44.384	44.384	3.937	0.033	2.152	0.408	0.616	0.028	0.700	0.083	0.618
1995		45.681	45.681	3.861	0.035	2.162	0.421	0.588	0.022	0.632	0.081	0.551
1996		48.191	48.191	4.116	0.036	2.207	0.521	0.553	0.018	0.780	0.079	0.702
1997		47.149	47.149	8.269	0.037	6.109	0.530	0.674	0.020	0.900	0.080	0.820
1998		44.420	44.420	7.988	0.033	6.107	0.446	0.627	0.017	0.757	0.081	0.676
1999		41.011	41.011	4.516	0.026	1.740	0.733	0.587	0.140	1.291	0.082	1.209
2000		37.295	37.295	4.114	0.028	1.739	0.544	0.570	0.054	1.180	0.083	1.097
2001		41.039	41.039	4.927	0.026	2.217	0.432	0.548	0.045	1.659	0.084	1.575
2002		38.830	38.830	4.997	0.026	2.220	0.577	0.532	0.050	1.591	0.084	1.507
2003		38.983	38.983	4.956	0.026	2.220	0.575	0.558	0.042	1.536	0.085	1.451
2004		37.667	37.667	4.920	0.026	2.220	0.724	0.568	0.031	1.350	0.089	1.261
2005		38.760	38.760	4.981	0.035	2.324	0.658	0.642	0.041	1.281	0.092	1.190
Trend												
1990–2005		*-61.8%*	*-61.8%*	*-90.4%*	*4.8%*	*-95.4%*	*35.0%*	*30.3%*	*37.8%*	*85.9%*	*16.4%*	*94.8%*
2004–2005		*2.9%*	*2.9%*	*1.2%*	*34.2%*	*4.7%*	*-9.1%*	*13.0%*	*32.3%*	*-5.1%*	*3.0%*	*-5.7%*
Share in Sector 1 A 2 Manufacturing Industry and Combustion												
1990			*100.0%*	*51.3%*	*0.0%*	*49.6%*	*0.5%*	*0.5%*	*0.0%*	*0.7%*	*0.1%*	*0.6%*
2005			*100.0%*	*12.9%*	*0.1%*	*6.0%*	*1.7%*	*1.7%*	*0.1%*	*3.3%*	*0.2%*	*3.1%*
Share in National Total												
1990		*63.5%*	*63.5%*	*32.5%*	*0.0%*	*31.5%*	*0.3%*	*0.3%*	*0.0%*	*0.4%*	*0.0%*	*0.4%*
2005		*90.9%*	*90.9%*	*11.7%*	*0.1%*	*5.5%*	*1.5%*	*1.5%*	*0.1%*	*3.0%*	*0.2%*	*2.8%*

Table 74: HCB emissions and trends from Sector 1 A 2 Manufacturing Industry and Combustion and source categories 1990–2005.

Year	HCB [kg] 1	1 A	1 A 2	1 A 2 a	1 A 2 b	1 A 2 c	1 A 2 d	1 A 2 e	1 A 2 f	1 A 2 f 1	1 A 2 f 2
1990	72.313	72.313	17.453	0.006	17.151	0.074	0.099	0.004	0.119	0.016	0.103
1991	69.519	69.519	9.005	0.005	8.681	0.079	0.106	0.004	0.129	0.016	0.113
1992	56.647	56.647	1.613	0.004	1.290	0.093	0.100	0.003	0.123	0.017	0.106
1993	53.421	53.421	1.280	0.005	0.983	0.065	0.102	0.004	0.120	0.016	0.104
1994	47.895	47.895	1.306	0.005	0.992	0.060	0.123	0.004	0.122	0.017	0.106
1995	50.119	50.119	1.293	0.005	0.992	0.062	0.118	0.003	0.112	0.016	0.096
1996	53.142	53.142	1.324	0.005	0.992	0.077	0.111	0.002	0.136	0.016	0.121
1997	49.121	49.121	3.318	0.006	2.942	0.077	0.136	0.002	0.156	0.016	0.140
1998	46.429	46.429	3.273	0.005	2.942	0.064	0.126	0.002	0.133	0.016	0.117
1999	44.891	44.891	1.221	0.004	0.757	0.107	0.117	0.021	0.213	0.016	0.197
2000	40.763	40.763	1.160	0.005	0.757	0.079	0.114	0.007	0.199	0.017	0.182
2001	44.959	44.959	1.455	0.005	0.998	0.062	0.110	0.006	0.275	0.017	0.258
2002	41.992	41.992	1.466	0.005	0.998	0.084	0.106	0.007	0.266	0.017	0.249
2003	42.032	42.032	1.460	0.004	0.998	0.084	0.112	0.005	0.256	0.017	0.239
2004	40.218	40.218	1.456	0.005	0.998	0.108	0.114	0.004	0.228	0.018	0.210
2005	41.655	41.655	1.466	0.006	1.016	0.099	0.128	0.006	0.210	0.018	0.192
Trend											
1990–2005	*-42.4%*	*-42.4%*	*-91.6%*	*-9.7%*	*-94.1%*	*35.2%*	*30.3%*	*49.2%*	*76.3%*	*16.4%*	*85.5%*
2004–2005	*3.6%*	*3.6%*	*0.6%*	*21.3%*	*1.8%*	*-7.7%*	*13.0%*	*51.4%*	*-7.9%*	*3.0%*	*-8.8%*
Share in Sector 1 A 2 Manufacturing Industry and Combustion											
1990		*100.0%*	*24.1%*	*<0.1%*	*23.7%*	*0.1%*	*0.1%*	*< 0.1%*	*0.2%*	*< 0.1%*	*0.1%*
2005		*100.0%*	*3.5%*	*<0.1%*	*2.4%*	*0.2%*	*0.3%*	*< 0.1%*	*0.5%*	*< 0.1%*	*0.5%*
Share in National Total											
1990	*79.0%*	*79.0%*	*19.1%*	*<0.1%*	*18.7%*	*0.1%*	*0.1%*	*< 0.1%*	*0.1%*	*< 0.1%*	*0.1%*
2005	*91.7%*	*91.7%*	*3.2%*	*<0.1%*	*2.2%*	*0.2%*	*0.3%*	*< 0.1%*	*0.5%*	*< 0.1%*	*0.4%*

Table 75: TSP emissions and trends from Sector 1 A 2 Manufacturing Industry and Combustion and source categories 1990–2005.

Year	TSP [Mg]	1	1 A	1 A 2	1 A 2 a	1 A 2 b	1 A 2 c	1 A 2 d	1 A 2 e	1 A 2 f	1 A 2 f 1	1 A 2 f 2
1990		32 631.46	31 984.43	3 871.34	57.04	12.53	359.73	1 056.00	120.43	2 265.61	1 764.30	501.31
1991		NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
1992		NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
1993		NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
1994		NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
1995		32 548.04	32 003.00	3 178.51	75.73	9.67	322.94	450.54	88.05	2 231.57	1 711.69	519.88
1996		NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
1997		NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
1998		NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
1999		32 609.30	32 109.66	3 294.46	34.25	16.77	552.96	297.00	120.59	2 272.89	1 387.70	885.19
2000		31 616.11	31 059.65	3 012.82	65.34	17.57	416.54	341.01	76.15	2 096.21	1 282.23	813.98
2001		32 844.76	32 257.62	3 038.89	47.12	11.22	341.78	324.00	60.56	2 254.20	1 198.00	1 056.20
2002		32 677.31	32 079.32	2 988.72	29.99	20.20	442.78	350.00	93.24	2 052.52	1 129.75	922.77
2003		33 077.75	32 422.55	2 764.62	23.76	13.49	440.50	319.00	55.67	1 912.21	994.94	917.27
2004		32 698.99	32 089.96	2 524.01	32.15	9.80	525.78	331.00	30.12	1 595.16	862.79	732.37
2005		32 576.05	31 962.22	2 568.56	51.44	41.09	471.83	361.46	52.76	1 589.97	799.92	790.05
Trend												
1990–2005		*-0.2%*	*-0.1%*	*-33.7%*	*-9.8%*	*227.9%*	*31.2%*	*-65.8%*	*-56.2%*	*-29.8%*	*-54.7%*	*57.6%*
2004–2005		*-0.4%*	*-0.4%*	*1.8%*	*60.0%*	*319.4%*	*-10.3%*	*9.2%*	*75.2%*	*-0.3%*	*-7.3%*	*7.9%*
Share in Sector 1 A 2 Manufacturing Industry and Combustion												
1990			*98.0%*	*11.9%*	*0.2%*	*0.0%*	*1.1%*	*3.2%*	*0.4%*	*6.9%*	*5.4%*	*1.5%*
2005			*98.1%*	*7.9%*	*0.2%*	*0.1%*	*1.4%*	*1.1%*	*0.2%*	*4.9%*	*2.5%*	*2.4%*
Share in National Total												
1990		*35.6%*	*34.9%*	*4.2%*	*0.1%*	*0.0%*	*0.4%*	*1.2%*	*0.1%*	*2.5%*	*1.9%*	*0.5%*
2005		*35.7%*	*35.0%*	*2.8%*	*0.1%*	*0.0%*	*0.5%*	*0.4%*	*0.1%*	*1.7%*	*0.9%*	*0.9%*

Table 76: PM10 emissions and trends from Sector 1 A 2 Manufacturing Industry and Combustion and source categories 1990–2005.

Year	PM10 [Mg]	1	1 A	1 A 2	1 A 2 a	1 A 2 b	1 A 2 c	1 A 2 d	1 A 2 e	1 A 2 f	1 A 2 f 1	1 A 2 f 2
1990		24 225.12	23 920.41	3 668.37	51.34	11.28	323.76	950.40	108.39	2 223.21	1 764.30	458.91
1991		NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
1992		NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
1993		NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
1994		NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
1995		23 574.93	23 318.02	3 039.32	68.16	8.71	290.64	405.54	79.25	2 187.02	1 711.69	475.33
1996		NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
1997		NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
1998		NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
1999		23 204.37	22 968.83	3 109.64	30.83	15.10	497.66	267.30	108.57	2 190.19	1 387.70	802.49
2000		22 196.27	21 933.77	2 845.73	58.81	15.81	374.89	306.91	68.57	2 020.73	1 282.23	738.50
2001		23 230.74	22 953.90	2 858.57	42.41	10.10	307.60	291.60	54.51	2 152.35	1 198.00	954.35
2002		22 955.14	22 673.10	2 806.32	26.99	18.18	398.50	315.00	83.92	1 963.74	1 129.75	833.99
2003		23 223.56	22 914.54	2 591.21	21.38	12.14	396.45	287.10	50.10	1 824.04	994.94	829.10
2004		22 760.91	22 473.50	2 361.44	28.94	8.82	473.20	297.90	27.11	1 525.47	862.79	662.68
2005		22 615.50	22 325.78	2 395.50	46.30	36.98	424.65	325.33	47.49	1 514.76	799.92	714.84
Trend												
1990–2005		*-6.6%*	*-6.7%*	*-34.7%*	*-9.8%*	*227.9%*	*31.2%*	*-65.8%*	*-56.2%*	*-31.9%*	*-54.7%*	*55.8%*
2004–2005		*-0.6%*	*-0.7%*	*1.4%*	*60.0%*	*319.4%*	*-10.3%*	*9.2%*	*75.2%*	*-0.7%*	*-7.3%*	*7.9%*
Share in Sector 1 A 2 Manufacturing Industry and Combustion												
1990			*98.7%*	*15.1%*	*0.2%*	*<0.1%*	*1.3%*	*3.9%*	*0.4%*	*9.2%*	*7.3%*	*1.9%*
2005			*98.7%*	*10.6%*	*0.2%*	*0.2%*	*1.9%*	*1.4%*	*0.2%*	*6.7%*	*3.5%*	*3.2%*
Share in National Total												
1990		*50.9%*	*50.3%*	*7.7%*	*0.1%*	*<0.1%*	*0.7%*	*2.0%*	*0.2%*	*4.7%*	*3.7%*	*1.0%*
2005		*49.7%*	*49.0%*	*5.3%*	*0.1%*	*0.1%*	*0.9%*	*0.7%*	*0.1%*	*3.3%*	*1.8%*	*1.6%*

Table 77: PM2.5 emissions and trends from Sector 1 A 2 Manufacturing Industry and Combustion and source categories 1990–2005.

Year	PM2.5 [Gg]	1	1 A	1 A 2	1 A 2 a	1 A 2 b	1 A 2 c	1 A 2 d	1 A 2 e	1 A 2 f	1 A 2 f 1	1 A 2 f 2
1990		21 135.60	21 040.64	3 356.54	57.55	9.40	269.80	781.44	90.32	2 148.03	1 764.30	383.73
1991		NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
1992		NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
1993		NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
1994		NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
1995		20 608.03	20 527.76	2 830.90	72.28	7.26	242.20	333.54	66.04	2 109.57	1 711.69	397.88
1996		NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
1997		NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
1998		NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
1999		20 183.31	20 109.69	2 836.78	41.39	12.58	414.72	219.78	90.54	2 057.77	1 387.70	670.07
2000		19 253.86	19 171.64	2 600.84	66.73	13.17	312.41	252.35	57.21	1 898.97	1 282.23	616.74
2001		20 150.76	20 064.17	2 595.64	51.76	8.42	256.34	239.76	45.42	1 993.94	1 198.00	795.94
2002		19 898.27	19 809.98	2 541.28	39.76	15.15	332.08	259.00	69.93	1 825.36	1 129.75	695.61
2003		20 106.24	20 009.50	2 340.81	36.04	10.11	330.37	236.06	41.75	1 686.48	994.94	691.54
2004		19 662.62	19 572.48	2 126.88	42.01	7.35	394.34	244.94	22.59	1 415.65	862.79	552.86
2005		19 503.85	19 412.96	2 145.72	57.67	30.82	353.88	267.51	39.57	1 396.28	799.92	596.36
Trend												
1990–2005		*-7.7%*	*-7.7%*	*-36.1%*	*0.2%*	*227.9%*	*31.2%*	*-65.8%*	*-56.2%*	*-35.0%*	*-54.7%*	*55.4%*
2004–2005		*-0.8%*	*-0.8%*	*0.9%*	*37.3%*	*319.4%*	*-10.3%*	*9.2%*	*75.2%*	*-1.4%*	*-7.3%*	*7.9%*
Share in Sector 1 A 2 Manufacturing Industry and Combustion												
1990			*99.6%*	*15.9%*	*0.3%*	*0.0%*	*1.3%*	*3.7%*	*0.4%*	*10.2%*	*8.3%*	*1.8%*
2005			*99.5%*	*11.0%*	*0.3%*	*0.2%*	*1.8%*	*1.4%*	*0.2%*	*7.2%*	*4.1%*	*3.1%*
Share in National Total												
1990		*73.9%*	*73.6%*	*11.7%*	*0.2%*	*0.0%*	*0.9%*	*2.7%*	*0.3%*	*7.5%*	*6.2%*	*1.3%*
2005		*74.7%*	*74.3%*	*8.2%*	*0.2%*	*0.1%*	*1.4%*	*1.0%*	*0.2%*	*5.3%*	*3.1%*	*2.3%*

General Methodology

Table 78 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 activity data from the emission trading system (ETS) has been considered for a sectoral breakdown.

Table 78: 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: ETS data.		All pollutants: National studies
1 A 2 b	Non Ferrous Metals	Energy balance 2005: ETS data.		All pollutants: National studies
1 A 2 c	Chemicals	Energy balance 2005: ETS data.		All pollutants: National studies
1 A 2 d	Pulp, Paper and Print	Energy balance 2005: 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: ETS data.		All pollutants: National studies
1 A 2 f	Cement Clinker Production	National Studies 2005: 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: 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: ETS data.		All pollutants: National studies
1 A 2 f	Bricks and Tiles Production	Association of Bricks and Tiles Industry 2005: ETS data.		All pollutants: National studies
1 A 2 f	Other	Energy balance 2005: ETS data.		All pollutants: National studies

NFR 1 A 2 a Iron and Steel

In this category mainly two integrated iron and steel plants with a 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, 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 79: 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 80 summarizes the selected emission factors for the main pollutants and activity data for the year 2005. It is assumed that emissions are uncontrolled.

Table 80: NFR 1 A 2 a main pollutant emission factors and fuel consumption for the year 2005.

Fuel	Source of NO_x, CO, NMVOC, SO_2 emission factors	Activity [TJ]	NO_x [kg/TJ]	CO [kg/TJ]	NMVOC [kg/TJ]	SO_2 [kg/TJ]	NH_3 [kg/TJ]
Coke oven coke	(BMWA 1990) [(1)]	240	220.0	150.0	8.0	500.0	0.01
Residual fuel oil < 1% S	(BMWA 1996) [(1)]	156	118.0	10.0	0.8	92.0	2.70
Residual fuel oil ≥ 1% S	(BMWA 1996) [(1)]	580	235.0	15.0	8.0	398.0	2.70
Heating oil	(BMWA 1996) [(2)]	4	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)]	4 985	41.0	5.0	0.5	NA	1.00
LPG	(BMWA 1996) [(4)]	10	41.0	5.0	0.5	[(6)]6.0	1.00
Biomass	(BMWA 1996) [(5)]	> 1	143.0	72.0	5.0	60.0	5.00

[(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 81 shows fuel consumption and main pollutant emission factors of category *1 A 2 b* for the year 2005.

Table 81: NFR 1 A 2 b main pollutant emission factors and fuel consumption for the year 2005.

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)	130	220.0	150.0	8.0	500.0	0.01
Residual fuel oil < 1% S	(BMWA 1996) (1)	166	118.0	10.0	0.8	92.0	2.70
Residual fuel oil ≥ 1% S	(BMWA 1996) (1)	74	235.0	15.0	8.0	398.0	2.70
Heating oil	(BMWA 1996) (2)	27	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)	2 648	41.0	5.0	0.5	NA	1.00
LPG	(BMWA 1996) (4)	164	41.0	5.0	0.5	(5)6.0	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 82 sumarizes activity data and emission factors for 2005. Underlined values indicate non default emission factors.

Table 82: NFR 1 A 2 c main pollutant emission factors and fuel consumption for the year 2005.

Fuel	Source of NO_X, CO, NMVOC, SO_2 emission factors	Activity [TJ]	NO_X [kg/TJ]	CO [kg/TJ]	NMVOC [kg/TJ]	SO_2 [kg/TJ]	NH_3 [kg/TJ]
Hard coal	(BMWA 1990) (1)	1 303	80.3(5)	150.0	15.0	60.0(9)	0.01
Coke oven coke	(BMWA 1990) (1)	271	220.0	150.0	8.0	500.0	0.01
Residual fuel oil < 1% S	(BMWA 1996) (1)	339	118.0	10.0	0.8	92.0	2.70
Residual fuel oil ≥ 1% S	(BMWA 1996) (1)	124	235.0	15.0	8.0	398.0	2.70
Heating oil	(BMWA 1996) (2)	55	65.0	15.0	4.8	45.0	2.70
Natural Gas	(BMWA 1996) (1)	12 742	41.0	5.0	0.5	NA	1.00
LPG	(BMWA 1996) (3)	19	41.0	5.0	0.5	6.0(4)	1.00
Industrial waste	(BMWA 1990) (1)	4 572	47.0(6)	200.0	38.00	65.00(6)	0.02
Solid biomass	(BMWA 1996) (1)	2 431	100.0(7)	72.00	5.0	30.0	5.00
Biogas	(BMWA 1990) (8)	464	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 2005 all black liquor recovery boilers are equipped with flue gas desulphurization and electrostatic precipitators. Additionally all fluidized bed boilers are equipped with electrostatic precipitators and/or fabric filters. A detailed description of boilers, emissions and emission controls is provided in the unpublished study (UMWELTBUNDESAMT 2005).

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

Table 83 shows activity data and emission factors for 2005. 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 83: NFR 1 A 2 d main pollutant emission factors and fuel consumption for the year 2005.

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)]	3 938	120.0[(9)]	150.0	15.0	112.0	0.01
Brown coal	(BMWA 1990) [(1)]	780	170.0	150.0	23.0	92.8	0.02
Brown coal briquettes	(BMWA 1990) [(1)]	> 1	170.0	150.0	23.0	92.8	0.02
Coke oven coke	(BMWA 1990) [(1)]	> 1	220.0	150.0	8.0	122.5	0.01
Residual fuel oil < 1% S	(BMWA 1996) [(1)]	183	118.0	10.0	0.8	16.1	2.70
Residual fuel oil ≥ 1% S	(BMWA 1996) [(1)]	1 497	235.0	15.0	8.0	69.7	2.70
Heating oil	(BMWA 1996) [(2)]	37	65.0	15.0	4.8	7.9	2.70
Kerosene	(BMWA 1996) [(6)]	> 1	118.0	15.0	4.8	16.1	2,7
LPG	(BMWA 1996) [(3)]	41	41.0	5.0	0.5	6.0[(4)]	1.00
Natural Gas	(BMWA 1996) [(1)]	30 585	41.0	5.0	0.5	NA	1.00
Industrial waste	(BMWA 1990) [(1)]	181	100.0	200.0	38.00	22.8	0.02
Black liquor	(BMWA 1990) [(1)]	26 647	77.0[(7)]	20.0	4.0	22.8	0.02
Fuel wood	(BMWA 1996) [(8)]	NO	110.0	370.0	5.00	10.5	5.00
Solid biomass	(BMWA 1996) [(1)]	7 271	120.0[(9)]	72.00	5.0	10.5	5.00
Biogas	(BMWA 1990) [(5)]	164	150.0	5.0	0.5	NA	1.00
Sewage sludge gas	(BMWA 1990) [(5)]	165	150.0	5.0	0.5	NA	1.00

(1) Default emission factors for industry

(2) Default emission factors for district heating plants

(3) Values for natural gas are selected

(4) From (LEUTGÖB et al. 2003)

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

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

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

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

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

NFR 1 A 2 e Food Processing, Beverages and Tobacco

Category 1 A 2 e includes emissions from fuel combustion in food processing, beverages and tobacco industry. Due to the low fuel consumption it is assumed that default emission factors of uncontrolled industrial boilers are appropriate although it is known that sugar factories operate some natural gas 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 84 sumarizes activity data and emission factors for 2005.

Table 84: NFR 1 A 2 e main pollutant emission factors and fuel consumption for the year 2005.

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)]	18	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)]	113	220.0	150.0	8.0	500.0	0.01
Residual fuel oil < 1% S	(BMWA 1996) [(1)]	706	118.0	10.0	0.8	92.0	2.70
Residual fuel oil ≥ 1% S	(BMWA 1996) [(1)]	313	235.0	15.0	8.0	398.0	2.70
Heating oil	(BMWA 1996) [(2)]	526	65.0	15.0	4.8	45.0	2.70
Kerosene	(BMWA 1996) [(6)]	1	118.0	15.0	4.8	92.0	2,7
LPG	(BMWA 1996) [(3, 8)]	141	41.0	5.0	0.5	6.0[(4)]	1.00
Natural Gas	(BMWA 1996) [(1)]	11 306	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)]	21	110.0	370.0	5.00	11.0	5.00
Solid biomass	(BMWA 1996) [(1)]	289	134.0	72.00	5.0	60.0	5.00
Biogas	(BMWA 1990) [(5)]	146	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 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 85 shows total fuel consumption and emissions of main pollutants for sub categories of *1 A 2 f* for the year 2005.

Table 85: NFR 1 A 2 f Other Manufacturing Industries. Fuel consumption and emissions of main pollutants by sub category for the year 2005.

Category	Fuel Consumption [TJ]	NO_x [Gg]	CO [Gg]	NMVOC [Gg]	SO_2 [Gg]	NH_3 [Gg]
SNAP 0301 Other boilers	38 035	2.97	1.38	0.14	1.51	0.08
SNAP 030311 Cement Clinker Production	11 826	4.20	8.34	0.22	0.50	0.01
SNAP 030312 Lime Production	2 925	0.84	0.08	0.00	0.13	0.00
SNAP 030317 Glass Production	3 225	0.95	0.02	0.00	0.12	0.00
SNAP 030319 Bricks and Tiles Production	4 270	1.08	0.11	0.01	0.17	0.01
Total	**60 281**	10.04	9.93	0.37	2.43	0.10

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 89. According to the energy balance total fuel consumption in 2005 is 38 PJ of which natural gas consumption is 21.4 PJ, biomass and industrial waste consumption is 10 PJ and consumption of oil products is 6.6 PJ.

Cement clinker manufacturing industry (SNAP 030311)

Currently nine cement clinker manufacturing plants are operated in Austria. Some rotary kilns are operated with a high share of industrial waste. In 2005 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 2003 and emissions of 25 pollutants of all plants are estimated in periodic surveys (HACKL & MAUSCHITZ 1995–2003) and (MAUSCHITZ 2004). Fuel consumption 2004 is derived from the preliminary energy balance using time series extrapolation and expert guess. Emission values of 2003 were also used for 2004 and 2005, as no up to date value was available. Table 86 shows detailled fuel consumption data for 2003.

Table 86: Cement clinker manufacturing industry. Fuel consumption for the year 2003.

Fuel	Activity [TJ]
Hard coal	2 035
Brown coal	705
Petrol coke	2 131
Residual fuel oil < 1% S	23
Residual fuel oil 0.5% S	0
Residual fuel oil ≥ 1% S	478
Natural Gas	309
Industrial waste	5 305
Total	**10 986**

Lime manufacturing industry (SNAP 030312)

This category includes emissions from natural gas fired lime kilns and magnesit sinter plants. Natural gas consumption is calculated by subtracting natural gas consumption of glass manufacturing industry (SNAP 030317), bricks and tiles industry (SNAP 030319) 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 is rather high especially for the last inventory year because the energy balance is based on preliminary data. Lime production data are shown in Table 87. Heavy metals emission factors are presented in the following subchapter. Fuel consumption and main pollutant emission factors are shown in Table 89.

Table 87: Lime production 1990 to 2005.

Year	Lime [kt]
1990	513
1995	523
2000	654
2004	789
2005	760

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 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. Fuel consumption and main pollutant emission factors are shown in Table 89. Table 88 shows the sum of flat and packaging glass production data 1990 to 2005. The share of flat glass in total glass production is about 5%.

Table 88: Glass production 1990 to 2005.

Year	Glass [kt]
1990	399
1995	435
2000	375
2001	441
2002	389
2003	477
2004	357
2005	418

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 from 1996 is linearly extrapolated. For main pollutants default emissions factors of industry are selected except for natural gas combustion for which the NO_x emission factor is taken from (WINDSPERGER et al. 2003). Fuel consumption and main pollutant emission factors are shown in Table 89.

1 A 2 f Fuel consumption and main pollutant emission factors

Table 89 shows activity data and main pollutant emission factors of 1 A 2 f sub categories except for SNAP 030311 cement industry were emission factors by fuel type are not available. Underlined cells indicate emission factors other than default values for industrial boilers.

Table 89: NFR 1 A 2 f main pollutant emission factors and fuel consumption for the year 2005 by sub category.

Fuel	Source of NO_x, CO, NMVOC, SO_2 emission factors	Activity [TJ]	NO_x [kg/TJ]	CO [kg/TJ]	NMVOC [kg/TJ]	SO_2 [kg/TJ]	NH_3 [kg/TJ]
SNAP 0301 Other boilers							
Hard coal	(BMWA 1990)(1)	NO	250.0	150.0	15.0	600.0	0.01
Coke oven coke	(BMWA 1990)(1)	2	220.0	150.0	8.0	500.0	0.01
Residual fuel oil < 1% S	(BMWA 1996)(1)	2 166	118.0	10.0	0.8	92.0	2.70
Residual fuel oil ≥ 1% S	(BMWA 1996)(1)	1 382	235.0	15.0	8.0	398.0	2.70
Heating oil, Diesel oil	(BMWA 1996)(2)	2 171	65.0	15.0	4.8	45.0	2.70
Kerosene	(BMWA 1996)(6)	7	118.0	15.0	4.8	92.0	2.70
LPG	(BMWA 1996)(3)	841	41.0	5.0	0.5	(4)6.0	1.00
Natural gas	(BMWA 1996)(1)	21 409	41.0	5.0	0.5	NA	1.00
Industrial waste	(BMWA 1990)(1)	1 524	100.0	200.0	38.00	130.0	0.02
Fuel wood	(BMWA 1996)(7)	919	110.0	370.0	5.00	11.0	5.00
Solid biomass	(BMWA 1996)(1)	7 545	143.0	72.00	5.0	60.0	5.00
Landfill gas	(BMWA 1990)(5)	34	150.0	5.0	0.5	NA	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]
SNAP 030312 Lime manufacturing							
Natural Gas	(BMWA 1996) (1)	2 606	(8)294.0	(9)30.0	0.5	NA	1.00
SNAP 030317 Glass manufacturing							
Residual fuel oil	(BMWA 1996) (1)	108	299.1	15.0	8.0	(10)432.1	2.70
LPG	(BMWA 1996) (3)	NO	299.1	5.0	0.5	(10)34.1	1.00
Natural Gas	(BMWA 1996) (1)	3 117	299.1	5.0	0.5	(10)34.1	1.00
SNAP 030319 Bricks and tiles manufacturing							
Brown coal	(BMWA 1990) (1)	35	170.0	150.0	23.0	630.0	0.02
Coke oven coke	(BMWA 1990) (1)	66	220.0	150.0	8.0	500.0	0.01
Petrol coke	(BMWA 1990) (1)	70	220.0	150.0	8.0	(11)81.0	0.01
Residual fuel oil < 1% S	(BMWA 1996) (1)	10	118.0	10.0	0.8	92.0	2.70
Residual fuel oil ≥ 1% S	(BMWA 1996) (1)	144	235.0	15.0	8.0	398.0	2.70
LPG	(BMWA 1996) (3)	53	41.0	5.0	0.5	(4)6.0	1.00
Natural Gas	(BMWA 1996) (1)	3 045	(8)294.0	5.0	0.5	NA	1.00
Industrial waste	(BMWA 1990) (1)	80	100.0	200.0	38.0	130.0	0.02
Solid biomass	(BMWA 1996) (1)	697	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 90: Cd emission factors for NFR 1 A 2 Manufacturing Industries and Construction.

Cadmium EF [mg/GJ]	1985	1990	1995	2005
Coal				
102A Hard coal 107A Coke oven coke	0.20	0.15	0.10	0.10
102A Hard coal 030311 IEF!	1.13	0.56	0.79	0.11
105A Brown coal 106A brown coal briquettes	0.80	0.60	0.40	0.40
105A Brown coal 030311 IEF!	4.53	2.24	3.16	0.44
Oil				
204A Heating and other gas oil 2050 Diesel		0.02 (all years)		
203B light fuel oil		0.05 (all years)		
203B light fuel oil 030311 IEF!	0.28	0.19	0.40	0.05
203C medium fuel oil		0.50 (all years)		
203C medium fuel oil 030311 IEF!	0.28	0.19	0.40	0.05
203D heavy fuel oil	1.00	0.75	0.50	0.50
203D heavy fuel oil 030311 IEF!	5.66	2.79	3.95	0.55
Other Fuels				
111A Fuel wood 215A Black liquor	6.10	6.10	2.50	2.50
116A Wood waste 115A Industrial waste	6.10	6.10	2.35	2.35
115A Industrial waste 030311 IEF!	34.55	22.73	18.57	2.58

Table 91: Hg emission factors for NFR 1 A 2 Manufacturing Industries and Construction.

Mercury EF [mg/GJ]	1985	1990	1995	2005
Coal				
102A Hard coal 107A Coke oven coke	3.40	2.55	1.70	1.70
102A Hard coal 030311 IEF!	163.57	96.75	12.21	10.15
105A Brown coal 106A brown coal briquettes	8.80	6.60	4.40	4.40
105A Brown coal 030311 IEF!	423.36	250.40	31.61	26.26
Oil				
204A Heating and other gas oil 2050 Diesel	0.007 (all years)			
203B light fuel oil	0.015 (all years)			
203B light fuel oil 030311 IEF!	0.72	0.57	0.11	0.09
203C medium fuel oil	0.04 (all years)			
203C medium fuel oil 030311 IEF!	1.92	1.52	0.29	0.24
203D heavy fuel oil	0.75 (all years)			
203D heavy fuel oil 030311 IEF!	3.61	2.85	0.54	0.45
Other Fuels				
111A Fuel wood 215A Black liquor 116A Wood waste 115A Industrial waste	1.90	1.90	1.25	1.25
115A Industrial waste 030311 IEF!	91.41	72.09	8.98	7.46

Table 92: Pb emission factors for NFR 1 A 2 Manufacturing Industries and Construction

LEAD EF [mg/GJ]	1985	1990	1995	2005
Coal				
102A Hard coal 107A Coke oven coke	12.00	9.00	6.00	6.00
102A Hard coal 030311 IEF!	144.44	33.36	3.37	0.57
105A Brown coal 106A brown coal briquettes	7.80	5.85	3.90	3.90
105A Brown coal 030311 IEF!	93.88	21.68	2.19	0.37
Oil				
204A Heating and other gas oil 2050 Diesel	0.02 (all years)			
203B light fuel oil	0.05 (all years)			
203B light fuel oil 030311 IEF!	0.60	0.19	0.03	> 0.01
203C medium fuel oil	1.20 (all years)			
203C medium fuel oil 030311 IEF!	1.44	0.44	0.07	0.01
203D heavy fuel oil	0.25	0.19	0.13	0.13
203D heavy fuel oil 030311 IEF!	3.01	0.69	0.07	0.01
Other Fuels				
111A Fuel wood 215A Black liquor 116A Wood waste	26.3	26.3	21.15	21.15
115A Industrial waste	72.00 (all years)			
115A Industrial waste 030311 IEF!	866.62	266.85	40.48	6.82

Emission factors not related to fuel input

The following Tables show production data of iron and steel, non ferrous metals and other activity data for selected years used as activity data for calculating heavy metals and POPs emissions from products processing.

Table 93: 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
2005	21 869	69 830	259 000	4 000

Sources of activity data are:
Secondary Lead: (ÖSTAT Industrie- und Gewerbestatistik)
Secondary Copper: Plant specific
Secondary Aluminium: (ÖSTAT Industrie- und Gewerbestatistik); (UMWELTBUNDESAMT 2000)
Nickel Production: (ÖSTAT Industrie- und Gewerbestatistik); (EUROPEAN COMMISSION 2000)

Table 94: 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
2005	76 447	3 221	(1)4 129

(1) Production data 2003.

Table 95: Asphalt concrete production 1990 and 2005.

Year	Asphalt concrete [kt]
1990	403
2005	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, U. 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, R. 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 96: 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[64]	--	389 000–24 000[64]
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[64]	50–30[64]	12 000–200[64]
1 A 2 f	030320	Fine ceramic materials	150	--	5 000
1 A 2 b	030324	Nickel production	5	570	230

Emission factors for POPs used in NFR 1 A 2

For cement industries the dioxin emission factor of 0.01 µg/GJ is derived from measured 0,02 ng TE/Nm³ at 10% O_2 (WURST & HÜBNER 1997) assuming a flue gas volume of 1600–1700 Nm³/t cement clinker (HÜBNER 2001b) and an average energy demand of 3.55 GJ/t cement clinker. HCB emission factors are taken from (HÜBNER 2001b). The PAK4 emission factor of 0.28 mg/GJ fuel input is derived on actual measurements communicated to the Umweltbundesamt.

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

The dioxin emission factor for bricks and tiles and lime production is based on findings of the study (WURST & HÜBNER 1997). HCB emissions were calculated on the basis of dioxin emissions and assuming a factor of 200.

For pulp and paper industries the dioxin emission factor of 0.009 µgTE/GJ for all fuels bases on measurements of fluidized bed combustors in pulp and paper industries (FTU 1997) and data from literature with typical fuel mixes (LAI-report 1995), (NUSSBAUMER 1994). HCB emissions were calculated on the basis of dioxin emissions and assuming a factor of 200.

For the other sub categories emission factors for plants with different capacities were applied, together with assumptions on plant structure of the Austrian industry mean values for each fuel were calculated. The IEFs (average EF per fuel category) were used for all years; they are presented in Table 98.

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 97: 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[65].

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.

[65] As the size structure for coal fired plants was not known, the EF for medium plants – which is the main size – was used for all activity data in this category.

EF	Dioxin [µg/GJ]	HCB [µg/GJ]	PAK4 [mg/GJ]
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

Table 98: POP emission factors (average EF per fuel category) for 1 A 2 Manufacturing Industries and Construction.

Emission factors not related to fuel input

Dioxin emission factors for reheating furnaces in iron and steel industries (foundries) were taken from (UBA BERLIN 1998) (average of hot air and cold air furnaces).

For calculation of PAK emissions from reheating furnaces in iron and steel industries the same emission factor as for coke in blast furnaces was used, as the coke fired reheating furnaces are technologically comparable to these.

HCB emissions for foundries were calculated on the basis of dioxin emissions and assuming a factor of 200.

The secondary lead dioxin emission factor of 3 µg/Mg product is derived from an assumed limit of 0,4 ng/Nm^3 flue gas.

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

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

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

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

The dioxin emission factors for secondary aluminium production for the years 1985–1989 was taken from the Belgian emission inventory, as in these years in Austrian facilities hexachloroethan was used which results in higher emissions (and the Belgian emission factor reflect this). For 1990 the emission factor was taken from (HÜBNER 2000). For 1999 onwards a reduction by 95% was assumed, as dioxin emission reduction measures in the main Austrian plant started to operate.

HCB emissions for secondary aluminium production were estimated on the basis of dioxin emissions and a factor of 500, which was calculated taken from (AITTOLA et al. 1996).

POPs emissions are released in asphalt concrete plants when the bitumen/flint mixture is heated.

As dioxin EF the mean value of the emission factors given in (US-EPA 1998) was applied.

The PAK emission factor for asphalt concrete plants was taken from (SCHEIDL 1996).

Nickel is mainly produced by one company which uses catalysts and other potential recyclable as raw material. The raw material is processed in a rotary kiln and an electric arc furnace. Dioxin emissions 1993 are taken from an emissions declaration. Dioxin emissions of the remaining time series are calculated by multiplying production data with the implied emission factor of 1993.

The dioxin emission factor for nickel production bases on measurements in the only relevant Austrian facility.

Table 99: 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[66]	200 000–1 300[66]	--
030310 Secondary aluminium	130/40–7[66]	65 000–3500[66]	--
030313 Asphalt concrete plants	0.01	2.8	0.15
030324 Nickel production	13	2 600–2.25[66]	--

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 b): emission values were taken from (HACKL & MAUSCHITZ 1995/1997/2001/2003);
- NFR 1 A 2 d pulp, paper and print: emission values were taken from (AUSTROPAPIER 2002–2004).

For these sources IEFs are presented in the following Table. The shares of PM10 and PM2.5 were taken from (WINIWARTER et al. 2001).

Table 100: PM emission factors for NFR 1 A 2.

	TSP Emission Factors [g/GJ]				PM10	PM2.5
	1990	1995	2000	2005	[%]	[%]
Gas						
301A and 303A	0.5				90	75
301A, Cement (IEF)	0.12	0.13	0.11	0.06	90	75
301A, Pulp&Paper (IEF)	0.20	0.10	0.11	0.11	90	75
Coal						
102A and 107A	45				90	75
105A and 106A	50				90	75
105A and 106A, Pulp & Paper (IEF)	8.01	3.99	4.49	4.21	95	80
102A, Cement (IEF)	11.05	11.78	10.05	5.35	90	74
105A, Cement (IEF)	12.27	13.08	11.17	5.95	95	80
110A, Cement (IEF)	11.05	11.78	10.05	5.35	95	80
Oil						
203B and 204A	3.0				90	75
203B, Cement (IEF)	0.74	0.79	0.67	0.36	90	75
203B and 204A, Pulp & Paper (IEF)	20.04	9.98	11.22	10.52	90	75
203C (only used in *1 A 2 f*)	35				90	75

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

	TSP Emission Factors [g/GJ]				PM10	PM2.5
	1990	1995	2000	2005	[%]	[%]
203C, Cement (IEF)	8.59	9.16	7.82	4.16	95	80
203D	65				90	75
203D, Cement (IEF)	15.96	17.01	14.52	7.73	90	75
203D, Pulp & Paper (IEF)	20.19	10.02	9.94	9.89	90	75
303A, Pulp & Paper (IEF)	20.04	9.98	9.37	10.52	90	74
206A	3.0				95	80
Other Fuels						
111A, 115A and 116A	55				90	75
111A, 115A and 116A, Pulp & Paper (IEF)	13.78	4.99	5.61	5.26	90	75
115 A, Cement (IEF)	13.50	14.39	12.29	6.54	95	80
215 D	55				90	75
215, Pulp & Paper (IEF)	41.33	14.98	11.22	10.52	90	75
309A, 310A and 309A	0.5				90	75
309A, 310A and 309A, Pulp & Paper (IEF)	2.00	1.00	1.12	1.05	90	74

4.2.5 NFR 1 A 3 e Other Transportation-pipeline compressors (SNAP 010506)

Category 1 A 3 e considers emissions from uncontrolled natural gas powered turbines used for natural gas pipelines transport. The simple CORINAIR methodology is used for emissions calculation.

Activity data is taken from the energy balance. The following Table 101 shows activity data and main pollutant emission factors. The NO_x emission factor of 150 kg/TJ is an expert guess by Umweltbundesamt.

Table 101: 1 A 3 e main pollutant emission factors and fuel consumption for the year 2005.

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)]	9 827	150.0	5.0	0.5	NA	1.00

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

4.2.6 NFR 1 A 4 Other Sectors

Category *1 A 4 Other sectors* enfolds emissions from stationary fuel combustion in the small combustion sector. It also includes emissions from mobile sources in households and gardening including snow cats and skidoos as well as from agriculture and forestry.

Source Description

Category *1 A 4 Oher Sectors* includes emissions from stationary fuel combustion in the small combustion sector as well as from some mobile machinery. Emissions of public district heating plants are included in category *1 A 1 a Public Electricity and Heat.* Emissions of district heat generation delivered to third parties by industry are included in *1 A 2 Manufacturing Industries and Construction*. Data of energy sources used for space and warm water heating in housholds and the commercial sector are collected by Statistik Austria using micro census questionnaires. According to Statistik Austria a clear distinction between "real" public district heating or micro heating networks which serve several buildings under same ownership can not always be made by the interviewed person or interviewers.

Figure 32 shows NFR 1 A 4 category definitions partly taken from the IPCC 2006 Guidelines.

Figure 32: NFR 1 A 4 category definitions.

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.
1 A 4	b	Residential		Fuel combustion in households.
1 A 4	b	*i*	*Residential plants*	Fuel combustion in buildings.
1 A 4	b	*ii*	*Household and gardening (mobile)* [63] (see page 123)	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* [63] (see page 123)	Fuels combusted in traction vehicles and other mobile machinery on farm land and in forests.
1 A 4	c	*iii*	*National Fishing*[63] (see page 123)	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).

Emission Trend

The increase of heated space, water heating demand, climatic circumstances and changes of fuel mix are the most important drivers for emissions from *1 A 4 Other Sectors*. While total fuel consumption increased by 18% from 258 PJ in 1990 to 305 PJ in 2005

- a decrease in emission due to fuel switches and the installation of more efficient combustion plants (modernisation) could be noted for
  - SO_2 emissions (-74%)
  - NO_x emissions (-3%)
  - NMVOC emissions (-35%)
  - CO emissions (-26%)
  - TSP, PM10, PM2.5 emissions (-20%, -20%, -20%)
  - Cd, Hg, Pb emissions (-19%, -50%, -66%)
  - PAH, dioxin/furan, HCB emissions (-22%, -29%, -26%)
- while NH_3 emissions increased by +18%.

Tables presenting the emission trends per sub category can be found in the Annex.

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

Table 102: SO_2 emissions and trends from Sector 1 A 4 Other Sectors and source categories 1990–2005.

SO_2 [Gg]	1	1 A	1 A 4	1 A 4 a	1 A 4 b	1 A 4 b 1	1 A 4 b 2	1 A 4 c	1 A 4 c 1	1 A 4 c 2	1 A 4 c 3
1990	71.92	69.92	33.28	5.10	25.92	25.87	0.06	2.25	1.18	1.07	6.73
1991	69.39	68.09	30.10	3.86	24.40	24.34	0.06	1.83	0.88	0.96	5.35
1992	53.20	51.20	26.36	3.15	21.43	21.37	0.06	1.78	0.79	0.99	3.48
1993	51.85	49.75	22.47	2.64	18.23	18.18	0.06	1.59	0.59	1.00	3.94
1994	46.09	44.81	20.09	2.37	16.33	16.28	0.05	1.39	0.48	0.90	4.24
1995	45.39	43.86	19.00	2.19	16.01	15.99	0.02	0.80	0.49	0.31	4.21
1996	43.31	42.11	19.38	2.66	15.88	15.85	0.02	0.85	0.51	0.34	4.76
1997	39.03	38.97	13.52	2.51	10.22	10.20	0.02	0.79	0.43	0.37	4.75
1998	34.33	34.29	12.57	2.16	9.64	9.62	0.02	0.77	0.42	0.35	4.70
1999	32.56	32.42	12.36	2.28	9.32	9.30	0.02	0.75	0.44	0.31	4.74
2000	30.27	30.12	10.91	1.69	8.51	8.49	0.02	0.70	0.41	0.29	4.47
2001	31.75	31.59	11.15	2.19	8.29	8.27	0.02	0.67	0.36	0.31	4.83
2002	30.65	30.51	10.51	2.43	7.44	7.42	0.02	0.64	0.33	0.32	4.90
2003	31.36	31.21	10.76	2.91	7.21	7.19	0.02	0.64	0.33	0.32	5.04
2004	25.98	25.84	8.70	1.82	6.52	6.51	0.00	0.36	0.32	0.05	4.71
2005	25.13	25.00	8.57	1.43	6.80	6.79	0.00	0.34	0.29	0.05	4.43
Trend											
1990–2005	*-65.1%*	*-64.2%*	*-74.2%*	*-71.9%*	*-73.8%*	*-73.7%*	*-92.2%*	*-84.9%*	*-75.3%*	*-95.7%*	*-74.2%*
2004–2005	*-3.3%*	*-3.2%*	*-1.5%*	*-21.3%*	*4.3%*	*4.3%*	*-0.2%*	*-6.7%*	*-7.2%*	*-3.4%*	*-1.5%*
Share in Sector 1 A 4 Other Sectors											
1990		*97.2%*	*46.3%*	*7.1%*	*36.0%*	*36.0%*	*0.1%*	*3.1%*	*1.6%*	*1.5%*	*46.3%*
2005		*99.5%*	*34.1%*	*5.7%*	*27.0%*	*27.0%*	*0.0%*	*1.3%*	*1.2%*	*0.2%*	*34.1%*
Share in National Total											
1990	*96.9%*	*94.2%*	*44.8%*	*6.9%*	*34.9%*	*34.9%*	*0.1%*	*3.0%*	*1.6%*	*1.4%*	*44.8%*
2005	*95.2%*	*94.7%*	*32.5%*	*5.4%*	*25.7%*	*25.7%*	*0.0%*	*1.3%*	*1.1%*	*0.2%*	*32.5%*

Table 103: NO_x emissions and trends from Sector 1 A 4 Other Sectors and source categories 1990–2005.

NO_x [Gg]	1	1 A	1 A 4	1 A 4 a	1 A 4 b	1 A 4 b 1	1 A 4 b 2	1 A 4 c	1 A 4 c 1	1 A 4 c 2	1 A 4 c 3
1990	200.09	200.09	36.84	3.32	14.09	13.02	1.07	19.42	1.05	18.36	36.84
1991	211.45	211.45	35.90	3.06	15.34	14.26	1.07	17.50	1.04	16.47	35.90
1992	198.87	198.87	35.43	3.25	14.18	13.09	1.09	18.00	0.95	17.05	35.43
1993	194.58	194.58	34.91	3.27	13.64	12.54	1.10	18.00	0.80	17.20	34.91
1994	186.26	186.26	34.62	2.89	12.63	11.50	1.13	19.10	0.65	18.45	34.62
1995	184.38	184.38	34.94	3.48	13.37	12.20	1.16	18.10	0.73	17.37	34.94
1996	204.77	204.77	38.13	3.72	14.32	13.17	1.15	20.09	0.80	19.28	38.13
1997	191.86	191.86	39.44	2.96	14.71	13.56	1.15	21.77	0.88	20.89	39.44
1998	204.55	204.55	38.45	2.68	14.74	13.59	1.15	21.03	0.88	20.15	38.45
1999	192.58	192.58	39.18	3.32	14.75	13.74	1.00	21.11	0.96	20.15	39.18
2000	197.62	197.62	36.02	2.66	13.89	12.90	0.98	19.48	0.93	18.55	36.02
2001	206.59	206.59	38.33	3.87	14.43	13.46	0.97	20.03	0.96	19.07	38.33
2002	212.71	212.71	37.31	3.60	13.69	12.74	0.95	20.02	0.92	19.10	37.31
2003	222.48	222.48	37.59	4.15	13.95	13.09	0.86	19.49	0.98	18.52	37.59
2004	218.04	218.04	35.99	3.19	13.32	12.48	0.83	19.48	1.00	18.48	35.99
2005	218.50	218.50	35.58	3.41	13.89	13.09	0.80	18.28	0.96	17.32	35.58
Trend											
1990–2005	*9.2%*	*9.2%*	*-3.4%*	*2.5%*	*-1.4%*	*0.5%*	*-25.3%*	*-5.9%*	*-8.7%*	*-5.7%*	*-3.4%*
2004–2005	*0.2%*	*0.2%*	*-1.1%*	*6.7%*	*4.3%*	*4.9%*	*-3.7%*	*-6.2%*	*-3.6%*	*-6.3%*	*-1.1%*
Share in Sector 1 A 4 Other Sectors											
1990		*100.0%*	*18.4%*	*1.7%*	*7.0%*	*6.5%*	*0.5%*	*9.7%*	*0.5%*	*9.2%*	*18.4%*
2005		*100.0%*	*16.3%*	*1.6%*	*6.4%*	*6.0%*	*0.4%*	*8.4%*	*0.4%*	*7.9%*	*16.3%*
Share in National Total											
1990	*94.8%*	*94.8%*	*17.5%*	*1.6%*	*6.7%*	*6.2%*	*0.5%*	*9.2%*	*0.5%*	*8.7%*	*17.5%*
2005	*97.1%*	*97.1%*	*15.8%*	*1.5%*	*6.2%*	*5.8%*	*0.4%*	*8.1%*	*0.4%*	*7.7%*	*15.8%*

Table 104: NMVOC emissions and trends from Sector 1 A 4 Other Sectors and source categories 1990–2005.

NMVOC [Gg]	1	1 A	1 A 4	1 A 4 a	1 A 4 b	1 A 4 b 1	1 A 4 b 2	1 A 4 c	1 A 4 c 1	1 A 4 c 2	1 A 4 c 3
1990	154.68	142.47	67.07	0.64	57.31	51.05	6.27	9.12	0.35	8.77	
1991	157.33	144.16	70.03	0.76	61.25	54.96	6.29	8.02	0.39	7.62	
1992	145.16	132.04	64.54	0.55	55.72	49.39	6.33	8.27	0.36	7.91	
1993	139.41	126.55	64.55	0.56	55.67	49.32	6.34	8.32	0.37	7.96	
1994	127.44	117.19	60.49	0.53	51.12	44.80	6.32	8.84	0.32	8.52	
1995	122.55	113.73	61.93	0.47	53.15	46.90	6.25	8.32	0.36	7.95	
1996	121.14	113.24	65.44	0.53	56.05	49.87	6.18	8.85	0.39	8.46	
1997	103.37	96.01	53.48	1.52	41.04	34.93	6.11	10.93	2.28	8.64	
1998	97.50	91.65	51.36	1.39	39.64	33.61	6.03	10.33	2.16	8.16	
1999	92.48	87.35	51.58	1.61	39.65	33.81	5.84	10.32	2.41	7.91	
2000	85.00	79.83	47.39	1.42	36.56	31.21	5.35	9.40	2.27	7.14	
2001	83.44	80.13	49.68	1.40	38.75	33.86	4.89	9.53	2.51	7.02	
2002	79.20	75.73	46.68	1.30	36.10	31.65	4.45	9.28	2.32	6.96	
2003	77.35	73.91	45.95	1.47	35.32	31.34	3.98	9.16	2.36	6.80	
2004	73.29	70.02	43.69	1.67	33.20	29.80	3.40	8.82	2.37	6.45	
2005	72.01	68.92	43.72	1.46	34.15	31.29	2.86	8.12	2.34	5.78	
Trend											
1990–2005	*-53.4%*	*-51.6%*	*-34.8%*	*127.5%*	*-40.4%*	*-38.7%*	*-54.3%*	*-11.0%*	*563.4%*	*-34.1%*	
2004–2005	*-1.7%*	*-1.6%*	*0.1%*	*-12.6%*	*2.9%*	*5.0%*	*-15.7%*	*-8.0%*	*-1.3%*	*-10.4%*	
Share in Sector 1 A 4 Other Sectors											
1990		*92.1%*	*43.4%*	*0.4%*	*37.1%*	*33.0%*	*4.1%*	*5.9%*	*0.2%*	*5.7%*	
2005		*95.7%*	*60.7%*	*2.0%*	*47.4%*	*43.5%*	*4.0%*	*11.3%*	*3.2%*	*8.0%*	
Share in National Total											
1990	*54.3%*	*50.0%*	*23.6%*	*0.2%*	*20.1%*	*17.9%*	*2.2%*	*3.2%*	*0.1%*	*3.1%*	
2005	*46.7%*	*44.7%*	*28.4%*	*0.9%*	*22.2%*	*20.3%*	*1.9%*	*5.3%*	*1.5%*	*3.7%*	

Table 105: CO emissions and trends from Sector 1 A 4 Other Sectors and source categories 1990–2005.

CO [Gg]	1	1 A	1 A 4	1 A 4 a	1 A 4 b	1 A 4 b 1	1 A 4 b 2	1 A 4 c	1 A 4 c 1	1 A 4 c 2	1 A 4 c 3
1990	1 161.83	1 161.83	494.04	11.47	441.36	415.67	25.70	41.20	12.73	28.48	
1991	1 186.85	1 186.85	534.01	13.12	481.18	455.39	25.79	39.71	14.24	25.48	
1992	1 139.85	1 139.85	489.82	11.37	438.72	412.79	25.94	39.72	13.49	26.23	
1993	1 095.00	1 095.00	467.99	11.16	417.27	391.26	26.01	39.56	13.19	26.37	
1994	1 041.62	1 041.62	431.97	10.39	382.20	356.38	25.82	39.38	11.61	27.78	
1995	954.09	954.09	442.93	10.36	393.34	368.13	25.21	39.23	13.09	26.14	
1996	971.34	971.34	463.40	10.43	411.53	386.92	24.61	41.45	14.17	27.27	
1997	906.31	906.31	419.45	14.64	356.27	332.28	23.98	48.54	20.96	27.58	
1998	870.37	870.37	401.09	12.47	342.38	319.03	23.35	46.24	19.99	26.25	
1999	826.02	826.02	401.26	13.90	340.47	317.82	22.65	46.89	21.27	25.62	
2000	766.04	766.04	371.62	12.73	314.87	293.37	21.50	44.02	20.32	23.70	
2001	756.51	756.51	395.63	13.56	336.37	315.87	20.49	45.71	22.20	23.51	
2002	723.48	723.48	371.22	12.99	314.14	294.50	19.64	44.09	20.65	23.44	
2003	728.75	728.75	368.57	15.41	309.13	290.14	18.98	44.03	20.77	23.26	
2004	704.96	704.96	352.01	14.88	293.73	275.30	18.42	43.40	20.60	22.80	
2005	688.99	688.99	363.35	13.61	307.63	289.67	17.96	42.11	20.73	21.38	
Trend											
1990–2005	*-40.7%*	*-40.7%*	*-26.5%*	*18.7%*	*-30.3%*	*-30.3%*	*-30.1%*	*2.2%*	*62.9%*	*-24.9%*	
2004–2005	*-2.3%*	*-2.3%*	*3.2%*	*-8.5%*	*4.7%*	*5.2%*	*-2.5%*	*-3.0%*	*0.6%*	*-6.3%*	
Share in Sector 1 A 4 Other Sectors											
1990		*100.0%*	*42.5%*	*1.0%*	*38.0%*	*35.8%*	*2.2%*	*3.5%*	*1.1%*	*2.5%*	
2005		*100.0%*	*52.7%*	*2.0%*	*44.6%*	*42.0%*	*2.6%*	*6.1%*	*3.0%*	*3.1%*	
Share in National Total											
1990	*95.2%*	*95.2%*	*40.5%*	*0.9%*	*36.2%*	*34.0%*	*2.1%*	*3.4%*	*1.0%*	*2.3%*	
2005	*95.7%*	*95.7%*	*50.4%*	*1.9%*	*42.7%*	*40.2%*	*2.5%*	*5.8%*	*2.9%*	*3.0%*	

Table 106: NH_3 emissions and trends from Sector 1 A 4 Other Sectors and source categories 1990–2005.

NH_3 [Gg]	1	1 A	1 A 4	1 A 4 a	1 A 4 b	1 A 4 b 1	1 A 4 b 2	1 A 4 c	1 A 4 c 1	1 A 4 c 2	1 A 4 c 3
1990	2.042	2.042	0.632	0.072	0.516	0.516	0.000	0.044	0.035	0.008	
1991	2.504	2.504	0.691	0.074	0.573	0.573	0.000	0.044	0.036	0.007	
1992	2.689	2.689	0.658	0.078	0.538	0.537	0.000	0.042	0.034	0.008	
1993	2.959	2.959	0.672	0.082	0.551	0.551	0.000	0.039	0.031	0.008	
1994	3.044	3.044	0.617	0.070	0.513	0.513	0.000	0.034	0.026	0.008	
1995	3.078	3.078	0.678	0.085	0.556	0.556	0.000	0.038	0.030	0.008	
1996	3.096	3.096	0.752	0.097	0.614	0.614	0.000	0.041	0.033	0.008	
1997	2.995	2.995	0.697	0.106	0.550	0.549	0.000	0.041	0.033	0.008	
1998	3.026	3.026	0.692	0.097	0.555	0.554	0.000	0.040	0.032	0.008	
1999	2.933	2.933	0.716	0.108	0.565	0.564	0.000	0.044	0.036	0.008	
2000	2.728	2.728	0.658	0.081	0.534	0.534	0.000	0.042	0.035	0.007	
2001	2.789	2.789	0.738	0.131	0.562	0.561	0.000	0.045	0.038	0.007	
2002	2.740	2.740	0.708	0.125	0.539	0.539	0.000	0.044	0.037	0.008	
2003	2.755	2.755	0.757	0.148	0.563	0.563	0.000	0.046	0.039	0.007	
2004	2.576	2.576	0.703	0.109	0.547	0.546	0.000	0.048	0.040	0.007	
2005	2.488	2.488	0.744	0.119	0.578	0.578	0.000	0.046	0.039	0.007	
Trend											
1990–2005	*21.8%*	*21.8%*	*17.6%*	*64.9%*	*12.0%*	*12.0%*	*-25.0%*	*5.5%*	*10.8%*	*-17.4%*	
2004–2005	*-3.4%*	*-3.4%*	*5.8%*	*9.9%*	*5.8%*	*5.8%*	*-4.5%*	*-2.8%*	*-2.3%*	*-5.8%*	
Share in Sector 1 A 4 Other Sectors											
1990		*100.0%*	*31.0%*	*3.5%*	*25.3%*	*25.3%*	*<0.1%*	*2.1%*	*1.7%*	*0.4%*	
2005		*100.0%*	*29.9%*	*4.8%*	*23.2%*	*23.2%*	*<0.1%*	*1.9%*	*1.6%*	*0.3%*	
Share in National Total											
1990	*3.0%*	*3.0%*	*0.9%*	*0.1%*	*0.8%*	*0.7%*	*<0.1%*	*0.1%*	*0.1%*	*<0.1%*	
2005	*3.9%*	*3.9%*	*1.2%*	*0.2%*	*0.9%*	*0.9%*	*<0.1%*	*0.1%*	*0.1%*	*<0.1%*	

Table 107: Cd emissions and trends from Sector 1 A 4 Other Sectors and source categories 1990–2005.

Cd [Mg]	1	1 A	1 A 4	1 A 4 a	1 A 4 b	1 A 4 b 1	1 A 4 b 2	1 A 4 c	1 A 4 c 1	1 A 4 c 2	1 A 4 c 3
1990	1.0560	1.0560	0.4121	0.0682	0.3114	0.3113	0.0000	0.0326	0.0322	0.0004	
1991	1.0864	1.0864	0.4412	0.0600	0.3448	0.3447	0.0000	0.0364	0.0361	0.0003	
1992	0.9685	0.9685	0.4013	0.0515	0.3150	0.3150	0.0000	0.0347	0.0344	0.0003	
1993	0.9337	0.9337	0.3726	0.0374	0.3002	0.3002	0.0000	0.0349	0.0346	0.0003	
1994	0.8737	0.8737	0.3364	0.0309	0.2747	0.2746	0.0000	0.0308	0.0305	0.0004	
1995	0.8050	0.8050	0.3448	0.0240	0.2855	0.2855	0.0000	0.0353	0.0350	0.0003	
1996	0.8397	0.8397	0.3733	0.0325	0.3022	0.3021	0.0000	0.0386	0.0383	0.0004	
1997	0.8059	0.8059	0.3425	0.0360	0.2690	0.2690	0.0000	0.0375	0.0371	0.0004	
1998	0.7304	0.7304	0.3197	0.0271	0.2570	0.2569	0.0000	0.0356	0.0352	0.0004	
1999	0.8083	0.8083	0.3390	0.0434	0.2561	0.2561	0.0000	0.0395	0.0391	0.0004	
2000	0.7473	0.7473	0.3101	0.0346	0.2370	0.2369	0.0000	0.0385	0.0382	0.0004	
2001	0.8034	0.8034	0.3341	0.0312	0.2587	0.2586	0.0000	0.0443	0.0439	0.0004	
2002	0.8072	0.8072	0.3184	0.0314	0.2439	0.2438	0.0000	0.0431	0.0427	0.0004	
2003	0.8312	0.8312	0.3256	0.0363	0.2437	0.2437	0.0000	0.0457	0.0453	0.0004	
2004	0.8267	0.8267	0.3263	0.0455	0.2326	0.2325	0.0000	0.0482	0.0478	0.0004	
2005	0.8572	0.8572	0.3340	0.0410	0.2449	0.2449	0.0000	0.0481	0.0477	0.0004	
Trend											
1990–2005	*-18.8%*	*-18.8%*	*-19.0%*	*-39.9%*	*-21.3%*	*-21.4%*	*0.7%*	*47.7%*	*48.1%*	*9.3%*	
2004–2005	*3.7%*	*3.7%*	*2.4%*	*-9.8%*	*5.3%*	*5.3%*	*0.6%*	*-0.3%*	*-0.3%*	*-2.0%*	
Share in Sector 1 A 4 Other Sectors											
1990		*100.0%*	*39.0%*	*6.5%*	*29.5%*	*29.5%*	*< 0.1%*	*3.1%*	*3.0%*	*< 0.1%*	
2005		*100.0%*	*39.0%*	*4.8%*	*28.6%*	*28.6%*	*< 0.1%*	*5.6%*	*5.6%*	*< 0.1%*	
Share in National Total											
1990	*67.1%*	*67.1%*	*26.2%*	*4.3%*	*19.8%*	*19.8%*	*< 0.1%*	*2.1%*	*2.0%*	*< 0.1%*	
2005	*79.4%*	*79.4%*	*31.0%*	*3.8%*	*22.7%*	*22.7%*	*< 0.1%*	*4.5%*	*4.4%*	*< 0.1%*	

Table 108: Hg emissions and trends from Sector 1 A 4 Other Sectors and source categories 1990–2005.

Hg [Mg]	1	1 A	1 A 4	1 A 4 a	1 A 4 b	1 A 4 b 1	1 A 4 b 2	1 A 4 c	1 A 4 c 1	1 A 4 c 2	1 A 4 c 3
1990	1.5595	1.5595	0.4248	0.0247	0.3864	0.3863	0.0000	0.0138	0.0136	0.0001	0.4248
1991	1.4990	1.4990	0.4682	0.0262	0.4266	0.4266	0.0000	0.0154	0.0153	0.0001	0.4682
1992	1.1796	1.1796	0.4143	0.0217	0.3782	0.3782	0.0000	0.0144	0.0143	0.0001	0.4143
1993	0.9550	0.9550	0.3664	0.0185	0.3345	0.3345	0.0000	0.0135	0.0133	0.0001	0.3664
1994	0.7578	0.7578	0.3317	0.0174	0.3025	0.3024	0.0000	0.0119	0.0118	0.0001	0.3317
1995	0.7125	0.7125	0.3290	0.0151	0.3011	0.3011	0.0000	0.0129	0.0128	0.0001	0.3290
1996	0.7087	0.7087	0.3350	0.0179	0.3035	0.3034	0.0000	0.0136	0.0135	0.0001	0.3350
1997	0.6865	0.6865	0.2862	0.0209	0.2526	0.2526	0.0000	0.0126	0.0125	0.0001	0.2862
1998	0.6008	0.6008	0.2626	0.0168	0.2340	0.2340	0.0000	0.0118	0.0116	0.0001	0.2626
1999	0.6513	0.6513	0.2578	0.0179	0.2271	0.2271	0.0000	0.0127	0.0126	0.0001	0.2578
2000	0.6434	0.6434	0.2331	0.0157	0.2052	0.2052	0.0000	0.0122	0.0121	0.0001	0.2331
2001	0.7064	0.7064	0.2439	0.0130	0.2175	0.2174	0.0000	0.0135	0.0133	0.0001	0.2439
2002	0.6700	0.6700	0.2251	0.0143	0.1979	0.1979	0.0000	0.0129	0.0127	0.0001	0.2251
2003	0.6869	0.6869	0.2215	0.0186	0.1896	0.1896	0.0000	0.0133	0.0132	0.0001	0.2215
2004	0.6559	0.6559	0.2064	0.0182	0.1742	0.1742	0.0000	0.0140	0.0139	0.0001	0.2064
2005	0.6495	0.6495	0.2127	0.0154	0.1832	0.1832	0.0000	0.0141	0.0139	0.0001	0.2127
Trend											
1990–2005	*-58.4%*	*-58.4%*	*-49.9%*	*-37.5%*	*-52.6%*	*-52.6%*	*0.7%*	*2.1%*	*2.1%*	*9.3%*	*-49.9%*
2004–2005	*-1.0%*	*-1.0%*	*3.0%*	*-15.3%*	*5.2%*	*5.2%*	*0.6%*	*0.5%*	*0.5%*	*-2.0%*	*3.0%*
Share in Sector 1 A 4 Other Sectors											
1990		*100.0%*	*27.2%*	*1.6%*	*24.8%*	*24.8%*	*< 0.1%*	*0.9%*	*0.9%*	*< 0.1%*	*27.2%*
2005		*100.0%*	*32.8%*	*2.4%*	*28.2%*	*28.2%*	*< 0.1%*	*2.2%*	*2.1%*	*< 0.1%*	*32.8%*
Share in National Total											
1990	*72.8%*	*72.8%*	*19.8%*	*1.2%*	*18.0%*	*18.0%*	*< 0.1%*	*0.6%*	*0.6%*	*< 0.1%*	*19.8%*
2005	*66.6%*	*66.6%*	*21.8%*	*1.6%*	*18.8%*	*18.8%*	*< 0.1%*	*1.4%*	*1.4%*	*< 0.1%*	*21.8%*

Table 109: Pb emissions and trends from Sector 1 A 4 Other Sectors and source categories 1990–2005.

Pb [Mg]	1	1 A	1 A 4	1 A 4 a	1 A 4 b	1 A 4 b 1	1 A 4 b 2	1 A 4 c	1 A 4 c 1	1 A 4 c 2	1 A 4 c 3
1990	173.66	173.66	7.716	0.407	5.935	3.813	2.121	1.375	0.135	1.240	7.716
1991	143.23	143.23	7.425	0.374	5.975	4.224	1.751	1.076	0.152	0.924	7.425
1992	100.14	100.14	6.358	0.321	5.154	3.774	1.380	0.883	0.143	0.740	6.358
1993	70.19	70.19	5.360	0.235	4.439	3.415	1.024	0.686	0.137	0.549	5.360
1994	47.05	47.05	4.419	0.201	3.740	3.105	0.635	0.479	0.121	0.358	4.419
1995	11.33	11.33	3.432	0.168	3.129	3.129	0.000	0.135	0.134	0.000	3.432
1996	11.18	11.18	3.584	0.231	3.208	3.208	0.000	0.144	0.144	0.000	3.584
1997	9.69	9.69	3.129	0.255	2.738	2.738	0.000	0.136	0.135	0.000	3.129
1998	8.23	8.23	2.886	0.191	2.567	2.567	0.000	0.128	0.127	0.000	2.886
1999	7.67	7.67	2.959	0.321	2.498	2.498	0.000	0.140	0.139	0.000	2.959
2000	6.38	6.38	2.684	0.260	2.288	2.288	0.000	0.135	0.135	0.000	2.684
2001	6.92	6.92	2.837	0.230	2.454	2.454	0.000	0.152	0.152	0.000	2.837
2002	6.84	6.84	2.655	0.235	2.273	2.273	0.000	0.147	0.146	0.000	2.655
2003	7.05	7.05	2.649	0.271	2.224	2.224	0.000	0.154	0.153	0.000	2.649
2004	7.18	7.18	2.567	0.336	2.069	2.069	0.000	0.162	0.162	0.000	2.567
2005	7.02	7.02	2.652	0.310	2.180	2.180	0.000	0.163	0.162	0.000	2.652
Trend											
1990–2005	*-96.0%*	*-96.0%*	*-65.6%*	*-23.8%*	*-63.3%*	*-42.8%*	*-100.0%*	*-88.2%*	*20.4%*	*-100.0%*	*-65.6%*
2004–2005	*-2.2%*	*-2.2%*	*3.3%*	*-7.7%*	*5.4%*	*5.4%*	*0.1%*	*0.3%*	*0.3%*	*-2.3%*	*3.3%*
Share in Sector 1 A 4 Other Sectors											
1990		*100.0%*	*4.4%*	*0.2%*	*3.4%*	*2.2%*	*1.2%*	*0.8%*	*0.1%*	*0.7%*	*4.4%*
2005		*100.0%*	*37.8%*	*4.4%*	*31.0%*	*31.0%*	*< 0.1%*	*2.3%*	*2.3%*	*< 0.1%*	*37.8%*
Share in National Total											
1990	*84.0%*	*84.0%*	*3.7%*	*0.2%*	*2.9%*	*1.8%*	*1.0%*	*0.7%*	*0.1%*	*0.6%*	*3.7%*
2005	*51.7%*	*51.7%*	*19.5%*	*2.3%*	*16.1%*	*16.1%*	*< 0.1%*	*1.2%*	*1.2%*	*< 0.1%*	*19.5%*

Table 110: PAH emissions and trends from Sector 1 A 4 Other Sectors and source categories 1990–2005.

PAH [Mg]	1	1 A	1 A 4	1 A 4 a	1 A 4 b	1 A 4 b 1	1 A 4 b 2	1 A 4 c	1 A 4 c 1	1 A 4 c 2	1 A 4 c 3
1990	9.441	9.441	8.527	0.136	7.920	7.893	0.027	0.471	0.351	0.120	
1991	10.294	10.294	9.313	0.132	8.680	8.653	0.027	0.500	0.393	0.107	
1992	9.363	9.363	8.411	0.124	7.811	7.783	0.027	0.476	0.365	0.111	
1993	9.259	9.259	8.311	0.101	7.733	7.705	0.028	0.477	0.365	0.112	
1994	8.373	8.373	7.441	0.104	6.915	6.887	0.028	0.422	0.302	0.119	
1995	8.833	8.833	7.884	0.103	7.314	7.286	0.028	0.466	0.355	0.112	
1996	9.557	9.557	8.447	0.138	7.801	7.773	0.028	0.508	0.386	0.122	
1997	8.582	8.582	7.549	0.154	6.900	6.872	0.028	0.496	0.366	0.130	
1998	8.285	8.285	7.116	0.119	6.531	6.503	0.028	0.467	0.341	0.125	
1999	8.319	8.319	7.146	0.155	6.476	6.449	0.028	0.514	0.387	0.128	
2000	7.731	7.731	6.477	0.124	5.861	5.834	0.027	0.492	0.372	0.120	
2001	8.511	8.511	7.143	0.110	6.467	6.440	0.027	0.566	0.440	0.126	
2002	8.175	8.175	6.671	0.111	6.009	5.981	0.027	0.552	0.422	0.130	
2003	8.329	8.329	6.690	0.131	5.978	5.951	0.027	0.581	0.451	0.130	
2004	8.161	8.161	6.463	0.159	5.695	5.668	0.027	0.610	0.476	0.134	
2005	8.447	8.447	6.659	0.144	5.918	5.891	0.028	0.597	0.466	0.131	
Trend											
1990–2005	*-10.5%*	*-10.5%*	*-21.9%*	*6.3%*	*-25.3%*	*-25.4%*	*1.4%*	*26.6%*	*32.7%*	*8.8%*	
2004–2005	*3.5%*	*3.5%*	*3.0%*	*-9.0%*	*3.9%*	*3.9%*	*0.2%*	*-2.1%*	*-2.1%*	*-2.2%*	
Share in Sector 1 A 4 Other Sectors											
1990		*100.0%*	*90.3%*	*1.4%*	*83.9%*	*83.6%*	*0.3%*	*5.0%*	*3.7%*	*1.3%*	
2005		*100.0%*	*78.8%*	*1.7%*	*70.1%*	*69.7%*	*0.3%*	*7.1%*	*5.5%*	*1.5%*	
Share in National Total											
1990	*54.7%*	*54.7%*	*49.4%*	*0.8%*	*45.9%*	*45.7%*	*0.2%*	*2.7%*	*2.0%*	*0.7%*	
2005	*95.3%*	*95.3%*	*75.1%*	*1.6%*	*66.7%*	*66.4%*	*0.3%*	*6.7%*	*5.3%*	*1.5%*	

Table 111: *Dioxin emissions and trends from Sector 1 A 4 Other Sectors and source categories 1990–2005.*

Dioxin [g]	1	1 A	1 A 4	1 A 4 a	1 A 4 b	1 A 4 b 1	1 A 4 b 2	1 A 4 c	1 A 4 c 1	1 A 4 c 2	1 A 4 c 3
1990	101.557	101.557	45.123	1.647	41.674	41.622	0.052	1.802	1.677	0.125	45.123
1991	80.645	80.645	49.552	1.616	45.948	45.895	0.052	1.989	1.876	0.112	49.552
1992	53.535	53.535	44.957	1.551	41.546	41.493	0.053	1.860	1.744	0.116	44.957
1993	49.153	49.153	42.477	1.270	39.371	39.318	0.054	1.835	1.718	0.117	42.477
1994	44.384	44.384	37.937	1.299	35.085	35.032	0.054	1.552	1.427	0.125	37.937
1995	45.681	45.681	39.547	1.297	36.475	36.422	0.054	1.775	1.657	0.118	39.547
1996	48.191	48.191	41.901	1.690	38.292	38.238	0.053	1.920	1.792	0.127	41.901
1997	47.149	47.149	36.973	1.815	33.337	33.283	0.053	1.822	1.688	0.134	36.973
1998	44.420	44.420	34.534	1.428	31.405	31.353	0.053	1.701	1.572	0.130	34.534
1999	41.011	41.011	34.753	1.851	30.997	30.944	0.053	1.905	1.773	0.132	34.753
2000	37.295	37.295	31.395	1.531	28.036	27.983	0.053	1.828	1.704	0.125	31.395
2001	41.039	41.039	34.305	1.412	30.763	30.710	0.053	2.130	2.000	0.130	34.305
2002	38.830	38.830	31.970	1.453	28.469	28.416	0.053	2.048	1.915	0.134	31.970
2003	38.983	38.983	32.035	1.706	28.156	28.103	0.053	2.173	2.038	0.134	32.035
2004	37.667	37.667	30.804	2.035	26.481	26.428	0.053	2.288	2.151	0.137	30.804
2005	38.760	38.760	31.901	1.925	27.733	27.680	0.053	2.242	2.108	0.134	31.901
Trend											
1990–2005	*-61.8%*	*-61.8%*	*-29.3%*	*16.9%*	*-33.5%*	*-33.5%*	*1.7%*	*24.4%*	*25.7%*	*7.0%*	*-29.3%*
2004–2005	*2.9%*	*2.9%*	*3.6%*	*-5.4%*	*4.7%*	*4.7%*	*0.0%*	*-2.0%*	*-2.0%*	*-2.5%*	*3.6%*
Share in Sector 1 A 4 Other Sectors											
1990		*100.0%*	*44.4%*	*1.6%*	*41.0%*	*41.0%*	*0.1%*	*1.8%*	*1.7%*	*0.1%*	*44.4%*
2005		*100.0%*	*82.3%*	*5.0%*	*71.6%*	*71.4%*	*0.1%*	*5.8%*	*5.4%*	*0.3%*	*82.3%*
Share in National Total											
1990	*63.5%*	*63.5%*	*28.2%*	*1.0%*	*26.0%*	*26.0%*	*0.0%*	*1.1%*	*1.0%*	*0.1%*	*28.2%*
2005	*90.9%*	*90.9%*	*74.9%*	*4.5%*	*65.1%*	*65.0%*	*0.1%*	*5.3%*	*4.9%*	*0.3%*	*74.9%*

Table 112: HCB emissions and trends from Sector 1 A 4 Other Sectors and source categories 1990–2005.

HCB [kg]	1	1 A	1 A 4	1 A 4 a	1 A 4 b	1 A 4 b 1	1 A 4 b 2	1 A 4 c	1 A 4 c 1	1 A 4 c 2	1 A 4 c 3
1990	72.313	72.313	53.944	1.215	50.165	50.155	0.010	2.564	2.539	0.025	
1991	69.519	69.519	59.596	1.176	55.554	55.543	0.010	2.866	2.844	0.022	
1992	56.647	56.647	54.203	1.126	50.396	50.386	0.011	2.680	2.657	0.023	
1993	53.421	53.421	51.444	0.889	47.880	47.870	0.011	2.674	2.651	0.023	
1994	47.895	47.895	45.950	0.926	42.779	42.769	0.011	2.245	2.220	0.025	
1995	50.119	50.119	48.234	0.917	44.704	44.693	0.011	2.613	2.590	0.024	
1996	53.142	53.142	51.246	1.251	47.153	47.143	0.011	2.842	2.816	0.025	
1997	49.121	49.121	45.281	1.325	41.252	41.242	0.011	2.703	2.676	0.027	
1998	46.429	46.429	42.642	0.993	39.120	39.110	0.011	2.529	2.503	0.026	
1999	44.891	44.891	43.151	1.315	38.984	38.974	0.011	2.852	2.825	0.026	
2000	40.763	40.763	39.085	1.038	35.296	35.285	0.011	2.751	2.726	0.025	
2001	44.959	44.959	42.990	0.891	38.867	38.857	0.011	3.231	3.205	0.026	
2002	41.992	41.992	40.000	0.916	35.975	35.965	0.011	3.109	3.082	0.027	
2003	42.032	42.032	40.032	1.076	35.643	35.633	0.011	3.312	3.285	0.027	
2004	40.218	40.218	38.228	1.304	33.427	33.416	0.011	3.497	3.470	0.027	
2005	41.655	41.655	39.669	1.200	35.033	35.022	0.011	3.436	3.409	0.027	
Trend											
1990–2005	*-42.4%*	*-42.4%*	*-26.5%*	*-1.2%*	*-30.2%*	*-30.2%*	*1.7%*	*34.0%*	*34.3%*	*7.0%*	
2004–2005	*3.6%*	*3.6%*	*3.8%*	*-8.0%*	*4.8%*	*4.8%*	*0.0%*	*-1.8%*	*-1.8%*	*-2.5%*	
Share in Sector 1 A 4 Other Sectors											
1990		*100.0%*	*74.6%*	*1.7%*	*69.4%*	*69.4%*	*0.0%*	*3.5%*	*3.5%*	*0.0%*	
2005		*100.0%*	*95.2%*	*2.9%*	*84.1%*	*84.1%*	*0.0%*	*8.2%*	*8.2%*	*0.1%*	
Share in National Total											
1990	*79.0%*	*79.0%*	*59.0%*	*1.3%*	*54.8%*	*54.8%*	*0.0%*	*2.8%*	*2.8%*	*0.0%*	
2005	*91.7%*	*91.7%*	*87.4%*	*2.6%*	*77.1%*	*77.1%*	*0.0%*	*7.6%*	*7.5%*	*0.1%*	

Table 113: TSP emissions and trends from Sector 1 A 4 Other Sectors and source categories 1990–2005.

TSP [Mg]	1	1 A	1 A 4	1 A 4 a	1 A 4 b	1 A 4 b 1	1 A 4 b 2	1 A 4 c	1 A 4 c 1	1 A 4 c 2	1 A 4 c 3
1990	32 631.46	31 984.43	13 377.87	593.04	9 744.08	9 486.60	257.48	3 040.75	443.70	2 597.05	
1991	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	
1992	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	
1993	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	
1994	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	
1995	32 548.04	32 003.00	12 275.43	388.08	9 054.30	8 803.19	251.11	2 833.05	466.46	2 366.59	
1996	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	
1997	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	
1998	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	
1999	32 609.30	32 109.66	11 787.18	497.66	8 194.02	7 969.47	224.55	3 095.50	517.15	2 578.35	
2000	31 616.11	31 059.65	10 808.63	377.00	7 552.65	7 340.39	212.26	2 878.98	491.05	2 387.93	
2001	32 844.76	32 257.62	11 557.61	377.64	8 177.76	7 976.52	201.24	3 002.21	553.25	2 448.96	
2002	32 677.31	32 079.32	11 038.42	387.76	7 688.34	7 497.90	190.44	2 962.31	526.92	2 435.39	
2003	33 077.75	32 422.55	11 004.36	454.47	7 658.89	7 482.68	176.21	2 891.00	550.23	2 340.77	
2004	32 698.99	32 089.96	10 659.41	464.92	7 327.07	7 162.18	164.89	2 867.42	570.47	2 296.95	
2005	32 576.05	31 962.22	10 708.01	363.64	7 669.63	7 515.10	154.53	2 674.74	561.44	2 113.30	
Trend											
1990–2005	*-0.2%*	*-0.1%*	*-20.0%*	*-38.7%*	*-21.3%*	*-20.8%*	*-40.0%*	*-12.0%*	*26.5%*	*-18.6%*	
2004–2005	*-0.4%*	*-0.4%*	*0.5%*	*-21.8%*	*4.7%*	*4.9%*	*-6.3%*	*-6.7%*	*-1.6%*	*-8.0%*	
Share in Sector 1 A 4 Other Sectors											
1990		*98.0%*	*41.0%*	*1.8%*	*29.9%*	*29.1%*	*0.8%*	*9.3%*	*1.4%*	*8.0%*	
2005		*98.1%*	*32.9%*	*1.1%*	*23.5%*	*23.1%*	*0.5%*	*8.2%*	*1.7%*	*6.5%*	
Share in National Total											
1990	*35.6%*	*34.9%*	*14.6%*	*0.6%*	*10.6%*	*10.4%*	*0.3%*	*3.3%*	*0.5%*	*2.8%*	
2005	*35.7%*	*35.0%*	*11.7%*	*0.4%*	*8.4%*	*8.2%*	*0.2%*	*2.9%*	*0.6%*	*2.3%*	

Table 114: PM10 emissions and trends from Sector 1 A 4 Other Sectors and source categories 1990–2005.

PM10 [Mg]	1	1 A	1 A 4	1 A 4 a	1 A 4 b	1 A 4 b 1	1 A 4 b 2	1 A 4 c	1 A 4 c 1	1 A 4 c 2	1 A 4 c 3
1990	24 225.12	23 920.41	12 325.53	533.73	8 795.42	8 537.94	257.48	2 996.38	399.33	2 597.05	
1991	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	
1992	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	
1993	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	
1994	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	
1995	23 574.93	23 318.02	11 309.70	349.31	8 173.98	7 922.87	251.11	2 786.41	419.82	2 366.59	
1996	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	
1997	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	
1998	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	
1999	23 204.37	22 968.83	10 888.75	447.89	7 397.07	7 172.52	224.55	3 043.79	465.44	2 578.35	
2000	22 196.27	21 933.77	9 987.79	339.30	6 818.62	6 606.36	212.26	2 829.87	441.94	2 387.93	
2001	23 230.74	22 953.90	10 666.87	339.88	7 380.11	7 178.87	201.24	2 946.88	497.92	2 448.96	
2002	22 955.14	22 673.10	10 197.16	348.99	6 938.55	6 748.11	190.44	2 909.62	474.23	2 435.39	
2003	23 223.56	22 914.54	10 155.62	409.02	6 910.63	6 734.42	176.21	2 835.97	495.20	2 340.77	
2004	22 760.91	22 473.50	9 839.65	418.43	6 610.85	6 445.96	164.89	2 810.38	513.43	2 296.95	
2005	22 615.50	22 325.78	9 863.99	327.28	6 918.12	6 763.59	154.53	2 618.59	505.29	2 113.30	
Trend											
1990–2005	*-6.6%*	*-6.7%*	*-20.0%*	*-38.7%*	*-21.3%*	*-20.8%*	*-40.0%*	*-12.6%*	*26.5%*	*-18.6%*	
2004–2005	*-0.6%*	*-0.7%*	*0.2%*	*-21.8%*	*4.6%*	*4.9%*	*-6.3%*	*-6.8%*	*-1.6%*	*-8.0%*	
Share in Sector 1 A 4 Other Sectors											
1990		*98.7%*	*50.9%*	*2.2%*	*36.3%*	*35.2%*	*1.1%*	*12.4%*	*1.6%*	*10.7%*	
2005		*98.7%*	*43.6%*	*1.4%*	*30.6%*	*29.9%*	*0.7%*	*11.6%*	*2.2%*	*9.3%*	
Share in National Total											
1990	*50.9%*	*50.3%*	*25.9%*	*1.1%*	*18.5%*	*17.9%*	*0.5%*	*6.3%*	*0.8%*	*5.5%*	
2005	*49.7%*	*49.0%*	*21.7%*	*0.7%*	*15.2%*	*14.9%*	*0.3%*	*5.8%*	*1.1%*	*4.6%*	

Table 115: PM2.5 emissions and trends from Sector 1 A 4 Other Sectors and source categories 1990–2005.

PM2.5 [Gg]	1	1 A	1 A 4	1 A 4 a	1 A 4 b	1 A 4 b 1	1 A 4 b 2	1 A 4 c	1 A 4 c 1	1 A 4 c 2	1 A 4 c 3
1990	21 135.60	21 040.64	11 267.89	469.12	7 846.76	7 589.28	257.48	2 952.01	354.96	2 597.05	11 267.89
1991	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
1992	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
1993	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
1994	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
1995	20 608.03	20 527.76	10 342.45	309.03	7 293.66	7 042.55	251.11	2 739.76	373.17	2 366.59	10 342.45
1996	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
1997	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
1998	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
1999	20 183.31	20 109.69	9 989.77	397.57	6 600.13	6 375.58	224.55	2 992.07	413.72	2 578.35	9 989.77
2000	19 253.86	19 171.64	9 166.44	301.10	6 084.58	5 872.32	212.26	2 780.77	392.84	2 387.93	9 166.44
2001	20 150.76	20 064.17	9 776.03	302.02	6 582.46	6 381.22	201.24	2 891.56	442.60	2 448.96	9 776.03
2002	19 898.27	19 809.98	9 355.90	310.21	6 188.76	5 998.32	190.44	2 856.92	421.53	2 435.39	9 355.90
2003	20 106.24	20 009.50	9 306.88	363.58	6 162.36	5 986.15	176.21	2 780.95	440.18	2 340.77	9 306.88
2004	19 662.62	19 572.48	9 019.89	371.93	5 894.63	5 729.74	164.89	2 753.33	456.38	2 296.95	9 019.89
2005	19 503.85	19 412.96	9 019.97	290.91	6 166.61	6 012.08	154.53	2 562.45	449.15	2 113.30	9 019.97
Trend											
1990–2005	*-7.7%*	*-7.7%*	*-19.9%*	*-38.0%*	*-21.4%*	*-20.8%*	*-40.0%*	*-13.2%*	*26.5%*	*-18.6%*	*-19.9%*
2004–2005	*-0.8%*	*-0.8%*	*0.0%*	*-21.8%*	*4.6%*	*4.9%*	*-6.3%*	*-6.9%*	*-1.6%*	*-8.0%*	*0.0%*
Share in Sector 1 A 4 Other Sectors											
1990		*99.6%*	*53.3%*	*2.2%*	*37.1%*	*35.9%*	*1.2%*	*14.0%*	*1.7%*	*12.3%*	*53.3%*
2005		*99.5%*	*46.2%*	*1.5%*	*31.6%*	*30.8%*	*0.8%*	*13.1%*	*2.3%*	*10.8%*	*46.2%*
Share in National Total											
1990	*73.9%*	*73.6%*	*39.4%*	*1.6%*	*27.4%*	*26.5%*	*0.9%*	*10.3%*	*1.2%*	*9.1%*	*39.4%*
2005	*74.7%*	*74.3%*	*34.5%*	*1.1%*	*23.6%*	*23.0%*	*0.6%*	*9.8%*	*1.7%*	*8.1%*	*34.5%*

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 micro census surveys and according to the energy statistics supplier.

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 in general 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 this categories. It is assumed that the fuel consumption reported in (IEA JQ 2006) is combusted in devices similar to central heatings and therefore the respective emissions 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 and 1999 (STATISTIK AUSTRIA 2002). The calculated shares are used to subdivide total final energy consumption to the several technologies. For the years in between the shares are interpolated and the shares of 1999 are taken for the years from 2000 on.

The share of natural gas and heating oil condensing boilers on 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.

Pellet consumption 2004 is taken from a survey of the Provincial Chamber of Agriculture of Lower Austria. Pellet consumption 2005 is taken from the Austrian association of pellets manufacturers 'ProPellets'. Wood chip consumption is calculated by subtracting pellet consumption from 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 boilers on fuel wood fired heatings is calculated by an annual substitution rate of 3000 central heatings from 1992 on assuming an average annual fuel consumption of 190 GJ/boiler which is approximately 10 t of fuel wood. Controlled wood gasification boilers are considered with lower POPs, NMVOC and CO emissions than manually operated heatings.

Heating oil 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 a annual exchange rate of 5 000 boilers assuming an average annual consumption of 80 GJ/boiler (1.9 t heating oil equivalent) from 1991 on.

Table 116: 1 A 4 b i Type of heatings split.

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 to 2005	**47.1**	**47.7**	**5.1**	**100**	**84.2**	**5.4**	**10.4**	**59.7**	**8.7**	**31.6**

Table 117: 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 to 2005	**47.2**	**18.7**	**34.1**	**26.2**	**10.1**	**63.7**	**75.6**	**7.5**	**16.9**

Table 118: 1 A 4 b i Type of heatings split.

Year	Fuel Wood			Wood Wastes		
	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 to 2005	**67.7**	**8.0**	**24.3**	**89.4**	**3.3**	**7.3**

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

Table 119: 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 120: 1 A 4 NO_x emission factors by type of heating for the year 2005.

	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 (2)20.0	42.0 (2)20.0	42.0
Natural gas	42.0 (2)16.0	43.0 (2)16.0	51.0
Solid biomass	107.0	107.0	106.0
Industrial waste	(1)100.0		

(1) Default values for industrial boilers

(2) Condensing boilers (LEUTGÖB et al. 2003)

Table 121: 1 A 4 NMVOC emission factors by type of heating for the year 2005.

	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 (1)338.0
Wood gasification	(1)325.0	(1)312.0	
Wood chips	(1)78.0		
Pellets	(3)35.0 (for all types of heating)		
Industrial waste	(2)38.0		

(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 122: 1 A 4 CO emission factors by type of heating for the year 2005.

	Central heating [kg/TJ]	Apartement heat-ing [kg/TJ]	Stove [kg/TJ]
Coal	4 206.0	4 206.0	3 705.0
Residual fuel oil < 1% S	45.0		
Residual fuel oil ≥ 1% S	15.0		
Heating oil	67.0	67.0	150.0
Kerosene	15.0		
LPG	37.0	37.0	
Natural gas	37.0	37.0	44.0
Solid biomass conventional	4 303.0	4 303.0	4 463.0 (2)2 345.0
Wood gasification	(2)3 237.0	(2)3 107.0	
Industrial waste	(1)200.0		

(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 123: 1 A 4 SO_2 emission factors by type of heating for the year 2005.

	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	(1)6.0	(1)6.0	(1)6.0
Natural gas	NA	NA	NA
Solid biomass	11.0	11.0	11.0
Industrial waste	(2)130.0		

(1) From (LEUTGÖB et al. 2003)

(2) Default value for industrial boilers (BMWA 1990)

Table 124: 1 A 4 NH_3 emission factors for the year 2005.

	Central heating [kg/TJ]
Coal	0.01
Oil	2.68
Natural gas	1.00
Biomass	5.00
Industrial waste	0.02

Emission factors for heavy metals, POPs and PM used in NFR 1 A 4

In the following the emission factors for heavy metals, POPs and PM which are used in NFR 1 A 3 are described.

Emission factors for heavy metals used in NFR 1 A 4

Fuel Oil

For fuel oil the same emission factors as for 1 A 1 were used.

Coal and Biomass

NFR 1 A 4 c

For deciding on an emission factor for fuel wood results from (OBERNBERGER 1995), (LAUNHARDT et al. 2000) and (FTU 2000) were considered.

The emission factors for coal were derived from (CORINAIR 1995), Table 12, B112.

For mercury the emission factors for 1 A 4 c were also used for the other sub categories.

For lead the emission factors for 1 A 4 c were also used for 1 A 4 b Residential plants: central and apartment heating.

NFR 1 A 4 b

Emission factors for central and apartment heatings base on findings from (HARTMANN, BÖHM & MAIER 2000), (LAUNHARDT, HARTMANN, LINK & SCHMID 2000), (PFEIFFER, STRUSCHKA & BAUMBACH 2000), (STANZEL, JUNGMEIER & SPITZER 1995).

Results of measurements (SPITZER et al. 1998): show that the TSP emission factor for stoves are about 50% higher than the emission factor for central heatings – thus the Cd and Pb emission factor was also assumed to be 50% higher.

Table 125: HM emission factors for Sector 1 A 4 Other Sectors (Commercial and Residential).

	Cadmium EF [mg/GJ]	Mercury EF [mg/GJ]	Lead EF [mg/GJ]
1A4a Commercial/Institutional plants (020103) 1A4c i Plants in Agriculture/Forestry/Fishing (020302)			
102A Hard coal 104A Hard coal briquettes 107A Coke oven coke	5.4	10.7	90
105A Brown coal 106A Brown coal briquettes	3.7	9.2	22
111A Fuel wood 116A Wood waste 113A Peat	7.0	1.9	23
1A4b Residential plants: central and apartment heating (020202)			
102A Hard coal 104A Hard coal briquettes 107A Coke oven coke	4.0	10.7	90
105A Brown coal 106A Brown coal briquettes	2.0	9.2	22
111A Fuel wood 116A Wood waste 113A Peat	3.0	1.9	23

	Cadmium EF [mg/GJ]	Mercury EF [mg/GJ]	Lead EF [mg/GJ]
1A4b Residential plants: stoves (020205)			
102A Hard coal 104A Hard coal briquettes 107A Coke oven coke	6.0	10.7	135
105A Brown coal 106A Brown coal briquettes	3.0	9.2	33
111A Fuel wood 116A Wood waste 113A Peat	4.5	1.9	35

Emission factors for POPs used in NFR 1 A 4

Residential plants

For residential plants the dioxin emission factors for coal and wood were taken from (HÜBNER & BOOS 2000); for heating oil a mean value from (PFEIFFER et al. 2000), (BOOS & HÜBNER 2000) and measurements by FTU (FTU 2000) was used. Combustion of waste in stoves was not considered, as no activity data was available.

For HCB 100 times the EF for dioxin were used.

The PAK emission factors are trimmed mean values from values given in (UBA BERLIN, 1998), (SCHEIDL 1996), (ORTHOFER & VESSELY 1990), (SORGER 1993), (LAUNHARDT et al. 2000), (PFEIFFER et al. 2000) (LAUNHARDT et al. 1998), (STANZEL et al. 1995), (BAAS et al. 1995). However, it was not possible to determine different emission factors for stoves and central heating from the values given in the cited literature. Thus for solid fuels the same proportions given from the dioxin EFs, and for oil the proportions of carbon black given in (HÜBNER et al. 1996), was used. For natural gas it was assumed that the values given in literature are valid for stoves, and that values for central heating are assumed to be five times lower.

Commercial and Institutional plants and Plants in Agriculture/Forestry/Fishing

The same emission factors as used for central heating in the residential sector and for small (and medium) plants of category 1 A 2 were used (the share of the different size classes is based on expert judgement). The values given in the following Table are averaged values per fuel category.

As emission factors for heavy fuel oil and other oil products the same factors as for *1 A 2 Manufacturing and Construction* were used.

Table 126: POP emission factors for 1 A 4.

EF	Dioxin [µg/GJ]	HCB [µg/GJ]	PAK4 [mg/GJ]
1A4a Commercial/Institutional plants (SNAP 020103)			
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 2005)	0.206	185	23.3
115A Industrial waste	0.3	250	26
116A Wood wastes (IEF 2005)	0.33	198	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 2005)	0.252	428	56.4
116A Wood wastes	0.38	600	85
1A4b Residential plants: central and apartment heating (SNAP 020202)			
102A, 105A, 106A, 107A	0.38	600	85 12
203B Light fuel oil 204A Heating oil	0.0015	0.15	
224A Other Oil Products	0.0017	0.14	0.011
301A Natural gas 303A LPG	0.0025	0.25	0.04
111A Wood, 116A Wood wastes Central heating (IEF 2005) Apartment heating	 0.252 0.38	 428 600	 56.4 85
1A4b Residential plants: stoves (SNAP 020205)			
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 127: 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 128: 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**	**2005**
Central heating	55.00	55.00	52.09	46.59
Apartment heating	90.00	90.00	83.02	69.82
Stoves	148.00	148.00	134.27	108.31

4.2.7 QA/QC

Comparison with EPER data

Comparison of emissions with reported 2004/2005 EPER data does not explicitely identify inconsistencies.

1 A 1 a Activity data and GHG emissions are in general of high quality due to the needs of GHG calculation and CO_2-trading. The quality system which is well defined for GHG is basicly also applied to non-GHG but is not always fully documented in the inventory system. The following QA/QC procedures are performed depending on resource availability.

1 A 1 a LPS data gap filling (DKDB)

It has to be noted that emissions from *DKDB* are reported for heating periods from October year$_{(n)}$ to September year$_{(n+1)}$. Due to this and in case of other missing values emissions and fuel consumption for an inventory year are completed by taking the monthly values from the previous inventory year if available. In some cases either activity data or emission data is not complete and gap filling is performed by using other monthly emission ratios of that plant. For boilers with mixed fuel consumption a linear regression model (MS-Excel function "RGP") is sometimes used.

1 A 1 a LPS data validation (DKDB)

An outcome of the methodology as presented in Table 49 are the ratios of measured and calculated emissions by fuel type. Possible reasons for unexplainable ratios:

- Default emission factors are not appropriate because the group includes inhomogen boiler technologies.
- Changed technologies are not reflected.
- Boilers used for default emission factor derivation are not the ident with boilers considered in the inventory aproach.
- Emission declarations are not appropriate (fuel consumption is not consistent with emissions).

Activity data of large boilers and other large plants is checked with the national energy balance. For some fuels (coal, residual fuel oil, waste) and categories total national consumption is limited to a few boilers. In this case LPS consumption may be checked with data from *Statistik Austria* or with the spatial „Bundesländer" energy balance. In some cases published environmental reports which underly a QA/QC system like EMAS are used for validation purpose.

1 A 1 b Petroleum refining

Reported fuel consumption is checked with energy balance. Monthly data from *DKDB* provides emissions by boiler which is cross-checked with reported flue gas concentrations or mandatory limits.

4.2.8 Planned improvements

Key Sources

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 2005 emission factors do not consider the improved combustion efficiency of modern boilers.

NO_x emissions of lime kilns (included in category 1 A 2 f) should be checked with actual measurements if available.

Update 2004 and 2005 emissions of category *1 A 2 d Pulp Paper and Print* and cement industry.

Update of residential type of heating split by actual micro census data 2004/2005.

Non-Key Sources

It is planned to estimate NH_3 slip emissions from NO_x controlled combustion sources (mainly category 1 A 1 a).

Smaller gaps of current POPs estimates should be be estimated for all sources.

4.3 NFR 1 A Mobile Fuel Combustion Activities

In this Chapter the methodology for estimating emissions of mobile sources (NFR 1 A 3 transport, and mobile sources of NFR 1 A 2 f, NFR 1 A 4, NFR 1 A 5) is described.

Table 129: NFR and SNAP categories of '1 A Mobile Fuel Combustion Activities'

Activity	NFR Category	SNAP
	NFR 1 A 2 Manufacturing Industry and Combustion	
Industry, Mobile Machinery	**NFR 1 A 2 f 1**	
		0808 Other Mobile Sources and Machinery-Industry
	NFR 1 A 3 Transport	
Civil Aviation	**NFR 1 A 3 a**	
● Civil Aviation (Domestic)	NFR 1 A 3 a 2	
● Civil Aviation (Domestic, LTO)	NFR 1 A 3 a 2 a	080501 Domestic airport traffic (LTO cycles – < 1000 m)
● Civil Aviation (Domestic, Cruise)	NFR 1 A 3 a 2 b	080503 Domestic cruise traffic (> 1000 m)
Road Transportation	**NFR 1 A 3 b**	
● R.T., Passenger cars	NFR 1 A 3 b 1	0701 Passenger cars
● R.T., Light duty vehicles	NFR 1 A 3 b 2	0702 Light duty vehicles < 3.5 t
● R.T., Heavy duty vehicles	NFR 1 A 3 b 3	0703 Heavy duty vehicles > 3.5 t and buses
● R.T., Mopeds & Motorcycles	NFR 1 A 3 b 4	0704 Mopeds and Motorcycles < 50 cm^3 0705 Motorcycles > 50 cm^3
● Gasoline evaporation from vehicles	NFR 1 A 3 b 5	0706 Gasoline evaporation from vehicles
● Automobile tyre and brake wear	NFR 1 A 3 b 6	0707 Automobile tyre and brake wear
Railways	**NFR 1 A 3 c**	
		0802 Other Mobile Sources and Machinery-Railways
Navigation	**NFR 1 A 3 d**	
		0803 Other Mobile Sources and Machinery-Inland waterways
Other mobile sources and machinery	**NFR 1 A 3 e**	
		0810 Other Mobile Sources and Machinery-Other off-road
	NFR 1 A 4 Other Sectors	
● Residential	1 A 4 b	0809 Other Mobile Sources and Machinery-Household and gardening
● Agriculture / Forestry/Fisheries	1 A 4 c	0806 Other Mobile Sources and Machinery-Agriculture 0807 Other Mobile Sources and Machinery-Forestry
	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 – < 1000 m)
International cruise		
International cruise	I B Av 2	080504 International cruise traffic (>1000 m)

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.

The following table presents the source categories from the NFR 1 A Mobile Fuel Combustion Activities which are key sources of the Austrian inventory with regard to the contribution to national total emissions (for details of the key source analysis see Chapter 1.4).

Table 130: Key Source in NFR 1 A Mobile Fuel Combustion Activities.

	1 A 2 mobile	1 A 3 a	1 A 3 b 1	1 A 3 b 2	1 A 3 b 3	1 A 3 b 4	1 A 3 b 5	1 A 3 b 6	1 A 3 c	1 A 3 d	1 A 3 e	1 A 4 mobile	1 A 5
	Other mobile in industry	**Civil Aviation**	**R.T., Passenger cars**	**R.T., Light duty vehicles**	**R.T., Heavy duty vehicles**	**R.T., Mopeds & Motorcycles**	**R.T., Gasoline evaporation**	**R.T., Automobile tyre and break wear**	**Railways**	**Navigation**	**Other**	**Other Sectors - mobile**	**Other**
SO_x	0.1%	0.3%	0.3%	0.0%	0.3%	0.0%			0.2%	0.1%		0.2%	0.1%
NO_x	5.0%	0.3%	15.3%	2.4%	40.4%	0.1%			0.6%	0.3%	0.7%	8.1%	0.1%
NMVOC	1.2%	0.2%	5.9%	0.4%	2.9%	1.1%	2.5%		0.1%	0.4%	0.0%	5.6%	0.0%
NH_3	0.0%	0.0%	1.7%	0.0%	0.1%	0.0%			0.0%	0.0%	0.0%	0.0%	0.0%
CO	1.8%	0.4%	17.3%	0.7%	2.3%	1.5%			0.1%	0.4%	0.0%	5.5%	0.1%
Cd	5.6%	0.0%	0.3%	0.0%	0.2%	0.0%		7.1%	0.0%	0.0%		0.0%	0.0%
Hg	8.0%	0.0%	0.1%	0.0%	0.1%	0.0%			0.0%	0.0%		0.0%	0.0%
Pb	14.3%	0.0%	0.1%	0.0%	0.0%	0.0%			0.0%	0.0%		0.0%	0.0%
PAH	1.4%		7.3%	1.8%	8.3%	0.4%			0.2%	0.1%		1.8%	0.0%
Diox	11.7%		1.0%	0.3%	1.5%	0.0%			0.0%	0.0%		74.8%	0.0%
HCB	2.5%		0.2%	0.1%	0.3%	0.0%			0.0%	0.0%	0.0%	0.1%	0.0%
TSP	2.8%	0.1%	2.1%	0.8%	2.3%	0.0%		12.3%	1.8%	0.0%	0.0%	11.7%	0.0%
PM10	5.3%	0.2%	4.2%	1.5%	4.5%	0.0%		8.2%	1.3%	0.1%	0.0%	21.6%	0.1%
PM2.5	8.2%	0.3%	7.4%	2.6%	7.9%	0.0%		9.3%	0.8%	0.2%	0.0%	34.5%	0.2%

Completeness

Table 131 provides information on the status of emission estimates of all sub categories. A "✓" indicates that emissions from this sub category have been estimated. Table 129 poviedes an overview about NFR categories and the corresponding SNAP codes.

Table 131: Completeness of "1 A Mobile Fuel Combustion Activities".

NFR Category	NO_x	CO	NMVOC	SO_x	NH_3	TSP	PM10	PM2.5	Pb	Cd	Hg	DIOX	PAH	HCB
1 A 2 f Industry, Mobile Machinery	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
1 A 3 a Civil Aviation	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	NE	NE	NE
1 A 3 b Road Trans portation	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
1 A 3 c Railways	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
1 A 3 d National Navi-gation	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
1 A 3 e ii Other mobile sources and machinery	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
1 A 4 b ii Household and gardening (mobile)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
1 A 4 c ii Off-road Vehi-cles and Other Machinery	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
1A 4 c iii National Fishing	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
1 A 5 b Other, Mobile (Including military)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
International Aviation	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	NE	NE	NE
International maritime Navigation	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
International inland waterways (Included in NEC totals only)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO

The following chapter describes the trend and the methodology of mobile fuel combustion activities.

4.3.1 Emission Trend in NFR 1 A Mobile Fuel Combustion Activities

Total fuel consumption increased by 85 % from 209 PJ in 1990 to 385 PJ in 2005 and road performance (miles driven within the Austrian territory) of passenger cars increased by +33 % and by +41% for low and high duty vehicles. Again it has to be noted that emissions from road transport are calculated on the basis of fuel loaded into vehicles within the Austrian territory.

- a decrease in emission could be noted for
  - SO_2 emissions (93%)
  - NMVOC emissions (64%)
  - CO emissions (57%)
  - Pb emissions (> 99%)
  - dioxin/furan emissions (60%)
  - HCB emissions (60%);
- an increase in emissions
  - NO_x emissions (22%)
  - NH_3 emissions (18%)
  - TSP, PM10, PM2.5 emissions (13%, 5%, 3%)
  - Cd, Hg emissions (40%)
  - Hg emissions (31%)
  - PAH emissions (83%).

Another main reason for this strong increase is the so-called 'tank tourism'. At the beginning of the 1990s fuel prices in Austria were higher compared to neighbouring countries, whereas since the middle of the 1990s it has been the other way round.

Table 132: Emissions and trends from Sector NFR 1 A Mobile Fuel Combustion Activities 1990–2005.

Year	SO_2	NO_x	NMVOC	NH_3	CO	TSP	PM10	PM2.5	Cd	Hg	Pb	PAH	Dioxin	HCB
			[Gg]				[Mg]		[kg]	[kg]	[Mg]	[Mg]	[g]	[kg]
1990	6.02	135.64	88.39	1.00	488.08	18 371.57	11 618.97	10 255.52	59.77	2.12	158.59	1.01	3.80	0.76
1991	6.65	146.41	85.94	1.38	498.08				61.74	2.19	127.78	1.06	3.70	0.74
1992	6.94	140.74	79.78	1.62	455.77				63.53	2.22	86.97	1.04	3.18	0.64
1993	7.31	138.94	74.40	1.82	423.80				64.66	2.19	58.22	1.04	2.82	0.56
1994	7.23	133.93	69.70	1.94	395.02				66.81	2.19	35.78	1.03	2.49	0.50
1995	5.78	131.29	64.23	1.93	365.09	20 048.39	12 528.81	11 031.14	67.95	2.23	0.02	1.04	2.20	0.44
1996	3.32	151.76	60.61	1.85	337.61				69.46	2.39	0.02	1.21	2.07	0.41
1997	2.92	135.73	55.51	1.76	311.21				70.61	2.02	0.01	1.13	1.78	0.36
1998	3.16	152.48	52.83	1.82	307.09				73.05	2.17	0.02	1.27	1.77	0.35
1999	2.82	140.70	47.89	1.69	280.74	20 483.08	12 477.67	10 894.73	74.89	2.10	0.01	1.24	1.56	0.31
2000	2.80	147.61	43.48	1.59	260.74	20 452.12	12 363.71	10 766.12	76.58	2.16	0.01	1.33	1.50	0.30
2001	2.90	153.28	40.69	1.53	248.61	20 654.39	12 486.10	10 874.62	77.73	2.27	0.01	1.43	1.48	0.30
2002	2.82	160.44	38.80	1.52	245.51	21 004.42	12 679.63	11 040.99	79.79	2.46	0.02	1.57	1.50	0.30
2003	2.88	167.09	36.86	1.45	237.84	21 154.33	12 737.10	11 082.17	81.50	2.63	0.02	1.71	1.53	0.31
2004	0.47	164.90	34.21	1.32	223.34	21 091.07	12 542.50	10 864.49	82.20	2.69	0.02	1.77	1.50	0.30
2005	0.43	164.84	31.53	1.18	209.59	20 789.86	12 241.19	10 563.04	83.97	2.77	0.02	1.86	1.50	0.30
Trend														
1990–2005	*-93%*	*22%*	*-64%*	*18%*	*-57%*	*13%*	*5%*	*3%*	*40%*	*31%*	*-100%*	*83%*	*-60%*	*-60%*
2004–2005	*-10%*	*0%*	*-8%*	*-11%*	*-6%*	*-1%*	*-2%*	*-3%*	*2%*	*3%*	*0%*	*5%*	*0%*	*0%*
National Share														
1990	*8%*	*64%*	*31%*	*1%*	*40%*	*20%*	*24%*	*36%*	*4%*	*0%*	*77%*	*6%*	*2%*	*1%*
2005	*2%*	*73%*	*20%*	*2%*	*29%*	*23%*	*27%*	*40%*	*8%*	*0%*	*0%*	*21%*	*4%*	*1%*

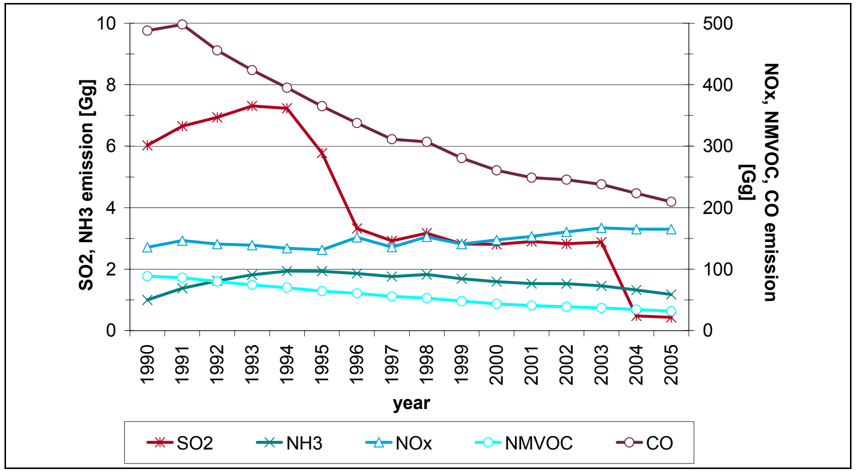


Figure 33: NEC gas emissions and CO emission from NFR 1 A Mobile Fuel Combustion Activities 1990–2005.

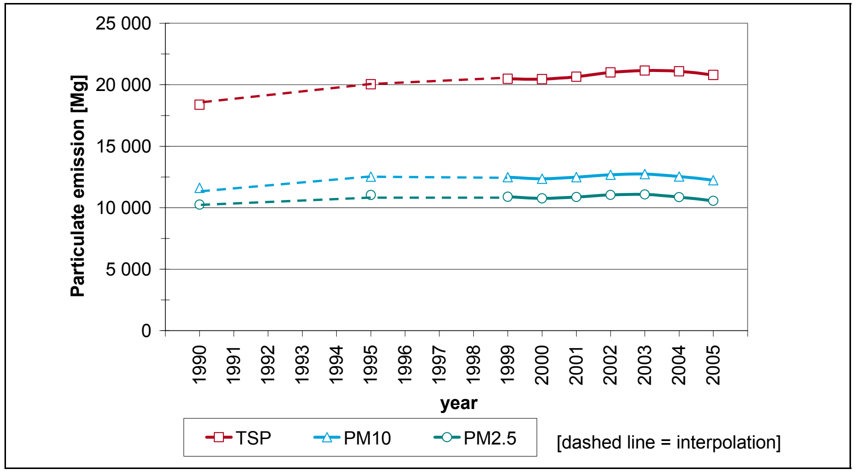


Figure 34: PM emissions from NFR 1 A Mobile Fuel Combustion Activities 1990–2005.

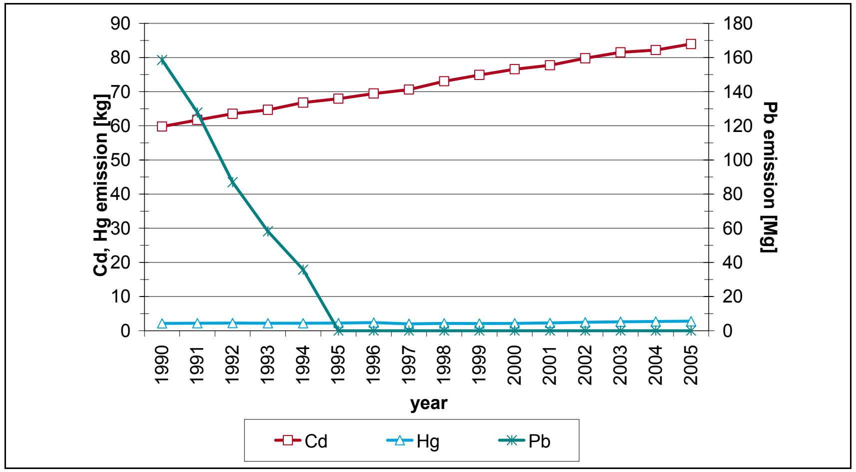


Figure 35: Heavy metal emissions from NFR 1 A Mobile Fuel Combustion Activities 1990–2005.

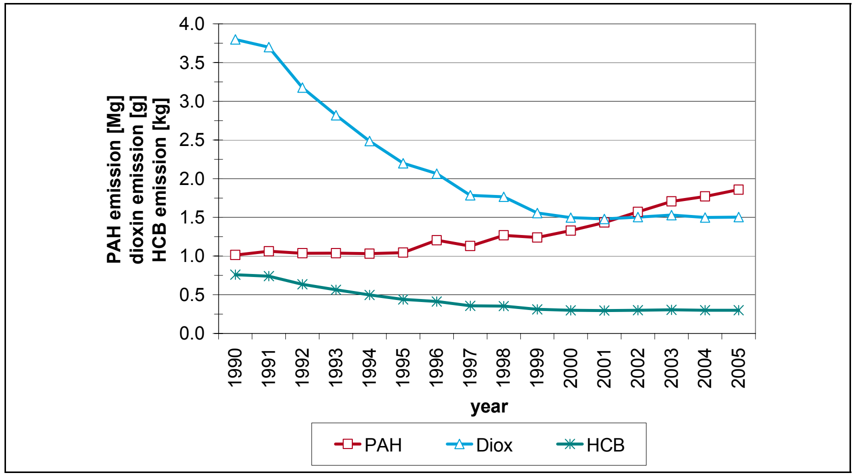


Figure 36: POP emissions from NFR 1 A Mobile Fuel Combustion Activities 1990–2005.

4.3.2 NFR 1 A 3 a Civil Aviation

As can be seen in Table 133 emissions from NFR 1 A 3 a Civil Aviation highly increased over the period from 1990–2005 due to an increase of activity by about 580%. NH_3 and NMVOC emission factors decreased over this period.

Table 133: Emissions from 1 A 3 a Civil Aviation 1990–2005.

Year	NO_x		SO_2		NH_3		NMVOC	
	LTO	cruise	LTO	cruise	LTO	cruise	LTO	cruise
	[Mg]	[Mg]	[Mg]	[Mg]	[Mg]	[Mg]	[Mg]	[Mg]
1990	36.13	40.53	4.20	4.51	0.10	0.03	20.63	18.25
1995	47.14	133.20	5.37	11.62	0.10	0.08	17.27	6.50
2000	67.50	199.10	7.73	17.16	0.11	0.12	50.80	21.30
2005	177.15	548.75	20.11	47.30	0.22	0.32	140.01	58.71
Trend 1990–2005	**390%**	**1254%**	**378%**	**949%**	**116%**	**942%**	**579%**	**222%**

Methodological Issues

NO_x and SO_2

Emission estimates for NO_x and SO_2 were taken from a study commissioned by the Umweltbundesamt that was finished in 2002 (KALIVODA et. al, 2002). Emissions have been calculated using implied emission factors and fuel allocation obtained from the values for the year 2000.

For the air transport class IFR (Instrument Flight Rules) the very detailed methodology from the CORINAIR guidebook in an advanced version (based on the (MEET, 1999) model) has been used. It is based on air traffic movement data[67] (flight distance and destination per aircraft type), aircraft/engine performance data and emission factors.

Fuel consumptions for the different transport modes IFR national LTO, IFR international LTO, IFR national cruise and IFR international cruise as obtained from the MEET model were summed up to a total fuel consumption figure. This value was compared by the Umweltbundesamt with the total amount of kerosene sold in Austria of the national energy balance: a difference was observed (lower fuel consumption in the energy balance). Therefore the fuel consumption of IFR international cruise was adjusted so that the total fuel consumption of the calculations according to the MEET model is consistent with national fuel sales figures from the energy balance. The reason for choosing IFR international cruise for this adjustment is that this mode is assumed to hold the highest uncertainty.

Only IFR national LTO and IFR national cruise is considered in 1 A 3 a Civil Aviation, IFR international LTO and IFR international cruise is considered in I B Av International Bunkers Aviation.

For calculation of NO_x and SO_2 emissions VFR flights were considered as well.

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

Fuel consumption for VFR flights were directly obtained from the energy balance, as total fuel consumption for this flight mode is represented by the total amount of aviation gasoline sold in Austria.

NMVOC

VOC emissions for IFR have been calculated like NO_x and SO_2. According to the CORINAIR guidebook 90.4% of VOC of the LTO-IFR are assumed to be NMVOC.

NH_3

NH_3 emissions were calculated using the fuel consumptions as obtained in the study.

Emission factors are taken from the ICAO Engine Exhaust Emissions Databank (BALASHOW & SMITH 1995).

Fuel consumptions for 1 A 3 a Civil Aviation as obtained from the MEET model (or from the energy balance for VFR) presented in Table 134.

Table 134: Fuel consumptions 1 A 3 a Civil Aviation 1990–2005.

Year	LTO	cruise	
	Kerosene	Gasoline	Kerosene
	[Mg]	[Mg]	[Mg]
1990	3 164	2 487	4 508
1995	4 430	2 241	11 616
2000	6 868	2 039	17 161
2005	18 929	2 787	47 297
Trend 1990–2005	**498%**	**12%**	**949%**

Table 135: Emission factors and activities for Civil Aviation (LTO + cruise) 1990–2005.

Year	Activity	IEF NO_x	IEF SO_2	IEF NH_3	IEF NMVOC
	[PJ]	[t/PJ]	[t/PJ]	[t/PJ]	[t/PJ]
1990	0.44	175.04	19.90	0.30	88.77
1995	0.79	228.26	21.51	0.23	30.09
2000	1.13	236.53	22.08	0.20	63.97
2005	2.99	243.11	22.57	0.18	66.55

Recalculation

The splitting of the energy data into national and international aviation of 2003 has been updated according to the energy balance.

Planned improvements

The discrepancy between the development of fuel consumption and number of flights (both national) will be proofed.

For the category 1 A 3 a civil aviation it is planned to develop a new study to estimate emissions.

4.3.3 International Bunkers – Aviation

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

Table 136: Emissions for Civil Aviation (LTO+cruise) 1990–2005.

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	0.00020	0.00173	0.137	0.163
1995	0.632	3.601	0.049	0.372	0.00033	0.00254	0.186	0.279
2000	0.817	4.538	0.062	0.470	0.00042	0.00320	0.271	0.399
2005	0.845	4.690	0.064	0.486	0.00043	0.00331	0.280	0.412
Trend 1990–2005	**127%**	**95%**	**121%**	**92%**	**115%**	**91%**	**104%**	**153%**

Table 137: Activities for Civil Aviation (LTO + cruise) 1990-2005.

Year	Activity	
	LTO	cruise
	[PJ]	[PJ]
1990	1.25	11.01
1995	2.12	16.13
2000	2.67	20.36
2005	2.76	21.03
Trend 1990–2005	121%	91%

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

4.3.4 NFR 1 A 3 b Road Transport

Road Transport is the main emission source for NO_x, SO_2, NMVOC and NH_3 emissions of the transport sector. Due to decreasing emission factors SO_2, and NMVOC emissions were below 1990 levels in 2005.

The sector includes emissions from passenger cars, light duty vehicles, heavy duty vehicles and busses, mopeds and motorcycles as well as gasoline evaporation from vehicles and automobile tyre and brake wear.

Technical improvements and a stricter legislation led to a reduction of emissions per vehicles or per mileage, respectively. On the other hand a steady increase of transport activity is observed.

Emission trend

The road transport sector is one of the main sources of NO_x emissions in Austria. Around 58% of national total NO_x emissions are caused by road transport. NO_x emissions from road transport are dominated by road freight transport with heavy duty vehicles (with a share of about 69% in total road transport emissions) and passenger car transport (about 26% from total road transport emissions).

Table 138: NO_x emissions from Road Transport 1990–2005.

Year	NO_x [Gg]				
	Passenger Cars	**Light Duty**	**Heavy Duty Vehicles**	**Mopeds & Motorcycles**	**Total**
1990	63.8	7.4	27.0	0.1	98.4
1995	45.8	6.4	41.9	0.1	94.3
2000	32.9	6.2	70.1	0.2	109.4
2005	34.5	5.3	90.9	0.3	131.0
Trend 1990–2005	**-46%**	**-28%**	**236%**	**219%**	**33%**

For SO_2, NMVOC and NH_3 emissions passenger cars are the main source.

SO_2 and NH_3 emissions reached a maximum in 1994 and have steadily decreased since then: SO_2 emissions in 2005 were 96% below 1990 levels whereas NH_3 emissions were still 18% above emissions in 1990.

NMVOC emissions have constantly decreased since 1990, in 2005 emissions were 68% below the 1990 level.

Table 139: SO_2 emissions from Road Transport 1990-2005.

Year	SO_2 [Gg]				
	Passenger Cars	**Light Duty**	**Heavy Duty Vehicles**	**Mopeds & Motorcycles**	**Total**
1990	1.6	0.7	1.5	0.0	3.8
1995	2.0	0.8	2.1	0.0	4.9
2000	0.8	0.3	1.0	0.0	2.1
2005	0.1	0.0	0.1	0.0	0.2
Trend 1990–2005	**-96%**	**-98%**	**-96%**	**-100%**	**-96%**

Table 140: NH_3 emissions from Road Transport 1990–2005.

Year	NH_3 [Gg]				
	Passenger Cars	**Light Duty**	**Heavy Duty Vehicles**	**Mopeds & Motorcycles**	**Total**
1990	0.9	0.0	0.0	0.0	1.0
1995	1.8	0.0	0.0	0.0	1.9
2000	1.5	0.0	0.0	0.0	1.6
2005	1.1	0.0	0.1	0.0	1.2
Trend 1990–2005	**19%**	**-54%**	**79%**	**67%**	**18%**

Table 141: NMVOC emissions from Road Transport 1990–2005.

Year	NMVOC [Gg]				
	Passenger Cars	Light Duty	Heavy Duty Vehicles	Mopeds & Motorcycles	Total
1990	42.4	2.8	2.5	2.3	50.1
1995	25.7	1.8	3.1	2.0	32.6
2000	14.0	1.1	3.6	1.9	20.6
2005	9.1	0.7	4.5	1.8	16.0
Trend 1990–2005	**-79%**	**-77%**	**79%**	**-24%**	**-68%**

Table 142: PM emissions from Road Transport 1990–2005.

Year	PM [Gg]				
	Passenger Cars	Light Duty	Heavy Duty Vehicles	Mopeds & Motorcycles	Total
1990	1.2	1.1	1.1	-	3.4
1995	1.5	1.0	1.7	-	4.2
2000	1.5	0.9	1.9	-	4.2
2005	1.9	0.7	2.1	-	4.7
Trend 1990–2005	**65%**	**-34%**	**81%**	**-**	**39%**

Table 143: Non-exhaust PM emissions from Road Transport 1990–2005.

Year	PM [Gg]				
	Passenger Cars	Light Duty	Heavy Duty Vehicles	Mopeds & Motorcycles	Total
1990	2.1	0.2	0.6	0.0	2.9
1995	2.4	0.2	0.6	0.0	3.2
2000	2.6	0.3	0.6	0.0	3.5
2005	2.8	0.3	0.7	0.0	3.7
Trend 1990–2005	**32%**	**47%**	**21%**	**75%**	**31%**

Methodological Issues

Mobile combustion is differentiated into the categories Passenger Cars, Light Duty Vehicles, Heavy Duty Vehicles and Buses, Mopeds and Motorcycles. Calculations are based on the GLOBEMI study (HAUSBERGER, 1998).

For road transportation, energy consumption and emissions of the different categories are calculated by multiplying the yearly road performance (km/vehicle and year) and the specific energy use with emission factors (g/km, g/kWh, g/kg fuel). Emission factors are based on the "Handbook of Emission Factors" (HAUSBERGER & KELLER 1998). The emissions from cold starts are calculated separately – taking into account temperature, interception periods and driving distances.

Activity data

Calculation of the activity data is based on the GLOBEMI study (HAUSBERGER 1998). Information on the number of new vehicles is published yearly by Statistik Austria. Information on the yearly road performance of the vehicles is supplied by the Austrian automobile clubs throughout the annual vehicle inspection system.

Different road performance for different street categories depending on the engine type, vehicle size and vehicle age is taken into account. The extrapolation of the yearly vehicle stock- and performance share (by vehicle age, motor type and vehicle size) is based on a dynamic, vehicle specific drop out- and road performance function.

Based on the GLOBEMI model total fuel consumption and total emissions for road transport are calculated with a bottom-up approach. Calculated total fuel consumption of road transport is summed up with total fuel consumption of off road traffic and is compared with national total sold fuel: due to uncertainties of the bottom up method the values differ by about 5–20%. To be consistent with the national energy balance, activity data in the bottom-up approach is adjusted so that finally the calculated total fuel consumption equals the figure of fuel sold in the national energy balance.

Table 144: Implied emission factors and activities for 1 A 3 b Road Transport 1990–2005.

Year	Activity	IEF NO_x	IEF SO_2	IEF NH_3	IEF NMVOC	IEF PM	IEF PM Non exh.
	[PJ]	[t/PJ]					
1990	161.07	610.73	23.38	6.07	310.88	20.83	17.74
1995	188.82	499.17	25.98	10.13	172.67	22.35	17.17
2000	228.49	478.99	9.17	6.86	90.05	18.57	15.43
2005	315.60	415.13	0.48	3.66	50.72	14.82	11.87

Recalculations

- Update of statistical energy data
- Update of EURO 4 Diesel PC EF for 2005 (new CADC measurements). Minor influence on the 2005 inventory

Planned Improvements

For the category 1 A 3 b passenger cars it is planned to use new EURO 4 emission factors for Minivans ans SUV's which will be measured in springtime 2007.

4.3.5 Other mobile sources – Off Road

Methodology

In 2001 a study on off road emissions in Austria was finished (PISCHINGER 2000). The study was prepared to improve the poor data quality in this sector. The following categories were taken into account:

- 1 A 2 f Industry
- 1 A 3 c Railways
- 1 A 3 d Navigation
- 1 A 4 b Household and Gardening
- 1 A 4 c Agriculture and Forestry
- 1 A 5 Other: Military Activities.

Depending on the engine's fuel consumption the ratio power of the engine was calculated, emissions were calculated by multiplying ratio power and emission factors. To improve data quality the influence of the vehicle age on the operating time was taken into account.

With this method all relevant effects on engine emissions could be covered:

- Emissions according to the engine type
- Emissions according to the effective engine performance
- Emissions according to the engine age
- Emissions depending on the engine operating time
- Engine operating time according to the engine age.

Emission factors for NO_x, NMVOC and NH_3 were defined for four categories of engine type depending on the year of construction. They are listed in Table 145 to Table 148. The emission factors present fuel consumption and emissions according to the engine power output. Total emissions are calculated by multiplying emission factors with average motor capacity and activity data. With this bottom-up method national total fuel consumption and total emissions are calculated. Calculated total fuel consumption of off road traffic is summed up with total fuel consumption of road transport and is compared with national total sold fuel; due to uncertainties of the bottom-up method the values differ by about 5–20%. To be consistent with the national energy balance, activity data in the bottom-up approaches for both road transport and off- road traffic is adjusted so that finally the calculated total fuel consumption equals to the figure of fuel sold in the national energy balance.

Table 145: Emission Factors for diesel engines > 80 kW.

Year	Fuel	NO_x	NH_3	NMVOC	PM
	[g/kWh]				
1993	282	13.0	0.00300	1.95	1.50
1997	273	14.4	0.00240	1.56	1.10
2000	265	9.2	0.00195	1.27	0.70

Table 146: Emission Factors for diesel engines < 80 kW.

Year	Fuel	NO_x	NH_3	NMVOC	PM
	[g/kWh]				
1993	296	13.0	0.00600	3.90	1.80
1997	287	14.4	0.00450	2.93	1.50
2000	278	9.2	0.00390	2.54	1.05

Table 147: Emission Factors for 4-stroke-petrol engines.

Year	Fuel	NO_x	NH_3	NMVOC	PM
	[g/kWh]				
1993	550	5.0	0.00194	42.84	0.50
1997	520	5.5	0.00172	38.08	0.50
2000	500	5.5	0.00159	35.22	0.50

Year	Fuel	NO_x	NH_3	NMVOC	PM
			[g/kWh]		
1993	700	1.5	0.00168	297.0	8,00
1997	675	1.5	0.00151	267.3	8.00
2000	655	1.5	0.00134	237.6	8.00

Table 148: Emission Factors for 2-stroke-petrol engines.

Emission factors for SO_2 are based on the "Handbook of Emission Factors" (HAUSBERGER & KELLER 1998). They take into account analysis about the sulphur content of the fuel, which has been part of the inquiry of the yearly fuel quality monitory system.

Activity

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

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

Planned Improvements

For the category 1 A 2 f other mobile sources it is planned to use new emission factors which will be developed in a new study of off road emissions.

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

Most mobile sources of the industry are among the building industry. Within the industry sector there are different vehicles, which can be summarized to the following groups:

- vehicles with diesel engine > 80 kW
- vehicles with diesel engine < 80 kW
- vehicles with 4-stroke-petrol engine
- vehicles with 2-stroke-petrol engine.

Emissions from this category are presented in the following table.

Year	NO_x	SO_2	NH_3	NMVOC	PM
			[Gg]		
1990	14.59	0.82	< 0.01	2.87	1.76
1995	15.36	0.26	< 0.01	2.83	1.71
2000	14.47	0.23	< 0.01	2.34	1.28
2005	11.22	0.04	< 0.01	1.91	0.80
Trend 1990–2005	**-23%**	**-96%**	**-24%**	**-34%**	**-55%**

Table 149: Emissions from off-road – Industry 1990–2005.

Between 1990 and 2005, emissions from off road industry decreased because of improved technology.

Activity data

Activities as well as the implied emission factors (national total emissions divided by total fuel consumption in GWh) for mobile sources of 1 A 2 f Manufacturing Industries and Construction (off-road transport in industry) are presented in the following table.

Table 150: Implied emission factors and activities for off-road transport in industry (Category 1 A 2 f Manufacturing Industries and Construction – mobile 1990–2005.

Year	Activity	IEF NO_x	IEF SO_2	IEF NH_3	IEF NMVOC	IEF PM
	[PJ]			[t/PJ]		
1990	13.72	1 063.16	59.76	0.31	209.24	128.55
1995	14.03	1 094.53	18.64	0.29	201.93	121.98
2000	14.40	1 005.09	16.28	0.25	162.81	89.07
2005	16.01	701.01	2.30	0.20	119.15	49.97

4.3.5.2 NFR 1 A 3 c Railways

Only diesel and coal engines are taken into account, emissions driven by power plants due to production of electricity for electric engines are not included to avoid double counting of emissions.

Table 151: Emissions from railways 1990-2005.

Year	NO_x	SO_2	NH_3	NMVOC	PM
			[Gg]		
1990	1.95	0.26	0.00	0.30	0.20
1995	1.75	0.22	0.00	0.25	0.15
2000	1.77	0.10	0.00	0.24	0.11
2005	1.37	0.06	0.00	0.17	0.06
Trend 1990–2005	**-30%**	**-78%**	**-41%**	**-41%**	**-68%**

Emissions from Railways fluctuated over the period from 1990–2005. They reached a maximum in 1992; afterwards the trend was decreasing until 2005. In the year 2005 all emissions were below 1990 levels. The activity of railways also fluctuated over the past years.

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

Year	Activity [PJ]
1990	2.33
1995	2.22
2000	2.43
2005	2.07

Table 152: Activities for railways 1990–2005.

Year	IEF NO_x	IEF SO_2	IEF NH_3	IEF NMVOC	IEF PM
			[t/PJ]		
1990	834.93	111.73	0.93	127.89	84.89
1995	788.19	98.53	0.83	114.75	65.59
2000	731.10	42.23	0.72	99.06	45.13
2005	661.89	27.81	0.61	84.40	30.64

Table 153: Emission factors for railways 1990–2005.

4.3.5.3 NFR 1 A 3 d Navigation

Navigation is mainly freight traffic. NO_x and SO_2 emissions from this category fluctuated over the period from 1990 to 1997. From 1997 to 2000 NO_x emissions were quite stable. Between 2000 and 2005 NO_x emissions increased by 21%.

NH_3 and NMVOC emissions were constant with only minor fluctuations over the period from 1990 to 2005.

Year	NO_x	SO_2	NH_3	NMVOC	PM
			[Gg]		
1990	0.52	0.04	0.00	0.72	0.05
1995	0.52	0.03	0.00	0.71	0.05
2000	0.58	0.02	0.00	0.68	0.04
2005	0.70	0.02	0.00	0.65	0.04
Trend 1990–2005	**34%**	**-36%**	**17%**	**-10%**	**-23%**

Table 154: Emissions from navigation 1990–2005.

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

Year	Activity [PJ]
1990	0.70
1995	0.73
2000	0.86
2005	1.12

Table 155: Activities for navigation 1990–2005.

Table 156: Emission factors for navigation 1990–2005.

Year	IEF NO_x	IEF SO_2	IEF NH_3	IEF NMVOC	IEF PM
			[t/PJ]		
1990	746.83	50.76	0.12	1 023.46	77.13
1995	707.88	42.07	0.11	970.77	63.57
2000	672.15	20.60	0.10	788.90	49.80
2005	629.13	20.44	0.08	577.72	37.09

4.3.5.4 NFR 1 A 4 b Household and gardening – mobile sources

In addition to vehicles used in household and gardening this category contains ski slope machineries and snow vehicles.

Emissions from this category highly decreased over the period from 1990 to 2005, especially SO_2 emissions decreased to a greater extend due to decreasing emission factors.

Table 157: Emissions from off-road – household and gardening 1990–2005.

Year	NO_x	SO_2	NH_3	NMVOC	PM
			[Gg]		
1990	1.07	0.06	0.00	6.27	0.26
1995	1.16	0.02	0.00	6.25	0.25
2000	0.98	0.02	0.00	5.35	0.21
2005	0.80	0.00	0.00	2.86	0.15
Trend 1990–2005	**-25%**	**-92%**	**-25%**	**-54%**	**-40%**

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

Table 158: Emission factors and activities for off-road – household and gardening 1990–2005.

Year	Activity [PJ]
1990	1.89
1995	1.95
2000	1.90
2005	1.91

Table 159: Emission factors and activities for off-road – household and gardening 1990–2005.

Year	IEF NO_x	IEF SO_2	IEF NH_3	IEF NMVOC	IEF PM
			[t/PJ]		
1990	566.73	30.03	0.15	3 313.76	136.15
1995	597.17	11.09	0.14	3 208.83	128.86
2000	517.72	9.92	0.13	2 817.82	111.77
2005	420.32	2.33	0.11	1 502.80	81.09

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

Emissions from this category decreased over the period from 1990 to 2005, especially SO_2 emissions decreased by about 96% due to decreasing emission factors.

NH_3 and NMVOC emissions remained quite constant with only minor fluctuations over this period.

Table 160: Emissions from off-road – agriculture 1990–2005.

Year	NO_x	SO_2	NH_3	NMVOC	PM
	[Gg]				
1990	11.12	0.64	0.01	4.42	1.54
1995	10.55	0.19	0.00	4.14	1.41
2000	11.62	0.19	0.00	3.86	1.48
2005	10.11	0.03	0.00	3.12	1.19
Trend 1990–2005	**-9%**	**-96%**	**-20%**	**-29%**	**-23%**

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

Table 161: Activities for off-road – agriculture 1990–2005.

Year	Activity [PJ]
1990	11.09
1995	10.40
2000	11.64
2005	11.99

Table 162: Emission factors for off-road – agriculture 1990–2005.

Year	IEF NO_x	IEF SO_2	IEF NH_3	IEF NMVOC	IEF PM
	[t/PJ]				
1990	1 003.06	58.16	0.45	398.74	138.74
1995	1 014.92	18.20	0.44	397.89	135.81
2000	998.21	15.95	0.39	331.56	126.84
2005	842.95	2.30	0.34	260.35	99.35

Table 163: Emissions from off-road – forestry 1990–2005.

Year	NO_x	SO_2	NH_3	NMVOC	PM
	[Gg]				
1990	7.24	0.42	0.00	4.34	1.06
1995	6.82	0.12	0.00	3.81	0.95
2000	6.93	0.11	0.00	3.28	0.91
2005	7.21	0.02	0.00	2.66	0.92
Trend 1990–2005	**0%**	**-96%**	**-14%**	**-39%**	**-13%**

Table 164: Activities for off-road – forestry 1990–2005.

Year	Activity [PJ]
1990	7.23
1995	6.68
2000	6.78
2005	8.04

Table 165: Emission factors for off-road – forestry 1990–2005.

Year	IEF NO_x	IEF SO_2	IEF NH_3	IEF NMVOC	IEF PM
			[t/PJ]		
1990	1 001.15	58.46	0.46	600.54	146.35
1995	1 020.58	18.33	0.45	571.24	142.93
2000	1 021.40	16.05	0.40	483.01	134.38
2005	897.34	2.30	0.36	330.72	114.73

4.3.6 NFR 1 A 5 Other Military

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

Recalculation

An error in the last submission regarding the reported unit for the emissions (Gg instead of Mg) as well as the reported activities was identified and corrected for the whole time series.

4.3.6.1 Military off road transport

Estimates for military activities were taken from (PISCHINGER 2000). Information on the fleet composition was taken from official data presented in the internet as no other data was available. Also no information on the road performance of military vehicles was available, that's why emission estimates only present rough estimations, which were obtained making the following assumptions: for passenger cars and motorcycles the yearly road performance as calculated for civil cars was used. For tanks and other special military vehicles the emission factors for diesel engines > 80kW 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 166: Emissions from military off road transport 1990–2005 [Gg].

Year	NO_x	SO_2	NH_3	NMVOC	PM
			[Gg]		
1990	0.03120	0.00173	0.00001	0.00468	0.00360
1995	0.03170	0.00054	0.00001	0.00455	0.00346
2000	0.03054	0.00046	0.00001	0.00384	0.00267
2005	0.01973	0.00006	-	0.00296	0.00157
Trend 1990–2005	**-37%**	**-97%**	**-100%**	**-37%**	**-56%**

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

Table 167: Activities for military off road transport 1990–2005.

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

Table 168: Emission factors for military off road transport 1990–2005.

Year	IEF NO_x	IEF SO_2	IEF NH_3	IEF NMVOC	IEF PM
	[t/PJ]				
1990	1 081.20	59.95	0.35	162.18	124.75
1995	1 101.27	18.76	0.35	158.07	120.20
2000	1 086.69	16.37	0.36	136.64	95.01
2005	726.45	2.21	--	108.99	57.81

4.3.6.2 Military aviation

Emissions of military aviation were calculated following (KALIVODA et al. 2002). Fuel consumption for military flights was reported by the Ministry of Defence. Calculation of emissions from military aviation did not distinguish between LTO and cruise.

Table 169: Emissions and activities military aviation 1990–2005.

Year	NO_x	SO_2	NMVOC	NH_3	Activity
	[Mg]				[PJ]
1990	50.66	10.49	10.16	0.07	0.46
1995	46.93	9.72	9.41	0.07	0.42
2000	66.05	13.68	13.25	0.09	0.59
2005	182.04	37.70	36.51	0.26	1.62

4.3.7 Emission factors for heavy metals, POPs and PM used in NFR 1 A 3

In the following the emission factors for heavy metals, POPs and PM which are used in NFR 1 A 3 are described.

Emission factors for heavy metals used in NFR 1 A 3

As can be seen in Table 53, the HM content of lighter oil products in Austria are below the detection limit. For Cd and Hg and for Pb from 1995 onwards 50% of the detection limit was used as emission factor for all years.

For Pb emission factors for gasoline before 1995 were calculated from the legal content limit for the different types of gasoline and the amounts sold of the different types in the respective year. Furthermore it was considered that according to the CORINAIR 1997 Guidebook the emission rate for conventional engines is 75%, and for engines with catalyst 40% (the type of fuel used in the different engine types was also considered).

The same emission factors were also used for mobile combustion in Categories NFR *1 A 2* and NFR *1 A 4*.

For coal fired steam locomotives the emission factor for uncontrolled coal combustion from the CORINAIR 1997 Guidebook were used.

The emission factors for 'automobile tyre and break wear' were taken from (VAN DER MOST & VELDT 1992), where it was considered that only 10% of the emitted particulate matter (PM) were relevant as air pollutants.

Table 170: 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 171: 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.[68]

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.

[68] 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).

	Dioxin EF [µgTE/GJ]	PAK4 [mg/GJ]
Passenger cars, gasoline	0.046	5.3
PC, gasoline, with catalyst	0.0012	0.32
Passenger cars, diesel	0.0007	6.4
LDV	0.0007	6.4
HDV	0.0055	6.4
Motorcycles < 50 ccm	0.0031	21
Motorcycles < 50 ccm with catalyst	0.0012	2.1
Motorcycles > 50 ccm	0.0031	33
Coal fired steam locomotives	0.38	0.085

Table 172: POP emission factors for Sector 1 A 3 Transport and SNAP 08 Off-Road Machinery.

Emission factors for PM used in NFR 1 A 3

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.

4.4 NFR 1 B Fugitive Emissions

Key source: NMVOC

Fugitive Emissions arising from the production, extraction of coal, oil and natural gas; their storage, processing and distribution. These emissions are fugitive emissions and are reported in NFR Category 1 B. Emissions from fuel combustion during these processes are reported in NFR Category 1 A.

4.4.1 Emission trend in NFR Category 1 B Fugitive Emissions

NMVOC emissions from this category are a minor source of NMVOC emissions in Austria: in 1990 the contribution to national total emissions was 4.3%, in the year 2005 it was 2.0%. Fugitive NMVOC emissions decreased: in 2005, they were 75% below 1990 levels.

Table 173: NMVOC emissions and trends from NFR Category 1 B Fugitive Emissions 1990–2005.

NMVOC [Gg]	1	1 B 2	1 B 2 a	1 B 2 a 1	1 B 2 a 4	1 B 2 a 5	1 B 2 b	1 B 2 c
	Energy	**Fugitive Emissions from Fuels**	**Oil**	**Exploration, Production, Transport**	**Refining/ Storage**	**Distribution of oil products**	**Natural gas**	**Venting and flaring**
1990	154.68	12.22	12.10	1.09	6.59	4.42	0.11	IE
1991	157.33	13.16	13.04	1.09	7.11	4.84	0.12	IE
1992	145.16	13.12	12.99	1.09	7.27	4.63	0.13	IE
1993	139.41	12.86	12.71	1.08	7.19	4.45	0.14	IE
1994	127.44	10.26	10.10	1.04	4.72	4.35	0.15	IE
1995	122.55	8.83	8.66	1.00	3.70	3.96	0.16	IE
1996	121.14	7.90	7.73	0.98	3.67	3.07	0.17	IE
1997	103.37	7.37	7.19	0.98	3.65	2.55	0.18	IE
1998	97.50	5.85	5.66	0.96	3.75	0.95	0.19	IE
1999	92.48	5.13	4.93	0.95	3.00	0.98	0.20	IE
2000	85.00	5.16	4.95	0.95	2.99	1.01	0.21	IE
2001	83.44	3.31	3.10	0.95	1.13	1.01	0.22	IE
2002	79.20	3.47	3.24	0.94	1.16	1.14	0.23	IE
2003	77.35	3.44	3.20	0.94	1.14	1.12	0.24	IE
2004	73.29	3.27	3.02	0.93	1.06	1.04	0.25	IE
2005	72.01	3.09	2.84	0.91	0.94	0.98	0.25	IE
Trend								
1990–2005	*-53.4%*	*-74.7%*	*-76.6%*	*-16.7%*	*-85.7%*	*-77.7%*	*126.6%*	
2004–2005	*-1.7%*	*-5.5%*	*-6.1%*	*-1.7%*	*-11.0%*	*-4.9%*	*1.9%*	
Share in NFR Category 1 Energy								
1990		*7.9%*	*7.8%*	*0.7%*	*4.3%*	*2.9%*	*0.1%*	
2005		*4.3%*	*3.9%*	*1.3%*	*1.3%*	*1.4%*	*0.4%*	
Share in National Total								
1990	*54.3%*	*4.3%*	*4.3%*	*0.4%*	*2.3%*	*1.6%*	*0.0%*	
2005	*46.7%*	*2.0%*	*1.8%*	*0.6%*	*0.6%*	*0.6%*	*0.2%*	

This category is a minor source regarding SO_2 emissions, which originate from the first treatment of sour gas. The contribution in the year 1990 was 2.7%, in 2005 these emissions contributed 0.5% to national total SO_2 emissions. SO_2 emissions from NFR Category 1 B decreased by 93% between 1990 and 2005.

Table 174: SO_2 and NO_x emissions and trends from NFR Category 1 B Fugitive Emissions 1990–2005.

Year	SO_2 [Gg]				NO_x [Gg]	
	1	**1 B**	**1 B 2 b**	**1 B 2 c**	**1**	**1 B**
	Energy	**Fugitive Emissions from Fuels**	**Natural gas**	**Venting and flaring**	**Energy**	**Fugitive Emissions from Fuels**
1990	71.92	2.00	2.00	IE	200.09	IE
1991	69.39	1.30	1.30	IE	211.45	IE
1992	53.20	2.00	2.00	IE	198.87	IE
1993	51.85	2.10	2.10	IE	194.58	IE
1994	46.09	1.28	1.28	IE	186.26	IE
1995	45.39	1.53	1.53	IE	184.38	IE
1996	43.31	1.20	1.20	IE	204.77	IE
1997	39.03	0.07	0.07	IE	191.86	IE
1998	34.33	0.04	0.04	IE	204.55	IE
1999	32.56	0.14	0.14	IE	192.58	IE
2000	30.27	0.15	0.15	IE	197.62	IE
2001	31.75	0.16	0.16	IE	206.59	IE
2002	30.65	0.14	0.14	IE	212.71	IE
2003	31.36	0.15	0.15	IE	222.48	IE
2004	25.98	0.14	0.14	IE	218.04	IE
2005	25.13	0.13	0.13	IE	218.50	IE
Trend						
1990–2005	*-65.1%*	*-93.4%*	*-93.4%*		*9.2%*	
2004–2005	*-3.3%*	*-7.6%*	*-7.6%*		*0.2%*	
Share in NFR Category 1 Energy						
1990		*2.8%*	*2.8%*			
2005		*0.5%*	*0.5%*			
Share in National Total						
1990	*96.9%*	*2.7%*	*2.7%*		*94.8%*	
2005	*95.2%*	*0.5%*	*0.5%*		*97.1%*	

Fugitive TSP, PM10 and PM2.5 emissions originate from storage of solid fuels (coke oven coke, bituminous coal and anthracite, lignite and brown coal). Emissions from this category contribute less than 1% to national totals and remained stable between 1990 and 2005.

Table 175: TSP, PM10 and PM2.5 emissions and trends from NFR Category 1 B Fugitive Emissions 1990–2005.

PM [Mg]	TSP			PM10			PM2.5		
	1	1 B	1 B 1	1	1 B	1 B 1	1	1 B	1 B 1
	Energy	Fugitive Emissions from Fuels	Solid fuels	Energy	Fugitive Emissions From Fuels	Solid fuels	Energy	Fugitive Emissions from Fuels	Solid fuels
1990	32 631.46	647.03	647.03	24 225.12	304.71	304.71	21 135.60	94.96	94.96
1991	NR	NR	NR	NR	NR	NR	NR	NR	NR
1992	NR	NR	NR	NR	NR	NR	NR	NR	NR
1993	NR	NR	NR	NR	NR	NR	NR	NR	NR
1994	NR	NR	NR	NR	NR	NR	NR	NR	NR
1995	32 548.04	545.04	545.04	23 574.93	256.91	256.91	20 608.03	80.27	80.27
1996	NR	NR	NR	NR	NR	NR	NR	NR	NR
1997	NR	NR	NR	NR	NR	NR	NR	NR	NR
1998	NR	NR	NR	NR	NR	NR	NR	NR	NR
1999	32 609.30	499.64	499.64	23 204.37	235.54	235.54	20 183.31	73.61	73.61
2000	31 616.11	556.46	556.46	22 196.27	262.50	262.50	19 253.86	82.22	82.22
2001	32 844.76	587.13	587.13	23 230.74	276.84	276.84	20 150.76	86.59	86.59
2002	32 677.31	597.99	597.99	22 955.14	282.05	282.05	19 898.27	88.30	88.30
2003	33 077.75	655.20	655.20	23 223.56	309.02	309.02	20 106.24	96.75	96.75
2004	32 698.99	609.02	609.02	22 760.91	287.41	287.41	19 662.62	90.13	90.13
2005	32 576.05	613.83	613.83	22 615.50	289.72	289.72	19 503.85	90.89	90.89
Trend									
1990–2005	*-0.2%*	*-5.1%*	*-5.1%*	*-6.6%*	*-4.9%*	*-4.9%*	*-7.7%*	*-4.3%*	*-4.3%*
2004–2005	*-0.4%*	*0.8%*	*0.8%*	*-0.6%*	*0.8%*	*0.8%*	*-0.8%*	*0.8%*	*0.8%*
Share in NFR Category 1 Energy									
1990		*2.0%*	*2.0%*		*1.3%*	*1.3%*		*0.4%*	*0.4%*
2005		*1.9%*	*1.9%*		*1.3%*	*1.3%*		*0.5%*	*0.5%*
Share in National Total									
1990	*35.6%*	*0.7%*	*0.7%*	*50.9%*	*0.6%*	*0.6%*	*73.9%*	*0.3%*	*0.3%*
2005	*35.7%*	*0.7%*	*0.7%*	*49.7%*	*0.6%*	*0.6%*	*74.7%*	*0.3%*	*0.3%*

4.4.2 Completeness

Table 176 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 176: Overview of sub categories of Category 1 B Fugitive Emissions and status of estimation.

NFR Category		Status													
		NEC gas				CO	PM			Heavy metals			POPs		
		NO_x	SO_x	NH_3	NMVOC	CO	TSP	PM10	PM2.5	Cd	Hg	Pb	Dioxin	PAH	HCB
1B1	Fugitive Emissions from Solid Fuels	NA	NA	NA	NA	NA	✓	✓	✓	NA	NA	NA	NA	NA	NA
1 B 1 a	Coal Mining and Handling	NA	NA	NA	NA	NA	✓	✓	✓	NA	NA	NA	NA	NA	NA
1 B 1 b	Solid fuel transformation [(1)]	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
1 B 1 c	Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
1 B 2	Oil and natural gas	IE	✓	NA	✓	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1 B 2 a	Oil	NA	NA	NA	✓	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1 B 2 a	i Exploration	NA	NA	NA	✓	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	ii Production	NA	NA	NA	✓	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	iii Transport	NA	NA	NA	✓	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	iv Refining/Storage	NA	NA	NA	✓	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	v Distribution of oil products	NA	NA	NA	✓	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	vi Other	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
1 B 2 b	Natural gas	NA	✓	NA	✓	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1 B 2 c	Venting and flaring[(2)]	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE

[(1)] *included in 1 A 2 a Iron and Steel*

[(2)] *included in 1 A 1 b Petroleum Refining*

4.4.3 Methodological issues

1 B 1 Coal mining and handling

In this category TSP, PM10 and PM2.5 emissions from storage of solid fuels, including coke oven coke, bituminous coal and anthracite, lignite and brown coal, are considered.

Emissions are calculated with the simple CORINAIR methodology. Activity data are taken from the national energy balance and are presented in Table 177 together with the national emission factors (WINIWARTER et al. 2001).

Table 177: Emission factors and activity data for fugitive TSP, PM10 and PM2.5 emissions from NFR category 1B 1.

	Coke oven coke	Bituminous coal/Anthracite	Lignite/Brown coal
PM		**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	1 483.62	1 743.49	2 353.88
2000	1 847.84	1 360.96	2 435.40
2004	2 418.26	1 228.14	2 518.80
2005	2 135.57	1 234.00	2 809.26

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 (85%, 83% and 70% 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 178.

Table 178: 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
2004	262	215	270	2 133	59	8 442
2005	206	204	270	2 074	59	8 755

1 B 2 b Natural Gas

In this category SO_2 and NMVOC emissions from the first treatment of sour gas and NMVOC emissions from gas distribution networks are considered.

SO_2 emissions from the 1st treatment of sour gas are reported directly by the operator of the only sour gas treatment plant in Austria. NMVOC emissions were reported for the years 1992 onwards, for the years before the emission value of 1992 was used.

NMVOC emissions from gas distribution networks were calculated by applying an emission factor of 7 380 g/km distribution main. This emission factor is based on the mean IPCC default EF for CH_4 (615 kg/km) with an average of 1.2% NMVOC in natural gas.

Table 179: 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/m³] NMVOC	IEF [g/m³] SO_2	Natural gas [1000 m³]	EF [g/km]	Distribution mains [km]
1990	4.41	8.06	248 090	7 380	15 200
1995	2.47	3.77	405 638	7 380	22 400
2000	2.65	0.40	358 357	7 380	28 800
2004	2.48	0.39	373 099	7 380	33 800
2005	2.69	0.39	338 349	7 380	34 450

4.4.4 Recalculations

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

5 INDUSTRIAL PROCESSES (NFR SECTOR 2)

5.1 Sector overview

This chapter includes information on the estimation of the emissions of NEC gases, CO, particle matter (PM), heavy metals (HM) and persistent organic pollutant (POP) as well as references for activity data and emission factors reported under NFR Category *2 Industrial Processes* for the period from 1990 to 2005 in the NFR.

Emissions from this category comprise emissions from the following sub categories: *Mineral Products*, *Chemical Industry*, *Metal Production* and *Other Production* (*Chipboard* and *Food and Drink)*.

Only process related emissions are considered in this Sector, emissions due to fuel combustion in manufacturing industries are allocated in NFR Category *1 A 2 Fuel Combustion – Manufacturing Industries and Construction* (see Chapter 4.2.4).

Some categories in this sector are not occurring (NO) in Austria as there is no such production. For some categories emissions have not been estimated (NE) or are included elsewhere (IE). In Chapter 1.7 and Chapter 5.3.4 a general and sector specific, respectively description regarding completeness is given. A summary of these categories is given in Table 197.

The Sector *Industrial Processes* is responsible for PAH emissions: they amount to about 2% of national total emissions; the other POPs Dioxin and HCB make up about 8% each of national total emissions in 2005 (see Table 180 and Table 195).

Furthermore the sector *Industrial Processes* is an important source regarding heavy metal emissions in Austria, they make up about 48% of national total Pb emissions, about 31% of national total Hg emissions, and 20% of national total Cd emissions (see Table 180 and Table 195).

This sector is also an important source regarding particulate matter, where it contributes to about 29%, 30% and 17%, respectively, to national total TSP, PM10 and PM2.5 emissions.

The Sector *Industrial Processes* contributes 4.6% to national total SO_2 emissions, 0.6% to national total NO_x emissions, and 2.9% to national total NMVOC emissions. Also this sector contributes 3.3% to national total CO emissions and less than 1% to national total NH_3 emissions.

The following Table presents the source categories from the industrial sector which are key sources of the Austrian inventory with regard to the contribution to national total emissions (for details of the key source analysis see Chapter 1.4).

Table 180: Key Source in NFR sector 2 Industrial Processes.

Pollutant	Source category				
	2 A	2 B	2 C	2 D	2 G
	Mineral Products	Chemical Industry	Metal Production	Other Production	Other
SO_2		**2.90%**	1.71%		
NO_x		0.25%	0.05%	0.27%	
NMVOC		0.86%	0.29%	**1.70%**	
NH_3		0.10%			0.00%
CO	**1.36%**	**1.54%**	0.35%	0.06%	
Cd		0.06%	**20.16%**		
Hg		0.01%	**31.24%**		
Pb		0.01%	**47.85%**		
PAH			**2.02%**	0.42%	
Diox			**8.00%**	0.31%	
HCB			**8.07%**	0.06%	
TSP	**26.27%**	0.50%	**2.50%**	0.00%	
PM10	**25.43%**	0.59%	**3.53%**	0.00%	
PM2.5	**13.81%**	0.54%	**2.67%**	0.00%	

Note: grey shaded are key sources

5.2 Emission trend in NFR Category 2 Industrial Processes

In the following the air pollutants are described with respect to annual emissions and their trends for the period 1990 to 2005. In cases where the sub sectors are key source, a more detailed description is given.

5.2.1 NEC gases and CO

SO_2 Emissions (key source)

SO_2 emissions from NFR Category *2 Industrial Processes* decreased over the period from 1990 to 2005. As can be seen in Table 181, in 1990 emissions amounted to 2.2 Gg, in 2005 they were 45% lower (1.2 Gg).

The share of SO_2 emissions from this sector in national total emissions was about 3% in 1990 and about 5% in 2005 because there was a strong reduction of SO_2 emissions from combustion processes whereas emissions from industrial processes remained quite stable.

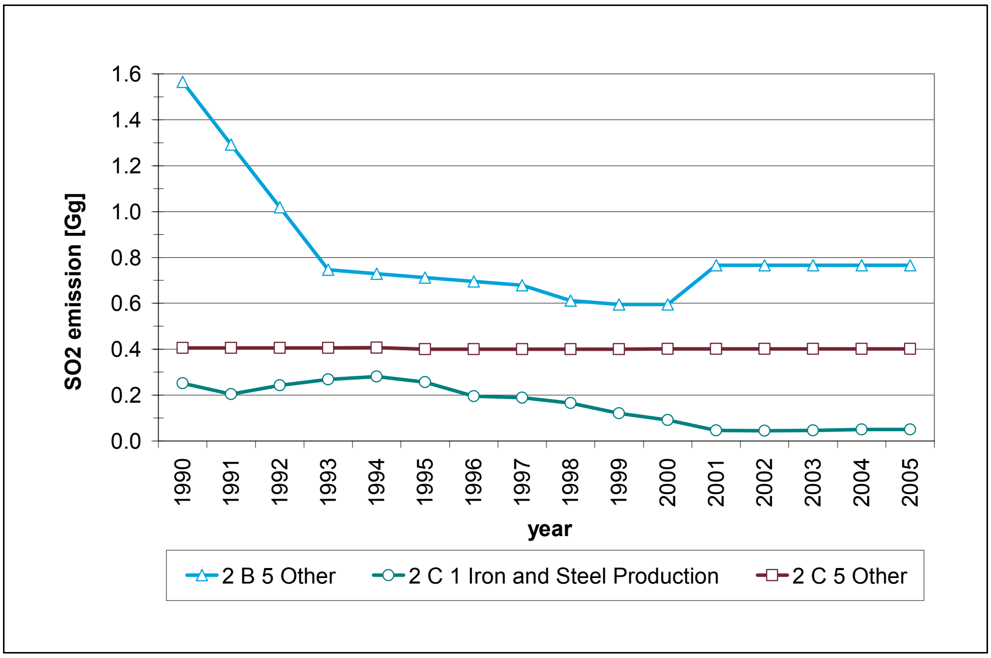


Figure 37: Emission trends of the key sources NFR 2 B and NFR 2 C.

SO_2 emissions arise from the sub-sectors 2 B *Chemical Industry* and 2 C *Metal Production* with a share of 2.9% (NFR 2 B) and 1.7% (NFR 2C) in National Total; the follwing category is key source:

- SO_2 emissions from sub sector 2 B *Chemical Industry* derived from NFR 2 B 5 *Other* which covers processes in inorganic chemical industries. The SO_2 emissions decreased by 51% in the period 1990–2005 where the emission reduction happened mainly from 1990 to 1993. In the years 1999 and 2000 the SO_2 emission were 62% under 1990 level by since then the emissions increased slightly. Reasons for the emission reduction are on the one hand a decline in production of about 8% and on the other hand abatement techniques such as systems for purification of waste gases and desulphurisation facilities.

Table 181: SO_2 emissions and trends from Sector 2 Industrial Processes and source categories 1990–2005.

SO_2 [Gg]	2	2 B	2 B 5	2 C	2 C 1	2 C 5
	Industrial Processes	Chemical Industry	Other	Metal Production	Iron and steel	Other
1990	2.22	1.56	1.56	0.66	0.25	0.41
1991	1.90	1.29	1.29	0.61	0.20	0.41
1992	1.67	1.02	1.02	0.65	0.24	0.41
1993	1.42	0.75	0.75	0.67	0.27	0.41
1994	1.42	0.73	0.73	0.69	0.28	0.41
1995	1.37	0.71	0.71	0.66	0.26	0.40
1996	1.29	0.70	0.70	0.60	0.19	0.40
1997	1.27	0.68	0.68	0.59	0.19	0.40
1998	1.18	0.61	0.61	0.57	0.17	0.40
1999	1.12	0.59	0.59	0.52	0.12	0.40
2000	1.09	0.59	0.59	0.49	0.09	0.40
2001	1.21	0.77	0.77	0.45	0.05	0.40
2002	1.21	0.77	0.77	0.45	0.05	0.40
2003	1.21	0.77	0.77	0.45	0.05	0.40
2004	1.22	0.77	0.77	0.45	0.05	0.40
2005	1.22	0.77	0.77	0.45	0.05	0.40
Trend						
1990–2005	*-45.2%*	*-51.1%*	*-51.1%*	*-31.2%*	*-80.0%*	*-0.9%*
2004–2005	*0.1%*	*< 0.1%*	*< 0.1%*	*0.2%*	*1.3%*	*0.0%*
Share in Sector 2 Industrial Processes						
1990		*70.4%*	*70.4%*	*29.6%*	*11.3%*	*18.2%*
2005		*62.9%*	*62.9%*	*37.1%*	*4.1%*	*33.0%*
Share in National Total						
1990	*3.0%*	*2.1%*	*2.1%*	*0.9%*	*0.3%*	*0.5%*
2005	*4.6%*	*2.9%*	*2.9%*	*1.7%*	*0.2%*	*1.5%*

NO_x Emissions

The share of NO_x emissions from this sector in national total emissions has was about 2.3% in 1990 and about 0.6% in 2005 (see Table 182) because of the strong reduction of NO_x emissions in this sector but also because the emissions from combustion processes remained quite stable on a high level. There are no key sources within this sector.

As it is shown in Table 182, NO_x emissions from the *industrial processes sector* decreased over the period from 1990 to 2005. In 1990 they amounted to 4.8 Gg, in the year 2005 they were 73% below 1990 levels (1.29 Gg). The main source for NO_x emissions of NFR Category *2 Industrial Processes* with a contribution of 85% in 1990 is *2 B Chemical Products*. However, emissions from this sector were reduced due to use of low-emission fuels and energy-savings; in 2005 category *2 D Other Production* (Chipboard Production) was the main NO_x source from this sector as emissions increased due to increasing production. Category *2 C Metal Production* is only a minor source within this sector.

Table 182: NO_x emissions and trends from Sector 2 Industrial Processes and source categories 1990–2005.

NO_x [Gg]	2	2 B	2 B 1	2 B 2	2 B 5	2 C	2 C 1	2 C 5	2 D	2 D 1
1990	4.80	4.07	IE	IE	4.07	0.17	0.16	0.02	0.55	0.55
1991	4.48	3.76	IE	IE	3.76	0.14	0.13	0.02	0.58	0.58
1992	4.55	3.82	IE	IE	3.82	0.17	0.15	0.02	0.57	0.57
1993	1.98	1.25	0.47	0.69	0.09	0.18	0.16	0.02	0.55	0.55
1994	1.92	1.16	0.45	0.63	0.09	0.19	0.17	0.02	0.57	0.57
1995	1.46	0.69	0.29	0.35	0.06	0.18	0.16	0.01	0.59	0.59
1996	1.42	0.69	0.28	0.36	0.05	0.15	0.13	0.02	0.59	0.59
1997	1.50	0.68	0.29	0.34	0.05	0.15	0.13	0.02	0.67	0.67
1998	1.46	0.66	0.25	0.36	0.05	0.14	0.13	0.02	0.66	0.66
1999	1.44	0.67	0.23	0.37	0.06	0.12	0.10	0.02	0.66	0.66
2000	1.54	0.68	0.21	0.41	0.07	0.12	0.10	0.02	0.74	0.74
2001	1.57	0.66	0.20	0.38	0.07	0.09	0.07	0.02	0.82	0.82
2002	1.63	0.66	0.22	0.37	0.07	0.09	0.07	0.02	0.88	0.88
2003	1.34	0.69	0.23	0.38	0.08	0.09	0.07	0.02	0.56	0.56
2004	1.28	0.56	0.23	0.28	0.05	0.10	0.08	0.02	0.61	0.61
2005	1.29	0.57	0.24	0.24	0.09	0.10	0.08	0.02	0.61	0.61
Trend										
1990–2005	*-73.1%*	*-85.9%*	*-*	*-*	*-97.8%*	*-40.5%*	*-47.3%*	*24.9%*	*11.3%*	*11.3%*
2004–2005	*1.0%*	*2.3%*	*5.6%*	*-15.1%*	*91.4%*	*0.4%*	*1.4%*	*-3.4%*	*< 0.1%*	*< 0.1%*
Share in Sector 2 Industrial Processes										
1990		*84.9%*	*-*	*-*	*84.9%*	*3.6%*	*3.2%*	*0.3%*	*11.5%*	*11.5%*
2005		*44.4%*	*18.9%*	*18.6%*	*6.9%*	*7.9%*	*6.4%*	*1.6%*	*47.6%*	*47.6%*
Share in National Total										
1990	*2.3%*	*1.9%*	*-*	*-*	*1.9%*	*0.1%*	*0.1%*	*< 0.1%*	*0.3%*	*0.3%*
2005	*0.6%*	*0.3%*	*0.1%*	*0.1%*	*< 0.1%*	*< 0.1%*	*< 0.1%*	*< 0.1%*	*0.3%*	*0.3%*

NMVOC Emissions (key source)

Sector *2 Industrial processes* is the third largest sector regarding NMVOC emissions, in 1990 the contribution to national total emissions was 4% (11.1 Gg) compared to 3% (4.4 Gg) in 2005 due to abetement techniques but also because of decreasing emissions from the other sectors as NFR *3 Solvents* and NFR *1 Energy*.

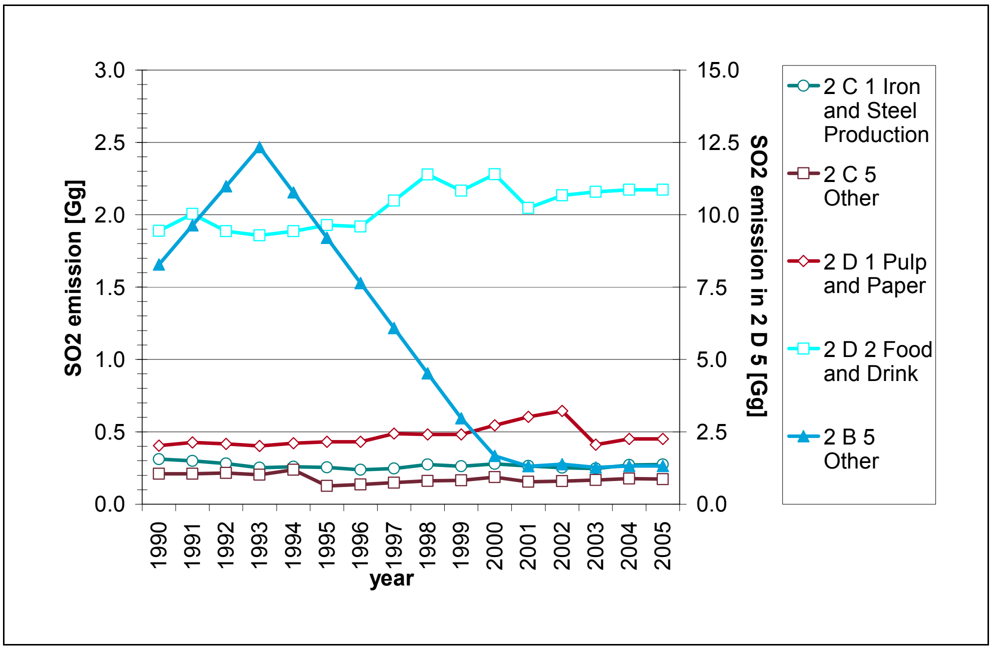


Figure 38: Emission trends of the key sources NFR 2 B and NFR 2 D as well as of NFR 2 C.

The trend regarding NMVOC emissions from *2 Industrial Processes* shows decreasing emissions: in the period from 1990 to 2005 emissions decreased by 60%, mainly due to decreasing emissions from *2B Chemical Industry*, which was with a share of 75% in sector NFR 2 the main contributor to NMVOC emissions from industrial processes (see Table 183) in 1990.

The decrease took place primarily from 1993 to 2000 since then the emissions remained quite stable. Other contributors to NMVOC emissions from industrial processes are the sector NFR 2 C *Metal production* and 2 D *Other production*.

With a share of 2% (NFR 2D) of the national NMVOC emissions this category is key sources:

- NMVOC emissions from sub-sector 2 D *Other Production* derived from NFR 2D 1 *Pulp and Paper* (10.3% of NFR 2) and 2 D 2 *Food and Drink* (49.4% of NFR 2). In both sub-sectors NMVOC emissions increased; in NFR 2D1 *Pulp and Paper* by 11%, in 2D2 *Food and Drink* by 15% to 2.2 Gg (1990–2005). The reason for this increase is the rise in output in the food and drink industry.

As can be seen in Table 183 NMVOC emissions of NFR 2 A and NFR 2 B 1 are includes elsewhere (IE):

- NMVOC emissions from NFR 2 A which covers activities form road paving with asphalt are reported in NFR 3.
- NMVOC emissions from NFR 2 B 1 which covers activities form Ammonia Production are reported in NFR 2 B 5.

Table 183: NMVOC emissions and trends from Sector 2 Industrial Processes and source categories 1990–2005.

NMVOC [Gg]	2	2 A	2 B	2 B 1	2 B 5	2 C	2 C 1	2 C 5	2 D	2 D 1	2 D 2
1990	11.10	IE	8.29	IE	8.29	0.52	0.31	0.21	2.29	0.40	1.89
1991	12.58	IE	9.64	IE	9.64	0.51	0.30	0.21	2.43	0.43	2.01
1992	13.78	IE	10.99	IE	10.99	0.50	0.28	0.22	2.30	0.42	1.89
1993	15.05	IE	12.34	IE	12.34	0.46	0.25	0.20	2.26	0.40	1.86
1994	13.57	IE	10.77	IE	10.77	0.50	0.26	0.24	2.31	0.42	1.89
1995	11.95	IE	9.21	IE	9.21	0.38	0.25	0.13	2.36	0.43	1.93
1996	10.37	IE	7.64	IE	7.64	0.37	0.24	0.14	2.35	0.43	1.92
1997	9.06	IE	6.08	IE	6.08	0.39	0.25	0.15	2.59	0.49	2.10
1998	7.71	IE	4.52	IE	4.52	0.43	0.27	0.16	2.76	0.48	2.28
1999	6.04	IE	2.97	IE	2.97	0.43	0.26	0.16	2.65	0.48	2.17
2000	4.96	IE	1.67	IE	1.67	0.47	0.28	0.19	2.83	0.54	2.28
2001	4.38	IE	1.31	IE	1.31	0.42	0.26	0.15	2.65	0.60	2.05
2002	4.57	IE	1.39	IE	1.39	0.41	0.25	0.16	2.78	0.64	2.13
2003	4.26	IE	1.28	IE	1.28	0.41	0.25	0.17	2.57	0.41	2.16
2004	4.40	IE	1.32	IE	1.32	0.45	0.27	0.18	2.62	0.45	2.17
2005	4.40	IE	1.32	IE	1.32	0.45	0.27	0.17	2.62	0.45	2.17
Trend											
1990–2005	*-60.4%*	-	*-84.0%*	-	*-84.0%*	*-13.9%*	*-11.8%*	*-17.0%*	*14.4%*	*11.3%*	*15.1%*
2004–2005	*0.0%*	-	*0%*	-	*0%*	*-0.1%*	*1.2%*	*-2.1%*	*0%*	*0%*	*0%*
Share in Sector 2 Industrial Processes											
1990		-	*74.7%*	-	*74.7%*	*4.7%*	*2.8%*	*1.9%*	*20.7%*	*3.6%*	*17.0%*
2005		-	*30.1%*	-	*30.1%*	*10.2%*	*6.2%*	*3.9%*	*59.7%*	*10.3%*	*49.4%*
Share in National Total											
1990	*3.9%*	-	*2.9%*	-	*2.9%*	*0.2%*	*0.1%*	*0.1%*	*0.8%*	*0.1%*	*0.7%*
2005	*2.9%*	-	*0.9%*	-	*0.9%*	*0.3%*	*0.2%*	*0.1%*	*1.7%*	*0.3%*	*1.4%*

CO Emissions

The share of CO emissions from this sector in national total emissions was about 4% in 1990 and about 3% in 2005 (see Table 184) because of the strong reduction measures for CO emissions in this sector but also because the emissions from combustion processes remained on a high level. The categories 2A and 2B with shares of the national total of 1.4% and 1.5% are key sources within this sector.

As it can be seen in Table 184, CO emissions from the *industrial processes sector* decreased over the period from 1990 to 2005. In 1990 they amounted to 46 Gg, in the year 2005 they were 49% below 1990 levels (24 Gg). Whereas 1990 NFR *2 C Metal Production* was with a contribution of 51% main source within NFR 2 *industrial processes,* emissions from this sector were reduced due to abatement techniques; in 2005 NFR *2 C Metal Production* had a share of 11% in NFR 2. In 2005, the main sources for CO emissions of NFR Category *2 Industrial Processes* with a contribution of 47% and 41%, respectively were NFR 2 B *Chemical Products* and NFR 2 A *Mineral Products*. NFR 2 D *Other Production* is a minor sources within this sector. Extensive technical abatement techniques as well as energy-saving technology are reasons for the emission reduction.

Table 184: CO emissions and trends from Sector 2 Industrial Processes and source categories 1990–2005.

CO [Gg]	2	2 A	2 A 5	2 B	2 B 1	2 B 5	2 C	2 C 1	2 C 5	2 D	2 D 1
1990	46.37	9.78	9.78	12.67	0.12	12.54	23.52	23.19	0.33	0.40	0.40
1991	41.67	9.80	9.80	12.18	0.13	12.05	19.26	18.93	0.33	0.42	0.42
1992	44.97	10.26	10.26	11.68	0.12	11.56	22.63	22.29	0.34	0.41	0.41
1993	47.15	10.76	10.76	11.20	0.13	11.07	24.80	24.47	0.33	0.40	0.40
1994	48.65	11.11	11.11	11.19	0.12	11.07	25.93	25.57	0.35	0.42	0.42
1995	45.08	10.93	10.93	11.17	0.10	11.07	22.55	22.28	0.28	0.43	0.43
1996	39.44	10.93	10.93	11.14	0.06	11.07	16.95	16.67	0.28	0.43	0.43
1997	38.30	10.49	10.49	11.20	0.13	11.07	16.13	15.84	0.29	0.48	0.48
1998	34.86	9.47	9.47	11.16	0.08	11.07	13.75	13.46	0.30	0.48	0.48
1999	30.58	9.32	9.32	11.11	0.04	11.07	9.68	9.38	0.30	0.48	0.48
2000	27.38	9.11	9.11	11.11	0.04	11.07	6.62	6.31	0.31	0.54	0.54
2001	24.20	10.03	10.03	11.11	0.04	11.07	2.47	2.17	0.30	0.60	0.60
2002	23.87	9.78	9.78	11.10	0.03	11.07	2.35	2.05	0.30	0.64	0.64
2003	23.59	9.78	9.78	11.09	0.03	11.07	2.30	2.00	0.31	0.41	0.41
2004	23.86	9.78	9.78	11.11	0.04	11.07	2.52	2.20	0.32	0.45	0.45
2005	23.89	9.78	9.78	11.12	0.05	11.07	2.54	2.22	0.32	0.45	0.45
Trend											
1990–2005	*-48.5%*	*0.0%*	*< 0.1%*	*-12.2%*	*-57.3%*	*-11.8%*	*-89.2%*	*-90.4%*	*-3.8%*	*11.3%*	*11.3%*
2004–2005	*0.2%*	*0.0%*	*0%*	*0.1%*	*23.7%*	*0.0%*	*1.0%*	*1.0%*	*1.2%*	*< 0.1%*	*< 0.1%*
Share in Sector 2 Industrial Processes											
1990		*21.1%*	*21.1%*	*27.3%*	*0.3%*	*27.1%*	*50.7%*	*50.0%*	*0.7%*	*0.9%*	*0.9%*
2005		*40.9%*	*40.9%*	*46.5%*	*0.2%*	*46.3%*	*10.6%*	*9.3%*	*1.3%*	*1.9%*	*1.9%*
Share in National Total											
1990	*3.8%*	*0.8%*	*0.8%*	*1.0%*	*< 0.1%*	*1.0%*	*1.9%*	*1.9%*	*< 0.1%*	*< 0.1%*	*< 0.1%*
2005	*3.3%*	*1.4%*	*1.4%*	*1.5%*	*< 0.1%*	*1.5%*	*0.4%*	*0.3%*	*< 0.1%*	*0.1%*	*0.1%*

NH_3 Emissions

NH_3 emissions from NFR 2 *Industrial Processes* nearly exclusively arise from NFR Category *2 B Chemical Products*, which is only a minor source of NH_3 emissions with a contribution to national total emissions of 0.4% in 1990 and 0.1% in 2005 respectively.

The trend concerning NH_3 emissions from NFR 2 *Industrial Processes* is generally decreasing: in the period from 1990 to 2005 emissions decreased by 75% from 0.27 Gg in 1990 to 0.07 Gg (see Table 185). Extensive abatement techniques are reasons for the emission reduction. As can be seen in Table 185 NH_3 emissions of NFR 2 C are includes in category 1 A 2 a.There are no key sources within this sector.

Table 185: NH_3 emissions and trends from Sector 2 Industrial Processes and source categories 1990–2005.

NH_3 [Gg]	2	2 B	2 B 1	2 B 2	2 B 5	2 C	2 G
1990	0.2688	0.2668	0.0074	0.0014	0.2580	IE	0.0020
1991	0.5075	0.5055	0.0076	0.0014	0.4965	IE	0.0020
1992	0.3689	0.3669	0.0069	0.0013	0.3588	IE	0.0020
1993	0.2188	0.2168	0.0075	0.0013	0.2079	IE	0.0020
1994	0.1680	0.1660	0.0071	0.0013	0.1576	IE	0.0020
1995	0.0986	0.0966	0.0107	0.0001	0.0858	IE	0.0020
1996	0.0969	0.0949	0.0123	0.0002	0.0824	IE	0.0020
1997	0.1029	0.1009	0.0109	0.0019	0.0881	IE	0.0020
1998	0.1030	0.1010	0.0042	0.0003	0.0965	IE	0.0020
1999	0.1185	0.1165	0.0085	0.0002	0.1078	IE	0.0020
2000	0.1002	0.0982	0.0070	0.0004	0.0908	IE	0.0020
2001	0.0794	0.0774	0.0060	0.0005	0.0709	IE	0.0020
2002	0.0606	0.0586	0.0111	0.0006	0.0469	IE	0.0020
2003	0.0761	0.0741	0.0113	0.0004	0.0624	IE	0.0020
2004	0.0588	0.0568	0.0096	0.0001	0.0471	IE	0.0020
2005	0.0678	0.0658	0.0099	0.0001	0.0558	IE	0.0020
Trend							
1990–2005	*-74.8%*	*-75.3%*	*34.2%*	*-96.4%*	*-78.4%*		*< 0.1%*
2004–2005	*15.3%*	*15.8%*	*3.1%*	*-50.0%*	*18.5%*		*< 0.1%*
Share in Sector 2 Industrial Processes							
1990		*99.3%*	*2.7%*	*0.5%*	*96.0%*		*0.7%*
2005		*97.0%*	*14.6%*	*0.1%*	*82.4%*		*3.0%*
Share in National Total							
1990	*0.4%*	*0.4%*	*< 0.1%*	*< 0.1%*	*0.4%*		*< 0.1%*
2005	*0.1%*	*0.1%*	*< 0.1%*	*< 0.1%*	*0.1%*		*< 0.1%*

5.2.2 Particle Matter (PM) Emissions (key source)

All three particulate matter sizes of PM are key sources in NFR Category 2 *Industrial Processes*. As shown in Figure 40 and Table 186 and Table 188 the period from 1990 to 2005 the

- **TSP** emissions increased by 6% to 26 734 Mg, which is a share of 29% in total TSP emissions;
- **PM10** emissions decreased by 3% to 13 452 Mg, which is a share of 30% in total PM10 emissions;
- **PM2.5** emissions decrease by 14% to 4 444 Mg, which is a share of 17% in total PM2.5 emissions.

The main source for PM emissions of NFR Category 2 *Industrial Processes* was the sub sector NFR 2 A *Mineral products* with a contribution of

- 71% in 1990 and 90% in 2005 for **TSP** emissions; emissions increased by 35%;
- 62% in 1990 and 86% in 2005 for **PM10** emissions; the emission trend amount to 34%;
- 52% in 1990 and 81% in 2005 **PM2.5** emissions; emissions increased by 35%.

The sub sector NFR 2 A *Mineral products* covers handling of bulk goods as well as activities of NFR 2 A 7 y *Construction and demolition*. Emissions from this sub sector increased by more than 13% due to increasing activities, whereas in the same time the installation of de-dusting devices, and dust-avoidance devices were promoted. Further measures were roofing and exhaust gas cleaning systems. Other important activities of NFR 2 A *Mineral products* are activities reported under NFR 2 A 1 *Cement Production*, NFR 2 A 2 *Lime Production* and NFR 2 A 3 *Limestone and Dolomite Use.*

Another large source for PM emissions of NFR Category *2 Industrial Processes* was the sub sector NFR *2 C Metal Production* with a contribution of

- 26% in 1990 and 9% in 2005 for **TSP** emissions; emissions decreased by 65%;
- 33% in 1990 and 12% in 2005 for **PM10** emissions; the emission trend amounts to -65%;
- 40% in 1990 and 16% in 2005 **PM2.5** emissions; the emissions decreased by -66%.

The sub-sector NFR *2 C Metal Production* covers activities reported under NFR 2 C 1 *Iron and steel*. Emissions from this sub sector decreased by more than 60% in the period 1990 to 2005 due to the installation of de-dusting- and dust-avoidance devices as well as roofing and exhaust gas cleaning systems. The higher share of PM2.5 is a result of the installed filters of the above mentioned devices, which retain only bigger particles. In spite of the dust emission reducing activities in the same period in this sub sector the activities grew.

Small sources for PM emissions of NFR Category 2 *Industrial Processes* were the sub sectors NFR *2 B Chemical Industry* with a contribution of

- 4% in 1990 and 2% in 2005 for **TSP** emissions; the emission trend amounts to -52%;
- 5% in 1990 and 2% in 2005 for **PM10** emissions; the emission trend amounts to -60%;
- 9% in 1990 and 3% in 2005 **PM2.5** emissions; the emission trend amounts to -68%.

NFR 2 D *Other Production* with a contribution of less than 0.1%.

Also in these sub sectors several de-dusting- and dust-avoidance devices as well as exhaust gas cleaning systems were installed.

Table 186: TSP emissions and trends from Sector 2 Industrial Processes and source categories 1990–2005.

TSP [Mg]	2	2 A	2 A 1	2 A 2	2 A 3	2 A 7	2 A 7 (1)	2 A 7 (2)	2 A 7 (3)
1990	25 170.41	17 788.60	373.97	14.34	372.55	17 027.74	11 139.34	5 503.74	384.66
1995	26 578.69	21 738.68	296.66	14.63	520.86	20 906.53	14 415.19	6 100.92	390.42
1999	29 667.09	25 013.67	292.79	16.67	682.94	24 021.26	17 393.15	6 230.04	398.07
2000	28 742.58	24 103.30	309.11	18.30	615.77	23 160.12	16 531.63	6 230.04	398.44
2001	28 307.32	23 637.44	309.96	18.65	606.34	22 702.49	16 075.67	6 230.04	396.78
2002	28 172.12	25 032.88	315.72	20.12	628.42	24 068.62	17 439.01	6 230.04	399.57
2003	27 705.12	24 571.60	315.88	21.15	611.01	23 623.56	16 993.73	6 230.04	399.79
2004	27 733.32	24 750.46	326.31	22.06	612.23	23 789.86	17 160.93	6 230.04	398.88
2005	26 734.31	23 989.93	326.14	21.27	580.69	23 061.83	16 430.15	6 230.04	401.64
Trend									
1990–2005	*6.2%*	*34.9%*	*-12.8%*	*48.4%*	*55.9%*	*35.4%*	*47.5%*	*13.2%*	*4.4%*
2004–2005	*-3.6%*	*-3.1%*	*-0.1%*	*-3.6%*	*-5.2%*	*-3.1%*	*-4.3%*	*0.0%*	*0.7%*
Share in Sector 2 Industrial Processes									
1990		*70.7%*	*1.5%*	*0.1%*	*1.5%*	*67.6%*	*44.3%*	*21.9%*	*1.5%*
2005		*89.7%*	*1.2%*	*0.1%*	*2.2%*	*86.3%*	*61.5%*	*23.3%*	*1.5%*
Share in National Total									
1990	*27.5%*	*19.4%*	*0.4%*	*0.0%*	*0.4%*	*18.6%*	*12.2%*	*6.0%*	*0.4%*
2005	*29.3%*	*26.3%*	*0.4%*	*0.0%*	*0.6%*	*25.2%*	*18.0%*	*6.8%*	*0.4%*

(1) *Quarrying and mining of minerals other than coal*

(2) *Construction and demolition*

(3) *Agricultural bulk materials and wood processing*

TSP [Mg]	2	2 B	2 B 5	2 C	2 C 1	2 D	2 D 2
1990	25 170.41	944.80	944.80	6 434.81	6 434.81	2.20	2.20
1995	26 578.69	448.40	448.40	4 389.51	4 389.51	2.10	2.10
1999	29 667.09	432.10	432.10	4 219.42	4 219.42	1.90	1.90
2000	28 742.58	446.89	446.89	4 190.49	4 190.49	1.90	1.90
2001	28 307.32	419.35	419.35	4 248.62	4 248.62	1.90	1.90
2002	28 172.12	442.86	442.86	2 694.48	2 694.48	1.90	1.90
2003	27 705.12	469.24	469.24	2 662.38	2 662.38	1.90	1.90
2004	27 733.32	476.18	476.18	2 504.78	2 504.78	1.90	1.90
2005	26 734.31	456.08	456.08	2 286.40	2 286.40	1.90	1.90
Trend							
1990–2005	*6.2%*	*-51.7%*	*-51.7%*	*-64.5%*	*-64.5%*	*-13.6%*	*-13.6%*
2004–2005	*-3.6%*	*-4.2%*	*-4.2%*	*-8.7%*	*-8.7%*	*< 0.1%*	*< 0.1%*
Share in Sector 2 Industrial Processes							
1990		*3.8%*	*3.8%*	*25.6%*	*25.6%*	*< 0.1%*	*< 0.1%*
2005		*1.7%*	*1.7%*	*8.6%*	*8.6%*	*< 0.1%*	*< 0.1%*
Share in National Total							
1990	*27.5%*	*1.0%*	*1.0%*	*7.0%*	*7.0%*	*< 0.1%*	*< 0.1%*
2005	*29.3%*	*0.5%*	*0.5%*	*2.5%*	*2.5%*	*< 0.1%*	*< 0.1%*

Table 187: PM10 emissions and trends from Sector 2 Industrial Processes and source categories 1990–2005.

PM10 [Mg]	2	2 A	2 A 1	2 A 2	2 A 3	2 A 7	2 A 7 (1)	2 A 7 (2)	2 A 7 (3)
1990	13 845.69	8 623.79	176.88	6.78	176.21	8 263.91	5 294.26	2 603.26	366.40
1995	13 901.89	10 494.45	140.32	6.92	246.35	10 100.87	6 846.00	2 885.73	369.13
1999	15 245.91	12 034.77	138.49	7.88	323.01	11 565.38	8 245.83	2 946.80	372.75
2000	14 814.02	11 613.94	146.21	8.66	291.24	11 167.84	7 848.11	2 946.80	372.93
2001	14 614.93	11 390.31	146.61	8.82	286.78	10 948.10	7 629.16	2 946.80	372.14
2002	14 217.05	12 066.55	149.33	9.52	297.23	11 610.47	8 290.21	2 946.80	373.46
2003	13 989.43	11 845.77	149.41	10.00	288.99	11 397.37	8 077.00	2 946.80	373.57
2004	13 968.70	11 930.89	154.34	10.44	289.57	11 476.55	8 156.61	2 946.80	373.14
2005	13 451.52	11 578.32	154.26	10.06	274.65	11 139.35	7 818.11	2 946.80	374.44
Trend									
1990-2005	*-2.8%*	*34.3%*	*-12.8%*	*48.4%*	*55.9%*	*34.8%*	*47.7%*	*13.2%*	*2.2%*
2004–2005	*-3.7%*	*-3.0%*	*-0.1%*	*-3.6%*	*-5.2%*	*-2.9%*	*-4.2%*	*0.0%*	*0.3%*
Share in Sector 2 Industrial Processes									
1990		*62.3%*	*1.3%*	*0.0%*	*1.3%*	*59.7%*	*38.2%*	*18.8%*	*2.6%*
2005		*86.1%*	*1.1%*	*0.1%*	*2.0%*	*82.8%*	*58.1%*	*21.9%*	*2.8%*
Share in National Total									
1990	*29.1%*	*18.1%*	*0.4%*	*0.0%*	*0.4%*	*17.4%*	*11.1%*	*5.5%*	*0.8%*
2005	*29.5%*	*25.4%*	*0.3%*	*0.0%*	*0.6%*	*24.5%*	*17.2%*	*6.5%*	*0.8%*

(1) Quarrying and mining of minerals other than coal

(2) Construction and demolition

(3) Agricultural bulk materials and wood processing

PM10 [Mg]	2	2 B	2 B 5	2 C	2 C 1	2 D	2 D 2
1990	13 845.69	660.00	660.00	4 560.81	4 560.81	1.10	1.10
1995	13 901.89	264.60	264.60	3 141.84	3 141.84	1.00	1.00
1999	15 245.91	253.00	253.00	2 957.24	2 957.24	0.90	0.90
2000	14 814.02	261.78	261.78	2 937.40	2 937.40	0.90	0.90
2001	14 614.93	245.59	245.59	2 978.13	2 978.13	0.90	0.90
2002	14 217.05	259.42	259.42	1 890.17	1 890.17	0.90	0.90
2003	13 989.43	274.82	274.82	1 867.93	1 867.93	0.90	0.90
2004	13 968.70	278.95	278.95	1 757.95	1 757.95	0.90	0.90
2005	13 451.52	267.14	267.14	1 605.16	1 605.16	0.90	0.90
Trend							
1990–2005	*-2.8%*	*-59.5%*	*-59.5%*	*-64.8%*	*-64.8%*	*-18.2%*	*-18.2%*
2004–2005	*-3.7%*	*-4.2%*	*-4.2%*	*-8.7%*	*-8.7%*	*0%*	*0%*
Share in Sector 2 Industrial Processes							
1990		*4.8%*	*4.8%*	*32.9%*	*32.9%*	*< 0.1%*	*< 0.1%*
2005		*2.0%*	*2.0%*	*11.9%*	*11.9%*	*< 0.1%*	*< 0.1%*
Share in National Total							
1990	*29.1%*	*1.4%*	*1.4%*	*9.6%*	*9.6%*	*< 0.1%*	*< 0.1%*
2005	*29.5%*	*0.6%*	*0.6%*	*3.5%*	*3.5%*	*< 0.1%*	*< 0.1%*

Table 188: PM2.5 emissions and trends from Sector 2 Industrial Processes and source categories 1990–2005.

PM2.5 [Mg]	2	2 A	2 A 1	2 A 2	2 A 3	2 A 7	2 A 7 [(1)]	2 A 7 [(2)]	2 A 7 [(3)]
1990	5 188.60	2 681.00	55.66	2.14	55.57	2 567.63	1 638.07	819.39	110.17
1995	4 897.50	3 265.61	44.15	2.18	77.69	3 141.59	2 122.26	908.30	111.03
1999	5 149.81	3 741.64	43.58	2.49	101.87	3 593.70	2 554.01	927.52	112.18
2000	5 017.84	3 612.73	46.01	2.73	91.85	3 472.15	2 432.40	927.52	112.23
2001	4 956.71	3 542.60	46.13	2.78	90.44	3 403.25	2 363.75	927.52	111.98
2002	4 710.29	3 755.27	46.99	3.00	93.73	3 611.54	2 571.62	927.52	112.40
2003	4 639.62	3 685.58	47.02	3.15	91.14	3 544.27	2 504.32	927.52	112.43
2004	4 622.20	3 712.43	48.57	3.29	91.32	3 569.26	2 529.44	927.52	112.30
2005	4 444.15	3 605.94	48.54	3.17	86.61	3 467.61	2 427.38	927.52	112.71
Trend									
1990–2005	*-14.3%*	*34.5%*	*-12.8%*	*48.4%*	*55.9%*	*35.1%*	*48.2%*	*13.2%*	*2.3%*
2004–2005	*-3.9%*	*-2.9%*	*-0.1%*	*-3.6%*	*-5.2%*	*-2.8%*	*-4.0%*	*0.0%*	*0.4%*
Share in Sector 2 Industrial Processes									
1990		*51.7%*	*1.1%*	*0.0%*	*1.1%*	*49.5%*	*31.6%*	*15.8%*	*2.1%*
2005		*81.1%*	*1.1%*	*0.1%*	*1.9%*	*78.0%*	*54.6%*	*20.9%*	*2.5%*
Share in National Total									
1990	*18.1%*	*9.4%*	*0.2%*	*0.0%*	*0.2%*	*9.0%*	*5.7%*	*2.9%*	*0.4%*
2005	*17.0%*	*13.8%*	*0.2%*	*0.0%*	*0.3%*	*13.3%*	*9.3%*	*3.6%*	*0.4%*

[(1)] Quarrying and mining of minerals other than coal

[(2)] Construction and demolition

[(3)] Agricultural bulk materials and wood processing

PM2.5 [Mg]	2	2 B	2 B 5	2 C	2 C 1	2 D	2 D 2
1990	5 188.60	441.20	441.20	2 065.90	2 065.90	0.50	0.50
1995	4 897.50	148.70	148.70	1 482.89	1 482.89	0.30	0.30
1999	5 149.81	133.30	133.30	1 274.57	1 274.57	0.30	0.30
2000	5 017.84	137.93	137.93	1 266.88	1 266.88	0.30	0.30
2001	4 956.71	129.39	129.39	1 284.41	1 284.41	0.30	0.30
2002	4 710.29	136.68	136.68	818.03	818.03	0.30	0.30
2003	4 639.62	144.80	144.80	808.95	808.95	0.30	0.30
2004	4 622.20	146.97	146.97	762.49	762.49	0.30	0.30
2005	4 444.15	140.75	140.75	697.16	697.16	0.30	0.30
Trend							
1990–2005	*-14.3%*	*-68.1%*	*-68.1%*	*-66.3%*	*-66.3%*	*-40.0%*	*-40.0%*
2004–2005	*-3.9%*	*-4.2%*	*-4.2%*	*-8.6%*	*-8.6%*	*0%*	*0%*
Share in Sector 2 Industrial Processes							
1990		*8.5%*	*8.5%*	*39.8%*	*39.8%*	*< 0.1%*	*< 0.1%*
2005		*3.2%*	*3.2%*	*15.7%*	*15.7%*	*< 0.1%*	*< 0.1%*
Share in National Total							
1990	*18.1%*	*1.5%*	*1.5%*	*7.2%*	*7.2%*	*< 0.1%*	*< 0.1%*
2005	*17.0%*	*0.5%*	*0.5%*	*2.7%*	*2.7%*	*< 0.1%*	*< 0.1%*

5.2.3 Heavy metal Emissions (key source)

The heavy metals Cd, Pb and Hg are rated as key sources of NFR Category 2 *Industrial Processes*. As shown in Figure 45 and Table 189 to Table 191 in the period from 1990 to 2005 the

- **Cd** emissions decreased by 52% to 0.22 Mg, which is a share of 20% to the total Cd emission; emissions increased by 10% from 2004 to 2005;
- **Pb** emissions decreased by 80% to 6.5 Mg, which is a share of 48% to the total Pb emission; emissions increased by 10% from 2004 to 2005;
- **Hg** emissions decreased by 42% to 0.3 Mg, which is a share of 31% to the total Hg emission; emissions increased by 12% from 2004 to 2005.

The main source for heavy metal emissions of NFR Category 2 *Industrial Processes* was the sub sectors NFR 2 C *Metal Production* with a contribution of

- nearly 100% in 1990 and 2005 for **Cd** emissions; the emission trend amount to -52%;
- nearly 100% in 1990 and 2005 for **Pb** emissions; the emission trend amount to -80%;
- 49% in 1990 and about 100% in 2005 for **Hg** emissions; the emission trend amount to 18%.

The sub sectors NFR 2 C *Metal Production* covers activities reported under NFR 2 C 1 *Iron and steel*. However, emissions from this sub sector decreased significantly due to extensive abatement measures but also by production and product substitution.

A small source for heavy metal emissions of NFR Category 2 *Industrial Processes* was the sub sectors NFR 2 B *Chemical Industry,* which covers processes in inorganic chemical industries reported under NFR 2 B 5 *Other*. However, emissions from this sub sector decreased significantly due to abatement measures but also by production and product substitution. Furthermore in 1999 the process of chlorine production was changed from mercury cell to membrane cell.

Table 189:
Cd emissions and trends from Sector 2 Industrial Processes and source categories 1990–2005.

Cd [Mg]	2	2 B	2 B 5	2 C	2 C 1
1990	0.4566	0.0009	0.0009	0.4556	0.4556
1991	0.3845	0.0009	0.0009	0.3837	0.3837
1992	0.2639	0.0008	0.0008	0.2631	0.2631
1993	0.2156	0.0008	0.0008	0.2147	0.2147
1994	0.1775	0.0008	0.0008	0.1766	0.1766
1995	0.1597	0.0006	0.0006	0.1590	0.1590
1996	0.1469	0.0006	0.0006	0.1463	0.1463
1997	0.1629	0.0006	0.0006	0.1622	0.1622
1998	0.1604	0.0006	0.0006	0.1598	0.1598
1999	0.1677	0.0006	0.0006	0.1671	0.1671
2000	0.1828	0.0006	0.0006	0.1822	0.1822
2001	0.1795	0.0006	0.0006	0.1789	0.1789
2002	0.1895	0.0006	0.0006	0.1889	0.1889
2003	0.1902	0.0007	0.0007	0.1896	0.1896
2004	0.1979	0.0007	0.0007	0.1972	0.1972
2005	0.2181	0.0007	0.0007	0.2175	0.2175
Trend					
1990–2005	*-52.2%*	*-30.3%*	*-30.3%*	*-52.3%*	*-52.3%*
2004–2005	*10.2%*	*-4.2%*	*-4.2%*	*10.3%*	*10.3%*
Share in Sector 2 Industrial Processes					
1990		*0.2%*	*0.2%*	*99.8%*	*99.8%*
2005		*0.3%*	*0.3%*	*99.7%*	*99.7%*
Share in National Total					
1990	*29.0%*	*0.1%*	*0.1%*	*28.9%*	*28.9%*
2005	*20.2%*	*0.1%*	*0.1%*	*20.2%*	*20.2%*

Table 190: Pb emissions and trends from Sector 2 Industrial Processes and source categories 1990–2005.

Pb [Mg]	2	2 B	2 B 5	2 C	2 C 1
1990	32.0928	0.0012	0.0012	32.0916	32.0916
1991	27.0913	0.0011	0.0011	27.0902	27.0902
1992	18.6092	0.0010	0.0010	18.6082	18.6082
1993	15.1460	0.0011	0.0011	15.1450	15.1450
1994	12.0254	0.0010	0.0010	12.0243	12.0243
1995	4.6801	0.0008	0.0008	4.6793	4.6793
1996	4.2607	0.0008	0.0008	4.2599	4.2599
1997	4.7918	0.0008	0.0008	4.7910	4.7910
1998	4.7035	0.0008	0.0008	4.7027	4.7027
1999	4.9069	0.0008	0.0008	4.9061	4.9061
2000	5.4813	0.0008	0.0008	5.4805	5.4805
2001	5.3509	0.0007	0.0007	5.3502	5.3502
2002	5.6498	0.0008	0.0008	5.6490	5.6490
2003	5.6763	0.0008	0.0008	5.6754	5.6754
2004	5.8995	0.0008	0.0008	5.8987	5.8987
2005	6.4937	0.0008	0.0008	6.4929	6.4929
Trend					
1990–2005	*-79.8%*	*-30.3%*	*-30.3%*	*-79.8%*	*-79.8%*
2004–2005	*10.1%*	*-4.2%*	*-4.2%*	*10.1%*	*10.1%*
Share in Sector 2 Industrial Processes					
1990		*< 0.1%*	*< 0.1%*	*100.0%*	*100.0%*
2005		*< 0.1%*	*< 0.1%*	*100.0%*	*100.0%*
Share in National Total					
1990	*15.5%*	*< 0.1%*	*< 0.1%*	*15.5%*	*15.5%*
2005	*47.9%*	*< 0.1%*	*< 0.1%*	*47.8%*	*47.8%*

Hg [Mg]	2	2 B	2 B 5	2 C	2 C 1
1990	0.5276	0.2701	0.2701	0.2575	0.2575
1991	0.4922	0.2521	0.2521	0.2400	0.2400
1992	0.4354	0.2341	0.2341	0.2013	0.2013
1993	0.4120	0.2161	0.2161	0.1959	0.1959
1994	0.3981	0.1981	0.1981	0.2000	0.2000
1995	0.4662	0.1801	0.1801	0.2861	0.2861
1996	0.4308	0.1801	0.1801	0.2507	0.2507
1997	0.4336	0.1801	0.1801	0.2535	0.2535
1998	0.3335	0.1101	0.1101	0.2234	0.2234
1999	0.2759	0.0451	0.0451	0.2308	0.2308
2000	0.2414	0.0001	0.0001	0.2413	0.2413
2001	0.2449	0.0001	0.0001	0.2448	0.2448
2002	0.2609	0.0001	0.0001	0.2608	0.2608
2003	0.2614	0.0001	0.0001	0.2613	0.2613
2004	0.2717	0.0001	0.0001	0.2716	0.2716
2005	0.3048	0.0001	0.0001	0.3047	0.3047
Trend					
1990–2005	*-42.2%*	*-100.0%*	*-100.0%*	*18.3%*	*18.3%*
2004–2005	*12.2%*	*-4.2%*	*-4.2%*	*12.2%*	*12.2%*
Share in Sector 2 Industrial Processes					
1990		*51.2%*	*51.2%*	*48.8%*	*48.8%*
2005		*< 0.1%*	*<0.1%*	*100.0%*	*100.0%*
Share in National Total					
1990	*24.6%*	*12.6%*	*12.6%*	*12.0%*	*12.0%*
2005	*31.3%*	*< 0.1%*	*< 0.1%*	*31.2%*	*31.2%*

Table 191: Hg emissions and trends from Sector 2 Industrial Processes and source categories 1990–2005.

5.2.4 Persistent organic pollutants (POPs)

The POP emissions (PAH, dioxin/furan and HCB) are rated as key sources in NFR Category *2 Industrial Processes*. As shown in Figure 42 and inTable 192 to Table 194 in the period from 1990 to 2005 the

- **PAH** emissions decreased by 97% to 0.20 Mg, which is a share of 2.4% to the total PAH emissions. The emission trend from 2004 to 2005 amount to 10%.
- **dioxin/furan** emissions decreased by 91% to 3.5 g, which is a share of 8% to the total dioxin/furan emissions. The emission trend from 2004 to 2005 amount to 7%.
- **HCB** emissions decreased by 62% to 3.7 kg, which is a share of 8% to the total HCB emissions. The emission trend from 2004 to 2005 amount to 12%.

The main source for POP emissions of NFR Category 2 *ndustrial Processes* was the sub sectors NFR *2 C Metal Production* with a contribution of

- 87% in 1990 and 83% in 2005 for **PAH** emissions; emissions decreased by 97%;
- 95% in 1990 and 96% in 2005 for **dioxin/furan** emissions; emissions decreased by 91%;
- 83% in 1990 and 99% in 2005 **HCB** emissions; emissions decreased by 55%.

The sub sectors NFR 2 C *Metal Production* covers activities reported under NFR 2 C 1 *Iron and steel* and NFR 2 C 3 Aluminium production. Aluminium production was stopped in 1992, which explains the strong decrease of PAH emissions. Dioxin/furan and HCB emissions decreased significantly due to extensive abatement measures.

Small source for persistent organic pollutant (POPs) emissions of NFR Category *2 Industrial Processes* were the sub sectors

- NFR 2 B *Chemical Industry,* which covers processes in inorganic chemical industries (graphite) reported under NFR 2 B 5 *Other*; also this production process is stopped;
- NFR 2 D *Other Production* which covers activities of NFR 2 D 2 *Food and Drink* (meat and fish smoking).

Table 192: PAH emissions and trends from Sector 2 Industrial Processes and source categories 1990–2005.

PAH [Mg]	2	2 B	2 B 5	2 C	2 C 1	2 C 3	2 D	2 D 2
1990	7.437	0.454	0.454	6.437	0.347	6.090	0.545	0.545
1991	7.175	0.395	0.395	6.371	0.281	6.090	0.409	0.409
1992	3.585	0.611	0.611	2.657	0.235	2.422	0.317	0.317
1993	0.524	0.083	0.083	0.194	0.194	NO	0.247	0.247
1994	0.592	0.246	0.246	0.168	0.168	NO	0.177	0.177
1995	0.492	0.240	0.240	0.145	0.145	NO	0.107	0.107
1996	0.898	0.662	0.662	0.154	0.154	NO	0.081	0.081
1997	0.467	0.252	0.252	0.156	0.156	NO	0.059	0.059
1998	0.410	0.215	0.215	0.158	0.158	NO	0.037	0.037
1999	0.250	0.053	0.053	0.160	0.160	NO	0.037	0.037
2000	0.192	0.013	0.013	0.142	0.142	NO	0.037	0.037
2001	0.183	0.002	0.002	0.144	0.144	NO	0.037	0.037
2002	0.190	NA	NA	0.153	0.153	NO	0.037	0.037
2003	0.191	NA	NA	0.154	0.154	NO	0.037	0.037
2004	0.197	NA	NA	0.160	0.160	NO	0.037	0.037
2005	0.216	NA	NA	0.179	0.179	NO	0.037	0.037
Trend								
1990–2005	*-97.1%*	*-100.0%*	*-100.0%*	*-97.2%*	*-48.4%*	*-100.0%*	*-93,2%*	*-93,2%*
2004–2005	*9.8%*	-	-	*12.1%*	*12.1%*	-	*0.0%*	*0.0%*
Share in Sector 2 Industrial Processes								
1990		*6,1%*	*6,1%*	*86.6%*	*4.7%*	*81,9%*	*7.3%*	*7.3%*
2005		-	-	*82.9%*	*82.9%*	-	*17.1%*	*17.1%*
Share in National Total								
1990	*43.1%*	*2,6%*	*2,6%*	*37.3%*	*2.0%*	*35,3%*	*3,2%*	*3,2%*
2005	*2.4%*	-	-	*2.0%*	*2.0%*	-	*0.4%*	*0.4%*

Table 193: Dioxin/Furan emissions and trends from Sector 2 Industrial Processes and source categories 1990–2005.

Dioxin/Furan [g]	2	2 C	2 C 1	2 C 3	2 D	2 D 2
1990	39.003	37.214	37.212	0.002	1.789	1.789
1991	35.149	33.802	33.801	0.002	1.347	1.347
1992	21.886	20.839	20.838	0.001	1.047	1.047
1993	17.012	16.194	16.194	NO	0.818	0.818
1994	11.262	10.673	10.673	NO	0.589	0.589
1995	12.227	11.867	11.867	NO	0.360	0.360
1996	11.168	10.895	10.895	NO	0.273	0.273
1997	12.151	11.949	11.949	NO	0.202	0.202
1998	11.452	11.321	11.321	NO	0.131	0.131
1999	12.602	12.471	12.471	NO	0.131	0.131
2000	14.053	13.922	13.922	NO	0.131	0.131
2001	13.555	13.424	13.424	NO	0.131	0.131
2002	3.239	3.108	3.108	NO	0.131	0.131
2003	2.983	2.852	2.852	NO	0.131	0.131
2004	3.302	3.171	3.171	NO	0.131	0.131
2005	3.540	3.409	3.409	NO	0.131	0.131
Trend						
1990–2005	*-90.9%*	*-90.8%*	*-90.8%*	*-100.0%*	*-92.7%*	*-92.7%*
2004–2005	*7.2%*	*7.5%*	*7.5%*	*--*	*< 0.1%*	*< 0.1%*
Share in Sector 2 Industrial Processes						
1990		*95.4%*	*95.4%*	*< 0.1%*	*4.6%*	*4.6%*
2005		*96.3%*	*96.3%*	*--*	*3.7%*	*3.7%*
Share in National Total						
1990	*24.4%*	*23.3%*	*23.3%*	*< 0.1%*	*1.1%*	*1.1%*
2005	*8.3%*	*8.0%*	*8.0%*	*--*	*0.3%*	*0.3%*

Table 194: HCB emissions and trends from Sector 2 Industrial Processes and source categories 1990–2005.

HCB [kg]	2	2 B	2 B 5	2 C	2 C 1	2 C 3	2 D	2 D 2
1990	9.712	1.26	1.26	8.094	8.094	0.00	0.358	0.358
1991	8.032	0.36	0.36	7.402	7.402	0.00	0.269	0.269
1992	4.941	0.18	0.18	4.552	4.552	0.00	0.209	0.209
1993	3.702	NA	NA	3.538	3.538	NO	0.164	0.164
1994	2.453	NA	NA	2.335	2.335	NO	0.118	0.118
1995	2.670	NA	NA	2.598	2.598	NO	0.072	0.072
1996	2.440	NA	NA	2.386	2.386	NO	0.055	0.055
1997	2.655	NA	NA	2.614	2.614	NO	0.040	0.040
1998	2.500	NA	NA	2.473	2.473	NO	0.026	0.026
1999	2.756	NA	NA	2.730	2.730	NO	0.026	0.026
2000	3.074	NA	NA	3.048	3.048	NO	0.026	0.026
2001	2.978	NA	NA	2.952	2.952	NO	0.026	0.026
2002	3.170	NA	NA	3.143	3.143	NO	0.026	0.026
2003	3.178	NA	NA	3.151	3.151	NO	0.026	0.026
2004	3.301	NA	NA	3.274	3.274	NO	0.026	0.026
2005	3.691	NA	NA	3.665	3.665	NO	0.026	0.026
Trend								
1990–2005	*-62.0%*	*-100%*	*-100.0%*	*-54.7%*	*-54.7%*	*-100.0%*	*-92.7%*	*-92.7%*
2004–2005	*11.8%*	*-*	*-*	*11.9%*	*11.9%*	*-*	*< 0.1%*	*< 0.1%*
Share in Sector 2 Industrial Processes								
1990		*13.0%*	*13.0%*	*83.3%*	*83.3%*	*< 0.1%*	*3.7%*	*3.7%*
2005		*-*	*-*	*99.3%*	*99.3%*	*-*	*0.7%*	*0.7%*
Share in National Total								
1990	*10.6%*	*1.4%*	*1.4%*	*8.8%*	*8.8%*	*< 0.1%*	*0.4%*	*0.4%*
2005	*8.1%*	*-*	*-*	*8.1%*	*8.1%*	*-*	*0.1%*	*0.1%*

Table 195: *Emissions and trends from Sector 2 Industrial Processes 1990–2005.*

Year	SO_2	NO_x	NMVOC	CO	NH_3	TSP	PM10	PM2.5	Cd	Hg	Pb	PAH	Dioxin	HCB
			[Gg]				[Mg]			[Mg]		[Mg]	[g]	[kg]
1990	2.22	4.80	11.10	46.4	0.27	25 170.41	13 845.69	5 188.60	0.46	0.53	32.09	7.44	39.00	9.71
1991	1.90	4.48	12.58	41.7	0.51				0.38	0.49	27.09	7.18	35.15	8.03
1992	1.67	4.55	13.78	45.0	0.37				0.26	0.44	18.61	3.59	21.89	4.94
1993	1.42	1.98	15.05	47.2	0.22				0.22	0.41	15.15	0.52	17.01	3.70
1994	1.42	1.92	13.57	48.6	0.17				0.18	0.40	12.03	0.59	11.26	2.45
1995	1.37	1.46	11.95	45.1	0.10	26 578.69	13 901.89	4 897.50	0.16	0.47	4.68	0.49	12.23	2.67
1996	1.29	1.42	10.37	39.4	0.10				0.15	0.43	4.26	0.90	11.17	2.44
1997	1.27	1.50	9.06	38.3	0.10				0.16	0.43	4.79	0.47	12.15	2.65
1998	1.18	1.46	7.71	34.9	0.10				0.16	0.33	4.70	0.41	11.45	2.50
1999	1.12	1.44	6.04	30.6	0.12	29 667.09	15 245.91	5 149.81	0.17	0.28	4.91	0.25	12.60	2.76
2000	1.09	1.54	4.96	27.4	0.10	28 742.58	14 814.02	5 017.84	0.18	0.24	5.48	0.19	14.05	3.07
2001	1.21	1.57	4.38	24.2	0.08	28 307.32	14 614.93	4 956.71	0.18	0.24	5.35	0.18	13.55	2.98
2002	1.21	1.63	4.57	23.9	0.06	28 172.12	14 217.05	4 710.29	0.19	0.26	5.65	0.19	3.24	3.17
2003	1.21	1.34	4.26	23.6	0.08	27 705.12	13 989.43	4 639.62	0.19	0.26	5.68	0.19	2.98	3.18
2004	1.22	1.28	4.40	23.9	0.06	27 733.32	13 968.70	4 622.20	0.20	0.27	5.90	0.20	3.30	3.30
2005	1.22	1.29	4.40	23.9	0.07	26 734.31	13 451.52	4 444.15	0.22	0.30	6.49	0.22	3.54	3.69
Trend														
1990–2005	*-45.2%*	*-73.1%*	*-60.4%*	*-48.5%*	*-74.8%*	*6.2%*	*-2.8%*	*-14.3%*	*-52.2%*	*-42.2%*	*-79.8%*	*-97.1%*	*-90.9%*	*-62.0%*
2004–2005	*0.1%*	*1.0%*	*0.0%*	*0.2%*	*15.3%*	*-3.6%*	*-3.7%*	*-3.9%*	*10.2%*	*12.2%*	*10.1%*	*9.8%*	*7.2%*	*11.8%*
National Share														
1990	*3.0%*	*2.3%*	*3.9%*	*3.8%*	*0.4%*	*27.5%*	*29.1%*	*18.1%*	*29.0%*	*24.6%*	*15.5%*	*43.1%*	*24.4%*	*10.6%*
2005	*4.6%*	*0.6%*	*2.9%*	*3.3%*	*0.1%*	*29.3%*	*29.5%*	*17.0%*	*20.2%*	*31.3%*	*47.9%*	*2.4%*	*8.3%*	*8.1%*

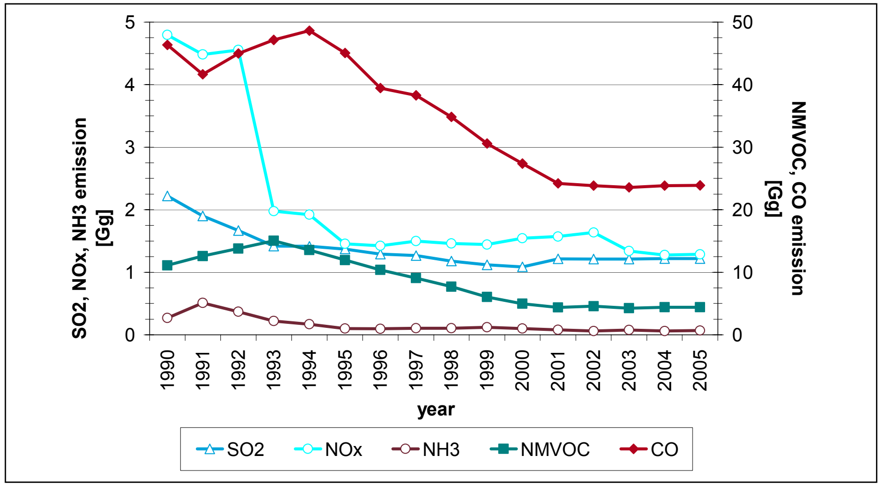


Figure 39: NEC gas emissions and CO emission from NFR Category 2 Industrial Processes 1990–2005.

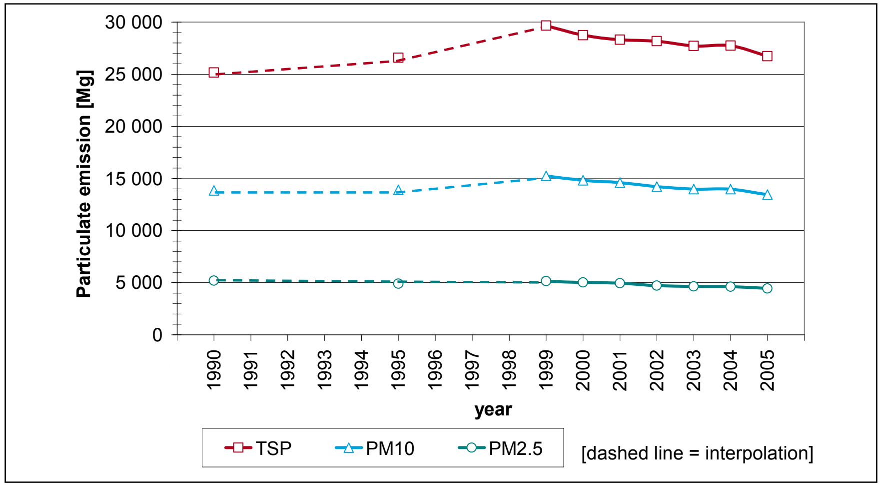


Figure 40: PM emissions from NFR Category 2 Industrial Processes 1990–2005.

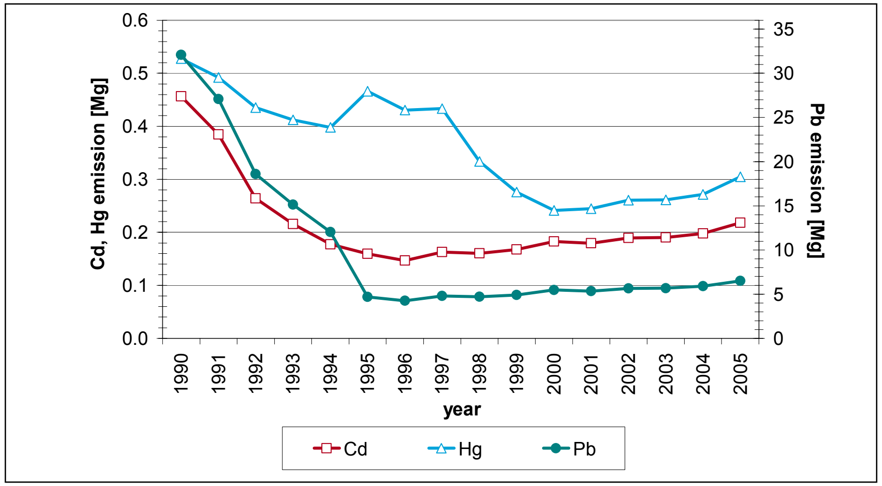


Figure 41: Heavy metal emissions from NFR Category 2 Industrial Processes 1990–2005.

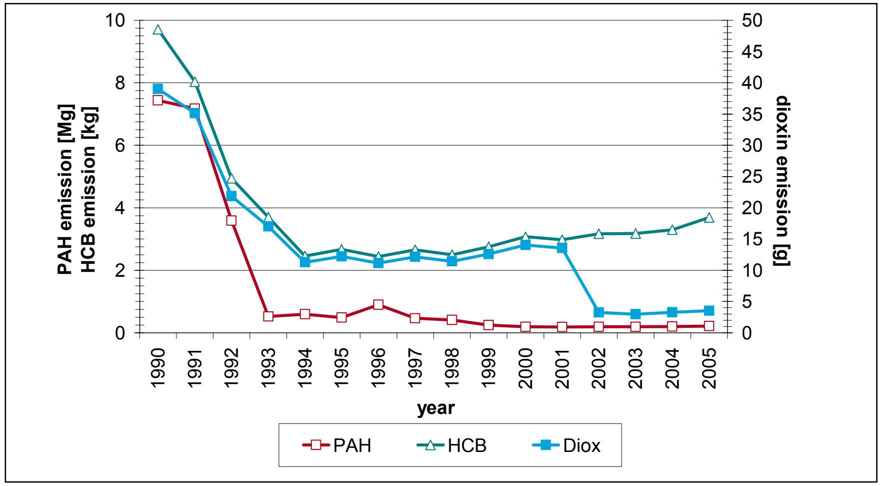


Figure 42: POP emissions from NFR Category 2 Industrial Processes 1990–2005.

5.3 General description

5.3.1 Methodology

The general method for estimating emissions for the industrial processes sector involves multiplying production data for each process by an emission factor per unit of production (CORINAIR simple methodology).

In some categories emission and production data were reported directly by industry or associations of industries and thus represent plant specific data.

5.3.2 Quality Assurance and Quality Control (QA/QC)

For the Austrian Inventory there is an internal quality management system, for further information see Chapter 1.6.

Concerning measurement and documentation of emission data there are also specific regulations in the Austrian legislation as presented in Table 196. 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 196: Austrian legislation with specific regulations concerning measurement and documentation of emission data.

IPCC Source Category	Austrian legislation
2 A 1	BGBl 1993/63 Verordnung für Anlagen zur Zementerzeugung
2 A 7	BGBl 1994/498 Verordnung für Anlagen zur Glaserzeugung
2 C 1	BGBl 1994/447 Verordnung für Gießereien
2 C 1	BGBl II 1997/160 Verordnung für Anlagen zur Erzeugung von Eisen und Stahl
2 C 1	BGBl II 1997/163 Verordnung für Anlagen zum Sintern von Eisenerzen
2 A/2 B/2 C/2 D	BGBl II 1997/331 Feuerungsanlagen-Verordnung
2 C 2/2 C 3/2 C 5	BGBl II 1998/1 Verordnung zur Erzeugung von Nichteisenmetallen
2 A/2 B/2 C/2 D	BGBl 1988/380 Luftreinhaltegesetz für Kesselanlagen
2 A/2 B/2 C/2 D	BGBl 1989/19 Luftreinhalteverordnung für Kesselanlagen

Extracts of the applicable paragraphs are provided in Annex 3.

5.3.3 Recalculations

Information on changes made with respect to last year's submission is provided in Chapter 3 *Methodological Changes,* details are provided in the corresponding sub chapters of this chapter.

Update of activity data

- 2 A 1 *Cement Production*: Activity data for 2004 has been updated using plant-specific data provided by the Association of the Austrian Cement Industry.
- 2 C 1 *Iron and Steel*: Activity data from iron and steel cast have been updated affecting process-specific Dioxine, PAH, HCB, Cd, Hg and Pb emissions.
- 2 B 5 *Chemical Products – Other* (organic chemical industries): NMVOC Emis-

sions have been updated for the years 1994-2004: From 1999 onwards data reported by the Austrian Association of Chemical Industry has been used; emissions between 1994 and 1998 have been estimated by interpolation. This recalculation results in a decrease of emissions compared to the previous submission, where a constant value was reported from 1993 onwards.

- 2 D 1 *Other Production - Pulp and Paper* (chipboard production): Activity data for 2004 has been updated.
- 2 D 2 *Other Production - Food and Drink* (Bread, Wine, Beer and Spirits): Activity data for 2004 has been updated.

Improvements of methodologies and emission factors

- 2 C 1 *Iron and Steel*: Emission factor for TSP, PM10 and PM2.5 for iron and steel production have been updated.

5.3.4 Completeness

Table 197 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 197: 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	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

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 D	OTHER PRODUCTION	✓	NA	NA	✓	✓	✓	✓	✓	NA	NA	NA	✓	✓	✓
2 D 1	Pulp and Paper	✓	NA	NA	✓	✓	NA	NA	NA	NA	NA	NA	NA	NA	NA
2 D 2	Food and Drink	NA	NA	NA	✓	NA	✓	✓	✓	NA	NA	NA	✓	✓	✓
2 G	OTHER	NA	NA	✓	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

(1) *included in 3 Solvent and other Product use*

(2) *included in 2 B 5 Other*

(3) *until 2001 from Graphite Production; later NO*

(4) *until 1992 from Tri-, Perchlorethylene Production; later NO*

5.4 NFR 2 A Mineral Products

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

5.4.1 Fugitive Particular Matter emissions

Source Category Description

In this category fugitive PM emissions from bulk material handling are reported. These include emissions from quarrying and mining of minerals other than coal, construction and demolition and agricultural bulk materials. Most of these emissions are reported in NFR category 2 A 7, except emissions from cement that are reported in NFR category 2 A 1, from lime that are reported in NFR category 2 A 2, and from limestone and dolomite use not including quarrying and mining that are reported in NFR category 2 A 3.

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 are presented in Table 198. Activity data are mainly taken from national statistics and presented in Table 199.

Table 198: 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	73.63	34.07	10.17
Sand & Gravel	159.70	78.29	24.82
Silicates	398.44	187.57	58.22
Dolomite	172.94	81.51	25.59
Limestone	399.16	187.63	57.90
Dolomite (1)	9.05	4.28	1.35
Limestone (1)	23.13	10.94	3.45
Basaltic rocks	176.43	82.18	24.41
Iron ore	216.78	104.70	30.43
Tungsten ore	25.12	11.88	3.75
Gypsum, Anhydride	112.28	52.86	16.41
Lime	27.97	13.23	4.17
Cement (2)	101.25	47.89	15.07
Rye flour	43.59	20.62	6.50
Wheat flour	43.59	20.62	6.50
Sunflower and rapeseed grist	24.76	11.85	3.79
Wheat bran and grist	10.90	5.16	1.63
Rye bran and grist	10.90	5.16	1.63
Concentrated feedingstuffs	30.28	14.32	4.51
Bulk material	**EF TSP [g/m^2]**	**EF PM10 [g/m^2]**	**EF PM2.5 [g/m^2]**
Construction and demolition	1 614	763.42	240.29

(1) emptying of containers at the end-user

(2) without emissions from mineral extraction

Table 199: Activity data for diffuse PM emissions from bulk material handling.

Activity data [t]	**1990**	**1995**	**2000**	**2004**	**2005**
Magnesite	1 179 162	783 497	725 832	715 459	693 754
Sand & Gravel	16 781 972	20 226 047	22 969 992	27 026 216	27 942 092
Silicates	1 690 178	1 690 178	1 690 178	1 690 178	1 690 178
Dolomite	1 879 837	8 789 688	7 152 245	5 906 701	6 291 413
Limestone	15 371 451	19 079 581	23 823 529	24 157 975	22 643 754
Dolomite (1)	1 879 837	8 789 688	7 152 245	5 906 701	6 291 413
Limestone (1)	15 371 451	19 079 581	23 823 529	24 157 975	22 643 754
Basaltic rocks	3 673 535	4 202 244	4 933 202	5 197 125	3 166 281
Iron ore	2 310 710	2 116 099	1 859 449	1 889 419	2 047 950
Tungsten ore	191 306	411 417	416 456	447 982	472 964
Gypsum, Anhydride	751 645	958 430	946 044	1 038 127	911 162
Lime, quick, slacked	512 610	522 934	654 437	788 790	760 464
Cement (2)	3 693 539	2 929 973	3 052 974	3 222 802	3 221 167
Rye flour	61 427	55 846	48 054	53 025	62 387

Activity data [t]	1990	1995	2000	2004	2005
Wheat flour	259 123	287 461	291 482	289 107	324 160
Sunflower and rapeseed grist	19 900	108 600	121 200	121 200	121 200
Wheat bran and grist	64 781	71 865	73 303	73 303	73 303
Rye bran and grist	15 357	13 962	13 139	13 139	13 139
Concentrated feeding stuff	638 014	720 972	980 808	991 621	1 018 649
Constructed floor space [m^2]	**1990**	**1995**	**2000**	**2004**	**2005**
Construction and demolition	3 410 000	3 780 000	3 860 000	3 860 000	3 860 000

(1) *emptying of containers at the end-user*

(2) *without emissions from mineral extraction*

5.4.2 NFR 2 A 5 Asphalt Roofing

Source Category Description

In this category CO emissions from the production of asphalt roofing are considered. CO emissions of this category are an important CO source from NFR Category *2 Industry*: in 2005 41% 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 200: Activity data for CO emissions from asphalt roofing.

	1990	1995	2000	2004	2005
Asphalt roofing [m^2]	27 945 000	31 229 000	26 020 734	27 952 613	27 952 613

5.4.3 NFR 2 A 6 Road Paving with Asphalt

NMVOC emissions previously reported under this category resulted from road paving with asphalt. However, these emissions are already accounted for in the solvents sector, that's why emissions are now reported as "IE".

5.5 NFR 2 B Chemical Products

Key source: SO_2, CO

5.5.1 NFR 2 B 1 and 2 B 2 Ammonia and Nitric Acid Production

Source Category Description

Ammonia (NH_3) is produced by catalytic steam reforming of natural gas or other light hydrocarbons (e.g. liquefied petroleum gas, naphtha). Nitric acid (HNO_3) is manufactured via the reaction of ammonia (NH_3) whereas in a first step NH_3 reacts with air to NO and NO_2 and is then transformed with water to HNO_3. Both processes are minor sources of NH_3 and NO_x emissions. During ammonia production also small amounts of CO are emitted.

In Austria there is only one producer of ammonia and nitric acid.

Methodological Issues

Activity data since 1990 and emission data from 1994 onwards were reported directly to the UMWELTBUNDESAMT by the only producer in Austria and thus represent plant specific data. From emission and activity data an implied emission factor was calculated (see Table 201 and Table 202). The implied emission factor that was calculated from activity and emission data from 1994 was applied to calculate emissions of the year 1993 for NO_x emissions and for the years 1990 to 1993 for NH_3 and CO emissions, as no emission data was available for these years.

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

Table 201: 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	16	123	267
1995	286	604	11	23	95	201
2000	207	428	7	15	43	89
2004	231	453	10	19	43	83
2005	244	510	10	21	53	110

Table 202: 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	1.4	2.6
1995	346	715	0.1	0.2
2000	407	762	0.4	0.8
2004	282	492	0.1	0.2
2005	239	429	0.1	0.1

NH_3 emission factors vary depending on the plant utilization and on how often the production process was interrupted, e.g. because of change of the catalyst.

5.5.2 NFR 2 B 5 Chemical Products – Other

Source Category Description

This category includes NH_3 emissions from the production of ammonium nitrate, fertilizers and urea as well as NO_x emissions from fertilizers. NO_x emissions from inorganic chemical processes for the years 1990 to 1992 are reported as a sum under this category.

This category furthermore includes SO_2 and CO emissions from inorganic chemical processes and NMVOC emissions from organic chemical processes, which were not further splitted in sub categories.

Emissions of minor importance are Heavy Metals and Particular Matter from fertilizers; PAH emissions from graphite production (2002 cessation of production); Hg emissions from Chlorine production (1999 changeover from mercury cell to membrane cell, thus nor more emissions); HCB emissions from the production of Per- and Trichloroethylene (1992 cessation of production).

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 factor that was calculated from activity and emission data of 1994 was applied to calculate emissions of the years 1990 to 1993 as no emission data was available for these years.

Table 203: Emissions and implied emission factors for NH_3 and CO from Ammonia nitrate and Urea production.

Year	Ammonia nitrate		Urea			
	NH_3 emission [Mg]	NH_3 IEF [g/Mg]	NH_3 emission [Mg]	NH_3 IEF [g/Mg]	CO emission [Mg]	CO IEF [g/Mg]
1990	0.71	72	39	137	7	25
1995	0.90	72	48	121	10	25
2000	0.20	13	17	45	4	9
2004	0.40	21	26	59	4	8
2005	0.33	17	30	72	4	9

Fertilizer production

For fertilizer production activity data from 1990 to 1994 were taken from national production statistics[69] (STATISTIK AUSTRIA); NO_x and NH_3 emissions and activity data from 1995 onwards were reported by the main producer in Austria. For the

[69] 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.

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. 2001) 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.

Table 204: NO_x and NH_3 emissions from Fertilizer Production.

Year	NO_x emission [Mg]	NH_3 emission [Mg]
1990	IE	219
1995	60	37
2000	71	73
2004	47	20
2005	89	25

Table 205: 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	660	441
1995	0.67	0.08	0.84	434	265	149
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

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 206.

Table 206: 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

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 207: Hg and PAH emission factors and HCB emissions from other processes in organic and inorganic chemical industries.

Year	Chlorine production	Graphite production	Per- Trichloroethylene production
	Hg EF [mg/Mg]	PAH EF [mg/Mg]	HCB emissions [g]
1990	270	20 000	1 260
1995	180	20 000	NO
2000	0	20 000	NO
2005	0	NO	NO

Recalculations

NMVOC Emissions have been updated for the years 1994-2004: From 1999 onwards data reported by the Austrian Association of Chemical Industry has been used; emissions between 1994 and 1998 have been estimated by interpolation. This recalculation results in a decrease of emissions compared to the previous submission, where a constant value was reported from 1993 onwards (see Table 208).

Table 208: Recalculation difference for NMVOC emissions from Other processes in organic and inorganic chemical industries with respect to submission 2006.

Year	Recalculation difference [Mg]
1990	0
1995	-3 130
2000	-10 672
2004	-11 013

5.6 NFR 2 C Metal Production

Key source: Cd, Hg, Pb, PAH, Dioxine, HCB, TSP, PM10, PM2.5

In this category emissions from iron and steel production and casting as well as process emissions from non-ferrous metal production and casting are considered.

5.6.1 NFR 2 C 1 Iron and Steel

In this category, emissions from blast furnace charging, basic oxygen furnace steel plants, electric furnace steel plants in Austria, from rolling mills and from iron casting are considered.

Blast Furnace Charging

In this category PM, POP and heavy metal emissions are considered. SO_2, NO_x, NMVOC, and CO emissions are included in category 1 A 2 a.

Heavy metal and POP emissions 1990-2000 were calculated by multiplying activity data with emission factors from unpublished national studies (HÜBNER 2001a[70]), (HÜBNER 2001b[71]) for each of the processes (sinter, coke oven, blast furnace cowpers) separately and summing up emissions. For the years 2001–2005 emissions were calculated by multiplying iron production with the implied emission factors for 2000, except dioxine emissions that were reported directly from plant operators since 2002.

Particular matter emissions for the years 1990 to 2001 were taken from a national study (WINIWARTER et al. 2001[72]). Fugitive emissions 1990-2001 were considered for the first time in this submission. The sources for these emissions are environmental declarations from the companies. For the years 2002–2005 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 209.

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

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

[72] according to VOEST (2000)

Table 209: 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

Basic Oxygen Furnace Steel Plant

In this category POP and heavy metal emissions are considered. SO_2, NO_x, NMVOC and CO emissions are included in category 1 A 2a. PM emissions are reported together with emissions from blast furnace charging.

Emission factors for heavy metal emissions were taken from national studies, 1990–1994 (WINDSPERGER et al. 1999[73]), 1995–2004 (HÜBNER 2001a[70]), and multiplied with steel production to calculate HM emissions. POP emissions were calculated by multiplying steel production with national emission factors (HÜBNER 2001b[71]).

Steel production data was taken from national production statistics, the amount of electric steel was subtracted. Activity data, POP and HM emission factors, and PM emissions are presented in Table 210.

Table 210: 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									

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 211 together with electric steel production figures.

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

Table 211: Activity data and emission factors for emissions from Electric Steel Production 1990-2005.

	1990	1995	2000	2004	2005
	Electric steel production [Mg]				
Activity	370 107	453 645	540 539	614 362	624 262
	Emission factor [g/Mg Electric steel production]				
SO_2	590(1)	511(3)	119(3)	40 (2)	40(2)
NO_x	330(1)	295(3)	119(3)	84 (2)	84(2)
NMVOC	60(1)	60(1)	60(1)	60 (1)	60(1)
CO	52 000(1)	44 594(3)	7 565(3)	159 (2)	159(2)
	Emission factor [mg/Mg Electric steel produced]				
Cd	80.0(4)	13.0(5)	13.0(5)	0.4 (2)	0.4(2)
Hg	75.0(4)	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)
PAH	4.6(6)	4.6(6)	4.6(6)	4.6 (6)	4.6(6)
	Emission factor [µg/Mg Electric steel produced]				
DIOX	4.2(6)	1.4(6)	1.4(6)	0.1 (2)	0.1(2)
HCB	840.0(6)	280.0(6)	280.0(6)	20.0 (2)	20.0(2)
	Emission factor [g/Mg Electric steel produced]				
TSP	610.0(7)	610.0(7)	30.0(7)	30.0(7)	30.0(7)
PM10	579.5(8)	579.5(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)

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[73])

(5) (HÜBNER 2001a[70])

(6) (HÜBNER 2001b[71])

(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 212: Emission factors and activity data for cast iron 1990–2005.

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

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.

Recalculations

PM emissions from iron and steel production were re-evaluated and fugitive emissions were included for the whole time-series. Emissions from basic oxygen furnace steel plants have been shifted to blast furnace charging, because the operator reports this plant specific data collectively. Emissions from electric furnace steel plants are estimated for the first time in this submission.

Activity data from iron cast was updated from 1996 onwards for this submission using data published by the Association of the Austrian foundry industry. Previously constant activity data since 1995 has been used. This update lead to recalculations of POP and HM emissions. Additionally a transcription error was found at the dioxine EF in one of the sub-sectors (grey cast). This error was corrected leading to minimal recalculations of dioxine emissions for the whole time-series.

Table 213: Recalculation difference for PM emissions from iron and steel production with respect to submission 2006.

Year	Recalculation difference								
	TSP	PM10	PM2.5	Diox	PAH	HCB	Cd	Hg	Pb
		[Mg]		[mg]	[kg]	[g]		[kg]	
1990	1 273	658	122	1.56	0.00	0.00	0.00	0.00	0.00
1995	1 489	1 009	434	2.38	0.00	0.00	0.00	0.00	0.00
2000	1 282	798	207	2.66	0.02	0.03	0.33	0.00	8.13
2004	-617	-459	-301	2.71	0.03	0.04	0.46	0.01	11.42

5.6.2 Non-ferrous Metals

In this category process emissions from non-ferrous metal production as well as from non-ferrous metal cast (light metal cast and heavy metal cast) are considered.

Non-ferrous Metals Production

Emission estimates for Non-ferrous Metal Production were taken from a study (WINDSPERGER & TURI 1997) and used for all years: 0.4 Gg SO_2, 0.01 Gg NMVOC and 0.2 Gg CO.

POP emissions from Aluminium Production were estimated in a national study (HÜBNER 2001b[74]) 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 214: Emission factors and activity data for light metal cast 1990–2005.

Year	Emission factors [g/Mg]				Activity [Mg]
	SO_2	NO_x	NMVOC	CO	Light metal cast
1990	120	330	4 040	2 340	46 316
1995	10	230	1 740	880	59 834
2000	10	230	1 740	880	92 695
2004	10	170	1 289	660	115 292
2005	10	170	1 289	660	109 927

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

Table 215: Emission factors and activity data for heavy metal cast 1990–2005.

Year	Emission factors [g/Mg]				Activity [Mg]
	SO_2	NO_x	NMVOC	CO	Heavy metal cast
1990	100	100	1 390	3 290	8 525
1995	80	80	1 180	2 770	10 384
2000	80	80	1 180	2 770	13 214
2004	80	80	1 180	2 770	15 799
2005	80	80	1 180	2 770	18 456

5.7 NFR 2 D Other Production

Key source: NMVOC

5.7.1 NFR 2 D 1 Pulp and Paper

Source Category Description

As emissions from pulp and paper production mainly arise from combustion activities, they are included in *1 A 2 Combustion in Manufacturing Industries*.

In this category NO_x, NMVOC and CO emissions from chipboard production are considered.

Methodological Issues

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 2004 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.

Planned Improvements

In chipboard production gas and wood dust are used as fuels. As wood dust accumulates as waste material during chipboard production it is not reported as a fuel in the energy balance, where fuel gas is reported and included in the fuel input of SNAP Category 03 *Combustion in Production Processes*.

As the used emission factor from SNAP Category 040601 Chipboard Production refers to all emissions from chipboard production but emissions due combustion of fuel gas in chipboard production are also included in SNAP 03, these emissions are counted double. However, it is not possible to separate emissions due to combustion of wood dust from gas as no detailed fuel input figures for chipboard production are available. Further investigation of this subject is planned and if possible the double count will be eliminated.

Recalculation

Activity data for the year 2004 was updated using statistical data, for the last submission this value was not available.

5.7.2 NFR 2 D 2 Food and Drink

Source Category Description

This category includes NMVOC emissions from the production of bread, wine, spirits and beer and PM emissions from the production of beer. Furthermore this category includes POP emissions from smokehouses.

Methodological Issues

NMVOC emissions were calculated by multiplying the annual production with an emission factor.

The following emission factors were applied:

- Bread ......4 200 kg_{NMVOC}/Mg_{bread}
- Wine........65 kg_{NMVOC}/hl_{wine}
- Beer ....20 kg_{NMVOC}/hl_{beer}
- Spirits......2 000 kg_{NMVOC}/hl_{spirit}

All emission factors were taken from (BUWAL 1995) because of the very similar structures and standards of industry in Austria and Switzerland. Activity data was taken from national statistics (STATISTIK AUSTRIA), for the year 2005 no activity data was available, that's why the values of 2004 were also used for 2005.

PM emissions from beer production correspond to fugitive emissions from barley used for the production of malt. Emissions were estimated in a national study (WINIWARTER et al. 2001) and are:

- TSP.........1990: 2.2 Mg, 1995: 2.1 Mg, 1999-2005: 1.9 Mg
- PM10 ......1990: 1.1 Mg, 1995: 1.0 Mg, 1999-2005: 0.9 Mg
- PM2.5 .....1990: 0.5 Mg, 1995: 0.3 Mg, 1999-2005: 0.3 Mg

POP emissions from smokehouses were estimated in an unpublished study (HÜBNER 2001b[75]) 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 216.

[75] according to MEISTERHOFER (1986)

Table 216: POP emissions and activity data from smokehouses 1990–2005.

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

Recalculations

Activity data (bread, wine, beer, spirits) for the year 2004 were updated using statistical data, for the last submission these values were not available.

6 SOLVENT AND OTHER PRODUCT USE (NFR SECTOR 3)

6.1 Sector Overview

This chapter describes the methodology used for calculating NMVOC emissions from solvent use in Austria. 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 3 C Chemical products, manufacture and processing as well as
- PAH, dioxins and HCB from NFR 3 D 2 Preservation of wood.

In the year 2005 this category had a contribution of 49% to NMVOC emissions (76 Gg NMVOC). There has been a decrease of 35% in NMVOC emissions from 1990 to 2005 (see Table 220) due to the positive impact of the enforced laws and regulations in Austria:

- Solvent Ordinance: for limitation of emission of volatile organic compounds due to the use of organic solvents in certain paints and varnishes and vehicle refinishing products in order to combat acidification and ground-level ozone,

  Federal Law Gazette 398/2005[76]*, amendment of Federal Law Gazette 872/1995*[77]*; amendment of Federal Law Gazette 492/1991*[78] *(implementation of Council Directive 2004/42/CE);*

- Ordinance for paint finishing system (surface technology systems): for limitation of emission of volatile organic compounds due to the use of organic solvents by activities such as surface coating, painting or varnishing of different materials and products along the entire chain in the painting process in order to combat acidification and ground-level ozone,

  Federal Law Gazette 873/1995[79]*, amendment of Federal Law Gazette 27/1990*[80]*;*

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[76] 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 398/2005; Umsetzung der Richtlinie 2004/42/EG

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

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

[79] Verordnung des Bundesministers für wirtschaftliche Angelegenheiten über die Begrenzung der Emission von luftverunreinigenden Stoffen aus Lackieranlagen in gewerblichen Betriebsanlagen (Lackieranlagen-Verordnung), BGBl 873/1995

[80] 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 27/1990

- 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[81]*;*
- 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[82]*;*
- Convention on Long-range Transboundary Air Pollution (LRTAP)[83], extended by eight protocols from which the following have relevance:
  - The 1988 Protocol concerning the Control of Nitrogen Oxides or their Transboundary Fluxes[84];
  - The 1991 Protocol concerning the Control of Emissions of Volatile Organic Compounds or their Transboundary Fluxes[85];
  - The 1998 Protocol on Persistent Organic Pollutants (POPs)[86];
  - The 1999 Protocol to Abate Acidification, Eutrophication and Ground-level Ozone; 21 Parties.[87]
- Ordinance for volatile organic compounds (VOC) due to the use of organic solvents in certain activities and installations,

  Federal Law Gazette 301/2002[88]*, amended by Federal Law Gazette*[89]*;*
- Council Directive 1999/13/EC[90] of March 1999 on the limitation of emissions of volatile organic compounds due to the use of organic solvents in certain activities and installations;

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[81] 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)

[82] 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. 865/1994

[83] Entered into force 14 February 1991; ratified by Austria 16 December 1982;; See for more information UMWELTBUNDESAMT (2006): Informative Inventory report. Vienna.

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

[85] 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 164/1997

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

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

[88] 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) VOC Anlagen - Verordnung BGBL II 301/2002 - VAV (Umsetzung der der Richtlinie 1999/13/EG

[89] Änderung der VOC-Anlagen-Verordnung – VAV, BGBl 42/2005

[90] 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

- Council Directive 2004/42/CE[91] 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 411/2005*[92].

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.

[91] 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

[92] 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. 411/2005

Table 217: Key Source in NFR sector 3 Solvent and Other Product Use.

Pollutant	Source category				
	3	**3 A**	**3 B**	**3 C**	**3D**
	Solvent and Other Product Use	**Paint Application**	**Degreasing and Dry Cleaning**	**Chemical Products, Manufacture & Processing**	**Other**
SO_2					
NO_x					
NMVOC	**49.2%**	**13.5%**	**5.9%**	**7.3%**	**22.4%**
NH_3					
CO					
Cd	0.0%			0.03%	
Hg					
Pb	0.2%			0.25%	
PAH					
Diox					
HCB					
TSP					
PM10					
PM2.5					

Note: grey shaded are key sources

6.1.1 Emission Trends

In the Sector 3 *Solvent and Other Product Use* there are no emissions of SO_2, NH_3, CO and NO_x as well as no particulate matter and Pb.

6.1.1.1 NEC gases and CO

NMVOC Emissions (key source)

Sector 3 *Solvent and Other Product Use* is the largest Sector regarding NMVOC emissions and thus also a key source; in 1990 the contribution to national total emissions was 41% (117 Gg) compared to 49% (76 Gg) in 2005 due to decreasing emissions from other sectors such as NFR 2 *Industrial Processes* and NFR 1 *Energy*.

The trend regarding NMVOC emissions from NFR 3 *Solvent and Other Product Use* shows decreasing emissions: in the period from 1990 to 2005 emissions decreased by 35%, mainly due to decreasing emissions from NFR 3 *A Paint Application*, whose share in sector NFR 3 was 40% in 1990 and 28% in 2005, respectively (see Table 218). This reduction was primarily achieved from 1990 to 1992 due to different enforced laws and regulations.

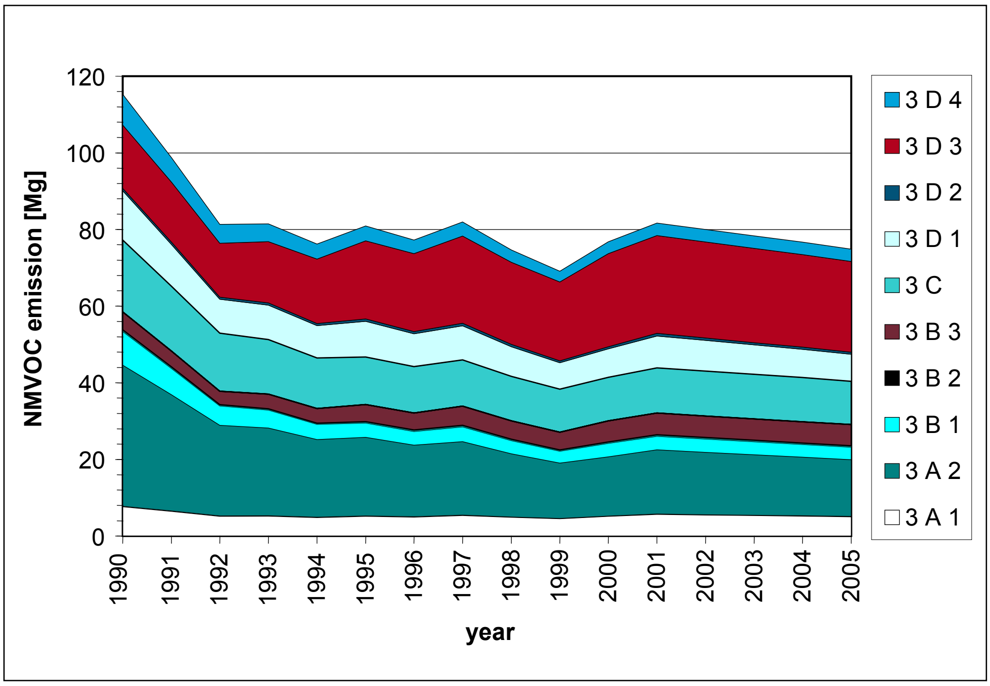


Figure 43: NMVOC emissions and trends by sub sector from Sector 3 Solvent and Other Product Use.

Other contributors to NMVOC emissions from NFR 3 are the sub sectors NFR 3 B *Degreasing and Dry Cleaning,* NFR 3 C *Degreasing and Dry Cleaning and NFR 3 D Other*, with a share of 14% (NFR 3 A) 6% (NFR 3 B), 7% (NFR 3 C) and 22% (NFR 3 D) of the national NMVOC emissions (see Table 218):

- NMVOC emissions from NFR *3 A Paint Applications* arose from the following sub categories
  - NFR 3 A 1 *Decorative Paint Application* which covers the use of paint in the area of construction and buildings (SNAP 060103) and for domestic use (except do-it-yourself)(SNAP 060104). NMVOC emissions decreased by 34% to 5 Gg in the period 1990–2005 due to a reduction of solvents in paint as well as due to substitution solvents based paint for paint with less or without solvents. The quantity of used solvents is reduced by about 33% within this period.
  - NFR 3 A 2 *Industrial Paint Application* which covers processes such as car repairing (SNAP 060102), coil coating (SNAP 060105), wood conditioning (SNAP 060107) and other industrial paint application (SNAP 060108). The NMVOC emissions decreased by 60% to 15 Gg in the period 1990–2005 but the reduction in emission happened mainly from 1990 to 1995 due to different enforced laws and regulations; since then the emissions remained stable. Also the quantity of used solvents is reduced by about 14% within this period.
    NFR 3 A (I) *Manufacture of automobiles* (SNAP 060101) which covers the use of paint in the automobile industry. NMVOC emissions decreased by 47% to 0.9 Gg in the period 1990–2005 due to a reduction of solvents in paint as well as due to substitution solvents based paint for paint with less or without solvents. The quantity of used solvents is reduced by about 13% within this period.

- NMVOC emissions from sub sector *3 B Degreasing and Dry Cleaning,* which had a share of 12% in NFR 3, arose in 2005 from the following sub categories
  - NFR 3 B 1 *Metal Degreasing*, where the emissions decreased by 63% to about 3 Gg;
  - NFR 3 B 2 *Dry Cleaning*, where the emissions decreased by 15% to 0.4 Gg;
  - NFR 3 B 3 *Other*, where the emissions increased by 18% to 6 Gg.

  The emission reduction could be achieved due to technical abatement measures such as closed loop processes, waste gas purification and recycling.
- The share of NMVOC emissions from sub sector NFR 3 C *Chemical Products, Manufacture and Processing* in national total emissions was about 7% in 1990 and also 2005 whereas an emission reduction of 9% could be achieved due to technical abatement measures such as closed loop processes, waste gas purification and recycling but also due to product substitution. The NFR 3 C covers activities such as rubber processing, asphalt blowing, textile finishing and leather tanning as well as the manufacturing of pharmaceutical products, paints, inks and glues.
- The share of NMVOC emissions from sub sector NFR 3 D *Other* in sector NFR 3 is about 33% in 1990 and about 46% in 2005 whereas an emission reduction of 45% could be achieved. Sub sector *3 D* causes the following emission sources
  - NFR 3 D 1 *Printing* with a share of 11% in NFR 3 and an emissions reduction of 19% (7 Gg);
  - NFR 3 D 2 *Preservation of wood* with a share of about 1% in NFR 3 and an emissions increas of 43% (0.6 Gg);
  - NFR 3 D 3 *Domestic Solvent Use* with a share of 31% in NFR 3 and an emissions increased by 60% (24 Gg);
  - NFR 3 D 4 *Other* with a share of 4% in NFR 3 and a decrease in emissions of 2% (3 Gg).

The emission reduction could be achieved due to technical abatement measures such as closed loop processes, waste gas purification and recycling. The high increase of the NMVOC emissions in category 3 D 3 is due to a considerable increase of do-it-yourself activities.

Table 218: NMVOC emissions and trends from Sector 3 Solvent and Other Product Use and source categories 1990–2005.

NMVOC [Gg]	3	3 A	3 A 1	3 A 2	3 B	3 B 1	3 B 2	3 B 3
	Solvent and Other Product Use	**Paint Application**	**Decorative Paint Application**	**Industrial Paint Application**	**Degreasing and Dry Clean.**	**Degreasing**	**Dry Cleaning**	**Other**
1990	116.95	46.31	7.64	36.96	13.90	8.78	0.44	4.67
1991	100.08	38.21	6.44	30.42	11.40	6.85	0.39	4.16
1992	82.33	29.89	5.16	23.71	8.93	5.06	0.32	3.55
1993	82.43	29.17	5.19	23.02	8.82	4.66	0.34	3.82
1994	77.06	26.04	4.82	20.40	8.07	3.91	0.33	3.82
1995	81.75	26.57	5.15	20.59	8.57	3.76	0.38	4.44
1996	78.07	24.54	4.94	18.78	8.40	3.57	0.37	4.47
1997	82.93	25.56	5.35	19.29	9.28	3.81	0.40	5.06
1998	75.54	22.33	4.86	16.60	8.59	3.42	0.37	4.81
1999	69.96	19.84	4.50	14.52	8.10	3.11	0.35	4.64
2000	77.74	21.66	5.12	15.58	9.38	3.47	0.40	5.51
2001	82.63	23.48	5.65	16.86	9.58	3.49	0.42	5.67
2002	80.95	22.81	5.49	16.37	9.48	3.44	0.41	5.63
2003	79.27	22.14	5.33	15.87	9.37	3.38	0.40	5.59
2004	77.59	21.48	5.18	15.38	9.27	3.33	0.39	5.56
2005	75.77	20.81	5.02	14.88	9.17	3.27	0.38	5.52
Trend								
1990–2005	*-35.2%*	*-55.1%*	*-34.3%*	*-59.7%*	*-34.0%*	*-62.7%*	*-15.3%*	*18.1%*
2003–2005	*-2.3%*	*-3.1%*	*-3.0%*	*-3.2%*	*-1.1%*	*-1.7%*	*-3.0%*	*-0.7%*
Share in Sector Solvent and Other Product Use								
1990		*39.6%*	*6.5%*	*31.6%*	*11.9%*	*7.5%*	*0.4%*	*4.0%*
2005		*27.5%*	*6.6%*	*19.6%*	*12.1%*	*4.3%*	*0.5%*	*7.3%*
Share in National Total								
1990	*41.1%*	*16.3%*	*2.7%*	*13.0%*	*4.9%*	*3.1%*	*0.2%*	*1.6%*
2005	*49.2%*	*13.5%*	*3.3%*	*9.7%*	*5.9%*	*2.1%*	*0.2%*	*3.6%*

NMVOC [Gg]	3	3 C	3 D	3 D 1	3 D 2	3 D 3	3 D 4
	Solvent and Other Product Use	Chemical Products(1)	Other(2)	Printing	Preservation of Wood	Domestic Solvent Use	Other(2)
1990	116.95	18.76	37.99	12.84	0.68	16.53	7.95
1991	100.08	16.91	33.56	10.90	0.60	15.65	6.41
1992	82.33	15.16	28.35	8.83	0.51	14.12	4.88
1993	82.43	14.24	30.20	9.01	0.55	16.02	4.62
1994	77.06	13.15	29.81	8.50	0.54	16.80	3.97
1995	81.75	12.42	34.18	9.29	0.62	20.42	3.85
1996	78.07	12.11	33.02	8.56	0.59	20.31	3.55
1997	82.93	12.08	36.02	8.90	0.63	22.80	3.70
1998	75.54	11.62	33.00	7.75	0.57	21.46	3.22
1999	69.96	11.22	30.81	6.86	0.52	20.57	2.85
2000	77.74	11.33	35.38	7.46	0.58	24.23	3.11
2001	82.63	11.77	37.80	8.36	0.64	25.53	3.27
2002	80.95	11.69	36.97	8.03	0.62	25.07	3.25
2003	79.27	11.61	36.14	7.70	0.59	24.61	3.24
2004	77.59	11.53	35.31	7.37	0.57	24.15	3.22
2005	75.77	11.31	34.48	7.04	0.55	23.69	3.21
Trend							
1990–2005	*-35.2%*	*-9.2%*	*-45.2%*	*-19.4%*	*43.3%*	*-59.6%*	*-39.7%*
2003–2005	*-2.3%*	*-2.3%*	*-4.5%*	*-4.1%*	*-1.9%*	*-0.5%*	*-1.9%*
Share in Sector Solvent and Other Product Use							
1990		*16.0%*	*32.5%*	*11.0%*	*0.6%*	*14.1%*	*6.8%*
2005		*14.9%*	*45.5%*	*9.3%*	*0.7%*	*31.3%*	*4.2%*
Share in National Total							
1990	*41.1%*	*6.6%*	*13.3%*	*4.5%*	*0.2%*	*5.8%*	*2.8%*
2005	*49.2%*	*7.3%*	*22.4%*	*4.6%*	*0.4%*	*15.4%*	*2.1%*

(1) *complete description: Chemical Products, Manufacture and Processing*

(2) *including Products Containing HMs and POPs*

6.1.1.2 Heavy metal Emissions

NFR Category 3 *Solvent and Other Product Use* is also a minor source for emissions of the heavy metals Cd and Pb. As shown in Table 220 and Figure 45 in the period from 1990 to 2005

- **Cd** emissions decreased by 50% to 0.30 g, which is a share of less than 0.1% of national total Cd emission;
- **Pb** emissions decrease by 51% to 33.7 g, which is a share of 0.25% of national total Pb emission.

Emissions exclusively arise from sub-sector NFR 3 C, which covers activities such as asphalt blowing, and leather tanning as well as the manufacturing of pharmaceutical products, paints, inks and glues. The emission reduction could be achieved due to technical abatement measures such as closed loop processes, waste gas purification and recycling but also due to product substitution.

6.1.1.3 Persistent organic pollutants (POPs)

POP emissions from NFR Category 3 *Solvent and Other Product Use* arose from 3 B and 3 D 2, where emissions of **PAH** stopped in 1997, emissions of **dioxin/furan** stopped in 1993 and emissions of **HCB** stopped in 2001.

Especially in case of HCB emission an enormous reduction could be realized: the production and use of HCB for preservation of wood is forbidden since 1992.

Table 219: HCB emissions and trends from Sector 3 Solvent and Other Product Use and source categories 1990–2005.

HCB [kg]	3	3 B	3 B 1	3 B 2	3 B 3	3 D 2
	Solvent and Other Product Use	**Degreasing and Dry Cleaning**	**Degreasing**	**Dry Cleaning**	**Other**	**Preservation of Wood[(1)]**
1990	9.0533	0.0033	0.0019	0.0001	0.0013	9.0500
1991	6.3919	0.0029	0.0016	0.0001	0.0012	6.3890
1992	7.4912	0.0024	0.0013	0.0001	0.0010	7.4888
1993	6.4733	0.0025	0.0013	0.0001	0.0012	6.4708
1994	1.2525	0.0025	0.0012	0.0001	0.0012	1.2500
1995	0.0028	0.0028	0.0013	0.0001	0.0014	NA
1996	0.0028	0.0028	0.0013	0.0001	0.0014	NA
1997	0.0032	0.0032	0.0015	0.0001	0.0016	NA
1998	0.0030	0.0030	0.0014	0.0001	0.0015	NA
1999	0.0029	0.0029	0.0013	0.0001	0.0015	NA
2000	0.0034	0.0034	0.0016	0.0001	0.0017	NA
2001	0.0036	0.0036	0.0016	0.0001	0.0018	NA
2002	NA	NA	NA	NA	NA	NA
2003	NA	NA	NA	NA	NA	NA
2004	NA	NA	NA	NA	NA	NA
2005	NA	NA	NA	NA	NA	NA
Trend						
1990–2005	*-100%*	*-100%*	*-100%*	*-100%*	*-100%*	*-100%*
Share in Sector Solvent and Other Product Use						
1990		*0.04%*	*0.02%*	*0.00%*	*0.01%*	*99.96%*
2005		-	-	-	-	-
Share in National Total						
1990	*9.89%*	*0.004%*	*0.002%*	*< 0.001%*	*0.001%*	*9.89%*
2005	-	-	-	-	-	-

(1) Including Products Containing HMs and POPs

Table 220: Emissions and trends from NFR Category 3 Solvent and Other Product Use 1990–2005.

Year	SO_2	NO_x	NMVOC	CO	NH_3	TSP	PM10	PM2.5	Cd	Hg	Pb	PAH	Dioxin	HCB
	[Gg]					[Mg]			[g]			[kg]	[g]	[g]
1990	NA	NA	116.95	NA	NA	NA	NA	NA	0.60	NA	68.35	151.73	1.06	9 053.29
1991	NA	NA	100.08	NA	NA	NE	NE	NE	0.55	NA	62.67	151.73	1.04	6 391.88
1992	NA	NA	82.33	NA	NA	NE	NE	NE	0.50	NA	56.99	109.48	0.02	7 491.16
1993	NA	NA	82.43	NA	NA	NE	NE	NE	0.45	NA	51.31	73.90	0.02	6 473.29
1994	NA	NA	77.06	NA	NA	NE	NE	NE	0.40	NA	45.63	55.80	NA	1 252.48
1995	NA	NA	81.75	NA	NA	NA	NA	NA	0.35	NA	39.95	35.91	NA	2.81
1996	NA	NA	78.07	NA	NA	NE	NE	NE	0.34	NA	39.31	15.00	NA	2.80
1997	NA	NA	82.93	NA	NA	NE	NE	NE	0.34	NA	38.67	6.80	NA	3.16
1998	NA	NA	75.54	NA	NA	NE	NE	NE	0.33	NA	38.03	NA	NA	2.98
1999	NA	NA	69.96	NA	NA	NA	NA	NA	0.33	NA	37.39	NA	NA	2.87
2000	NA	NA	77.74	NA	NA	NA	NA	NA	0.32	NA	36.75	NA	NA	3.38
2001	NA	NA	82.63	NA	NA	NA	NA	NA	0.35	NA	39.76	NA	NA	3.55
2002	NA	NA	80.95	NA	NA	NA	NA	NA	0.35	NA	39.63	NA	NA	NA
2003	NA	NA	79.27	NA	NA	NA	NA	NA	0.35	NA	39.49	NA	NA	NA
2004	NA	NA	77.59	NA	NA	NA	NA	NA	0.35	NA	39.36	NA	NA	NA
2005	NA	NA	75.77	NA	NA	NA	NA	NA	0.30	NA	33.70	NA	NA	NA
Trend														
1990–2005	-	-	*-35.2%*	-	-	-	-	-	*-50.7%*		*-50.7%*	*-100%*	*-100%*	*-100%*
2003–2005	-	-	*-2.3%*	-	-	-	-	-	*-14.4%*		*-14.4%*	-	-	-
National Share														
1990	-	-	*41.1%*	-	-	-	-	-	*0.04%*		*0.03%*	*0.88%*	*0.66%*	*9.98%*
2005	-	-	*49.2%*	-	-	-	-	-	*0.03%*		*0.25%*	-	-	-

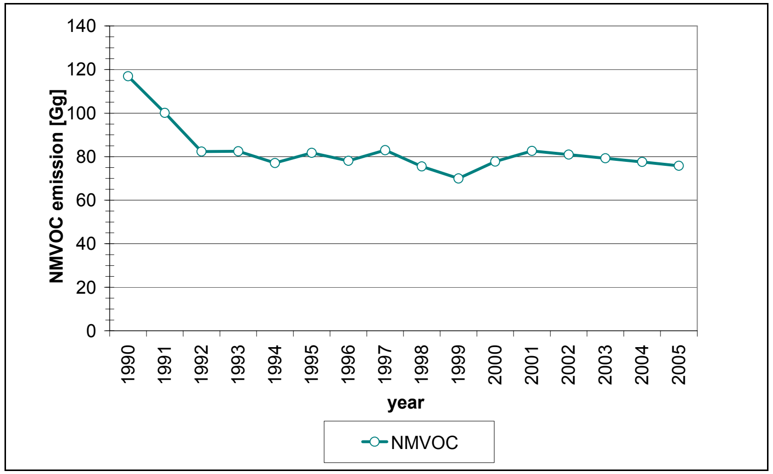


Figure 44: NMVOC emission from NFR 3 Solvent and Other Product Use 1990–2005.

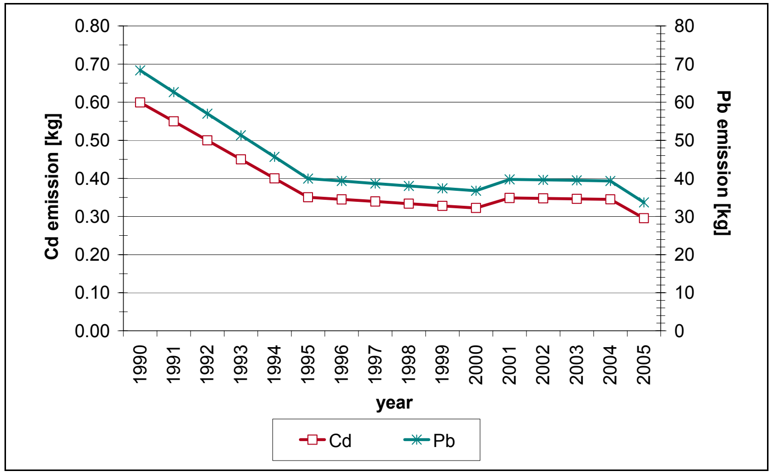


Figure 45: Heavy metal emissions from NFR 3 Solvent and Other Product Use 1990–2005.

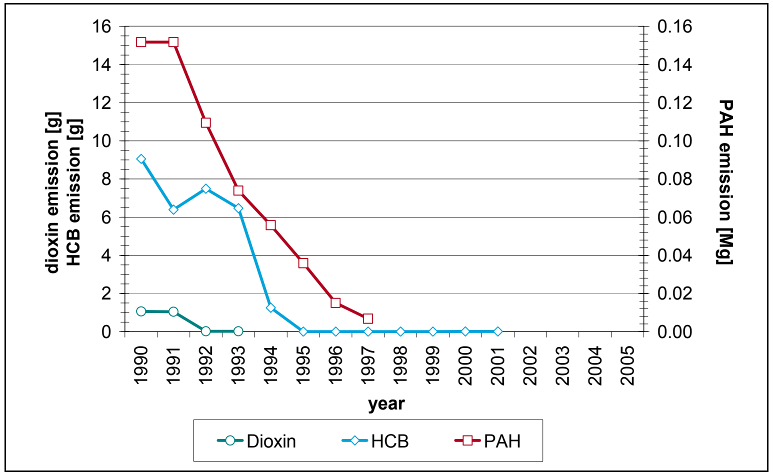


Figure 46: Emission of POPs from NFR 3 Solvent and Other Product Use 1990–2005.

6.2 Completeness

Table 221 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 221: Overview of sub categories of NFR Category Solvent and Other Product Use: transformation into SNAP Codes and status of estimation.

NFR Category		Status													
		NEC gas				CO	PM			Heavy metals			POPs		
		NO_x	SO_2	NH_3	NMVOC	CO	TSP	PM10	PM2.5	Cd	Hg	Pb	dioxin	PAK	HCB
3 A	Paint application	NA	NA	NA	✓	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3 B	Degreasing and Dry Cleaning	NA	NA	NA	✓	NA	NA	NA	NA	NA	NA	NA	✓	✓	✓
3 C	Chemical Products, Manufacture and Processing	NA	NA	NA	✓	NA	NA	NA	NA	✓	NA	✓	NA	NA	NA
3 D	Other	NA	NA	NA	✓	NA	NA	NA	NA	NA	NA	NA	NA	NA	✓

6.3 NMVOC Emissions from Solvent and Other Product Use (NFR Sector 3)

6.3.1 Methodology Overview

Calculation NMVOC emissions from solvent use were done in several steps. As a first step the quantity of solvents used and the solvent emissions were calculated.

To determine the quantity of solvents used in Austria in the various applications, a bottom up and a top down approach were combined. Figure 47 and Figure 48 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.

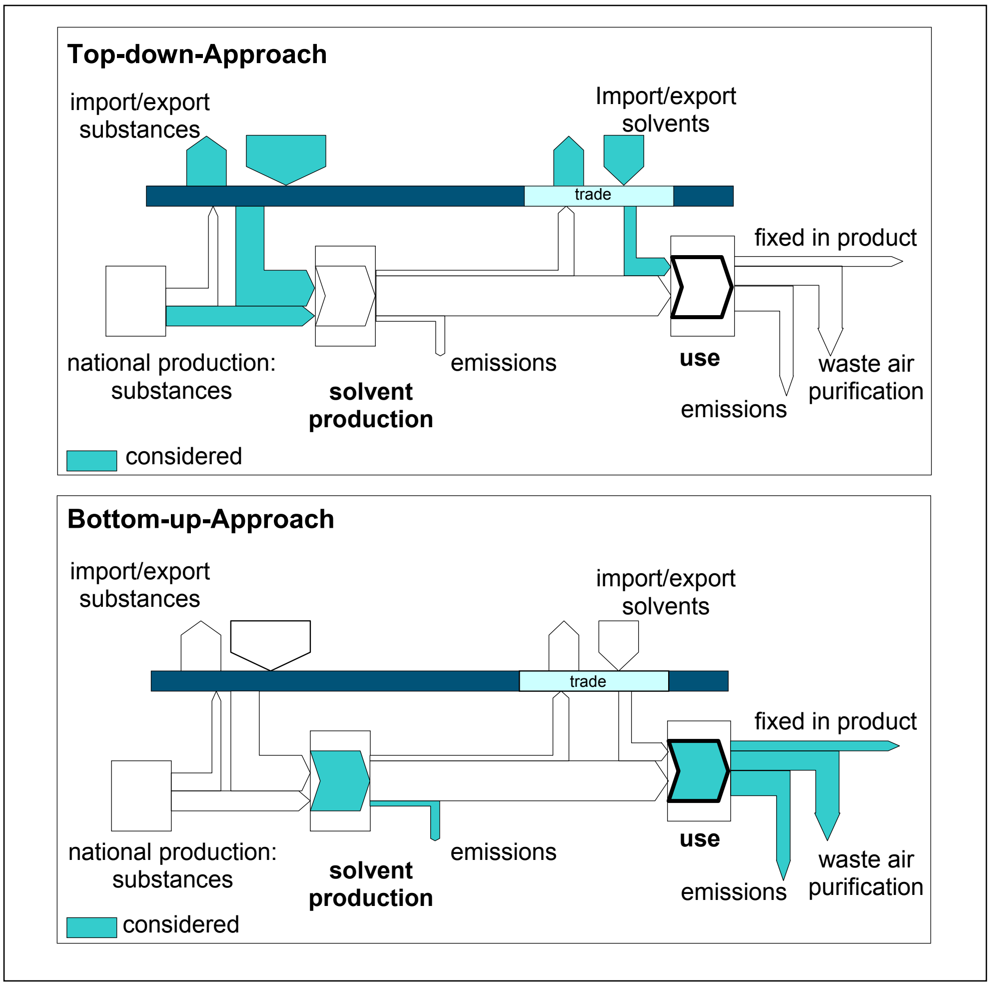


Figure 47: Top-down-Approach compared to Bottom-up-Approach.

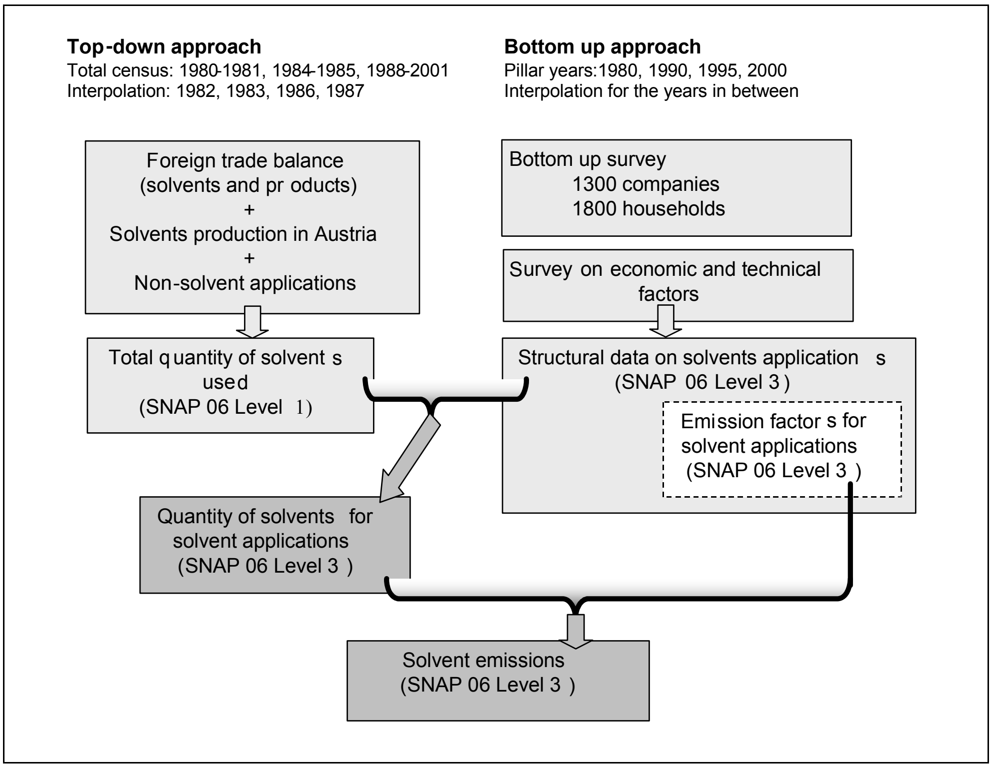
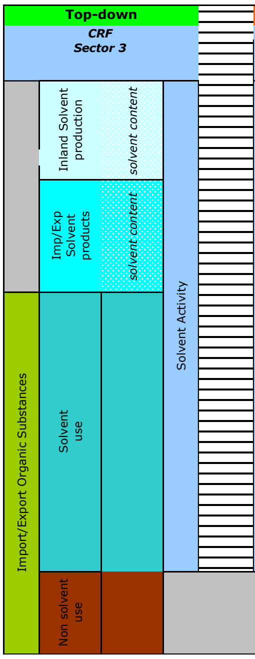


Figure 48: Overview of the methodology for solvent emissions.



Combination Top down - bottom up							Bottom-up					
Solvent Share				**Solvent Emissions**			**Solvent Emission Factor**			**Solvent Activity**		
CRF Sector 3	CRF Sector 3A-3D	SNAP Level 3		CRF Sector 3	CRF Sector 3A-3D	SNAP Level 3	CRF Sector 3	CRF Sector 3A-3D	SNAP Level 3	CRF Sector 3	CRF Sector 3A-3D	SNAP Level 3
	3 A, Paint application	060101	manufacture of automobiles				58%	45%	57%	100%	35.7%	1.2%
		060102	car repairing						89%			0.7%
		060103	construction and buildings						88%			3.0%
		060104	domestic use						89%			1.4%
		060105	coil coating						53%			3.5%
		060107	wood coating						67%			3.4%
		060108	Other industrial paint application						30%			22.5%
	3 B, Degreasing and Dry Cleaning	060201	Metal degreasing					55%	45%		12.6%	5.8%
		060202	Dry cleaning						85%			0.3%
		060203	Electronic components manufacturing						44%			1.2%
		060204	Other industrial cleaning						68%			5.2%
	3 C, Chemical Products, Manufacture and Processing	060305	Rubber processing					13%	94%		15.8%	0.4%
		060306	Pharmaceutical products manufacturing						26%			6.2%
		060307	Paints manufacturing						4%			
		060308	Inks manufacturing						5%			
		060309	Glues manufacturing						20%			
		060310	Asphalt blowing						1%			0.5%
		060311	Adhesive, magnetic tapes, films and photographs						94%			0.0%
		060312	Textile finishing						88%			0.0%
		060314	Other						16%			8.5%
	3 D, Other	060403	Printing industry					73%	66%		36.0%	8.4%
		060404	Fat, edible and non edible oil extraction						20%			0.2%
		060405	Application of glues and adhesives						64%			0.4%
		060406	Preservation of wood						99%			0.4%
		060407	Under seal treatment and conservation of vehicles						85%			0.1%
		060408	Domestic solvent use (other than paint application)						84%			16.6%
		060411	Domestic use of pharmaceutical products (k)						94%			4.3%
		060412	Other (preservation of seeds,...)						35%			5.5%

Figure 49: Combination of Top-down-Approach compared to Bottom-up-Approach for 2005.

A study (WINDSPERGER et al. 2002a) showed that emission estimates only based on the top down approach overestimate emissions because a large amount of solvent substances is used for "non-solvent-applications". "Non-solvent application" are applications where substances usually are used as feed stock in chemical, pharmaceutical or petrochemical industry (e.g. production of MTBE, formaldehyde, polyester, biodiesel, pharmaceuticals etc.) and where therefore no emissions from "solvent use" arise. However, there might be emissions from the use of the produced products, such as MTBE which is used as fuel additive and finally combusted, these emissions for example are considered in the transport sector.

Additionally the comparison of the top-down and the bottom-up approach helped to identify several quantitatively important applications like windscreens wiper fluids, antifreeze, moonlighting, hospitals, deicing agents of aeroplanes, tourism, cement- respectively pulp industry, which were not considered in the top-down approach.

6.3.2 Top down Approach

The top-down approach is based on

1. import-export statistics (foreign trade balance);
2. production statistics on solvents in Austria;
3. a survey on non-solvent-applications in companies (WINDSPERGER et al. 2004a);
4. survey on the solvent content in products and preparations at producers and retailers (WINDSPERGER et al. 2002 a).

ad (1) and (2):
Total quantity of solvents used in Austria were obtained from import-export statistics and production statistics provided by Statistik Austria.

Nearly a full top down investigation of substances of the import-export statistics from 1980 to 2002 was carried out (data in the years 1982, 1983, 1986 and 1987 were linearly interpolated). A main problem was that the methodology of the import-export statistics changed over the years. In earlier years products and substances had been pooled to groups and whereas the current foreign trade balance is more detailed with regard to products and substances. It was necessary to harmonise the time series in case of deviations.

There are only a few facilities producing solvents in Austria. Therefore due to confidentiality the Statistic Austria provided the data in an aggregated form. The solvents production fluctuated especially in the last years considerably.

ad (3):
In the study on the comparison of top down and bottom up approach (WINDSPERGER et al. 2002a) the amount of solvent substances used in "non-solvent-applications" was identified. The 20 most important companies in this context were identified and asked to report the quantities of solvents they used over the considered time period in "non-solvent-applications".

ad (4):
Relevant producers and retailers provided data on solvent content in products and preparations. As the most important substance groups alcohols and esters were identified.

6.3.3 Bottom up Approach

In a first step an extensive survey on the use of solvents in the year 2000 was carried out in 1 300 Austrian companies (WINDSPERGER et al. 2002b). In this survey data about the solvent content of paints, cleaning agents etc. and on solvents used (both substances and substance categories) like acetone or alcohols were collected.

Information about the type of application of the solvents was gathered, divided into the three categories "final application", "cleaner" and "product preparation" as well as the actual type of waste gas treatment, which was divided into the categories "open application", "waste gas collection" and "waste gas treatment".

For every category of application and waste gas treatment an emission factor was estimated to calculate solvent emissions in the year 2000 (see Table 222).

Table 222: Emission factors for NMVOC emissions from Solvent Use.

Category	Factor
final application	1.00
cleaner	0.85
product preparation	0.05
open application	1.00
waste gas collection	0.50
waste gas treatment	0.20

In a second step a survey in 1 800 households was made (WINDSPERGER et al. 2002 a) for estimating the domestic solvent use (37 categories in five 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. 2002 a).

To achieve a time series the development of the economic and technical situation in relation to the year 2000 was considered. It was distinguished between "general aspects" and "specific aspects" (see tables below). The information about these defined aspects were collected for three pillar years (1980, 1990, 1995) and were taken from several studies (SCHMIDT et al. 1998) (BARNERT 1998) and expert judgements from associations of industries (chemical industry, printing industry, paper industry) and other stakeholders. On the basis of this information calculation factors were estimated. With these factors and the data for solvent use and emission of 2000 data for the three pillar years was estimated. For the years in between data was linearly interpolated.

Table 223: General aspects and their development.

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

Table 224: Specific aspects and their development: distribution of the used paints (water based-paints – solvent-based paints) and part of waste gas purification (application – purification).

SNAP category	description	year	Distribution of used paints		Part of waste gas treatment	
			Solvent based paints	Water based paints	application	purification
060101	manufacture of automobiles	2000	73%	27%	10%	0%
		1995	80%	20%	8%	0%
		1990	90%	10%	5%	0%
		1980	100%	0%	0%	0%
060102	car repairing	2000	51%	49%	62%	1%
		1995	55%	45%	60%	0%
		1990	75%	25%	10%	0%
		1980	85%	15%	5%	0%

SNAP category	description	year	Distribution of used paints		Part of waste gas treatment	
			Solvent based paints	Water based paints	application	purification
060107	wood coating	2000	46%	54%	46%	3%
		1995	60%	40%	45%	2%
		1990	85%	15%	10%	0%
		1980	100%	0%	0%	0%
060108	Other industrial paint application	2000	97%	3%	90%	46%
		1995	99%	1%	87%	45%
		1990	100%	0%	26%	20%
		1980	100%	0%	0%	0%
060201	Metal degreasing	2000	92%	8%	75%	0%
		1995	95%	5%	65%	0%
		1990	100%	0%	10%	0%
		1980	100%	0%	0%	0%
060403	Printing industry	2000			44%	17%
		1995			29%	10%
		1990			10%	5%
		1980			0%	0%
060405	Application of glues and adhesives	2000			58%	0%
		1995			53%	0%
		1990			15%	0%
		1980			0%	0%
060103	Paint application: construction and buildings	2000	91%	9%	19%	4%
		1995	93%	7%	15%	2%
		1990	100%	0%	5%	0%
		1980	100%	0%	0%	0%
060105	Paint application: coil coating	2000	100%	0%	63%	0%
		1995	100%	0%	60%	0%
		1990	100%	0%	25%	0%
		1980	100%	0%	0%	0%
060406	Preservation of wood	2000	83%	17%	0%	0%
		1995	85%	15%	0%	0%
		1990	95%	5%	0%	0%
		1980	100%	0%	0%	0%
060412	Other (preservation of seeds, …)	2000	100%	0%	90%	0%
		1995	100%	0%	80%	0%
		1990	100%	0%	10%	0%
		1980	100%	0%	0%	0%

Table 225: Specific aspects and their development: changes in the number of employees compared to the year 2000.

SNAP		Changes in the number of employees compared to the year 2000			
		1980	1990	1995	2000
0601	Paint application				
060101	manufacture of automobiles	88%	82%	72%	100%
060102	car repairing	94%	98%	96%	100%
060103	construction and buildings	96%	90%	102%	100%
060104	domestic use	separate analysed			
060105	coil coating	99%	113%	107%	100%
060107	wood coating	107%	109%	112%	100%
060108	industrial paint application	122%	112%	106%	100%
0602	Degreasing, dry cleaning and electronics				
060201	Metal degreasing	151%	113%	83%	100%
060202	Dry cleaning	63%	75%	88%	100%
060203	Electronic components manufacturing	143%	122%	104%	100%
060204	Other industrial cleaning	33%	77%	56%	100%
0603	Chemical products manufacturing and processing				
060305	Rubber processing	110%	101%	102%	100%
060306	Pharmaceutical products manufacturing	118%	112%	97%	100%
060307	Paints manufacturing	118%	112%	97%	100%
060308	Inks manufacturing	118%	112%	97%	100%
060309	Glues manufacturing	118%	112%	98%	100%
060310	Asphalt blowing	124%	120%	120%	100%
060311	Adhesive, magnetic tapes, films and photographs	33%	57%	76%	100%
060312	Textile finishing	241%	171%	132%	100%
060314	Other	117%	112%	98%	100%
0604	Other use of solvents and related activities				
060403	Printing industry	129%	125%	111%	100%
060404	Fat, edible and non edible oil extraction	129%	116%	112%	100%
060405	Application of glues and adhesives	239%	156%	104%	100%
060406	Preservation of wood	108%	105%	100%	100%
060407	Under seal treatment and conservation of vehicles	97%	102%	103%	100%
060408	Domestic solvent use (other than paint application	separate analysed			
060411	Domestic use of pharmaceutical products (k)				
060412	Other (preservation of seeds,…)	108%	105%	101%	100%

A comprehensive summary on the methodology for the year 2000 can also be found in the Austrian Informative Inventory Report (UMWELTBUNDESAMT 2004a).

6.3.4 Combination Top down – Bottom up approach and updating

To verify and adjust the data the solvents given in the top down approach and the results of the bottom up approach were differentiated by 15 defined categories of solvent groups (see below Table 226). The differences between the quantities of solvents from the top down approach and bottom up approach respectively are lower than 10%. Table 226 shows the range of the differences in the considered pillar years broken down to the 15 substance categories.

Table 226: Differences between the results of the bottom up and the top down approach.

	Acetone	Methanol	Propanol	Solvent naphta	Paraffins	Alcohols	Glycols	Ester	Aromates	Ether	org. acids	Ketones	Aldehydes	Amines	cycl. Hydrocarb.	Others	Sum of differences [kt/a]
2000																	-14
1995																	-2
1990																	14
1980																	-18

Difference less than 2 kt/a

Difference 2–10 kt/a

Difference greater than 10 kt/a

As the data of the top down approach were obtained from national statistics, they are assumed to be more reliable than the data of the bottom up approach. That's why the annual quantities of solvents used were taken from the top down approach while the share of the solvents for the different applications (on SNAP level 3) and the solvent emission factors have been calculated on the basis of the bottom up approach. The following tables present activity data and implied emission factors Table 227 and Table 228 as well as in Figure 50.

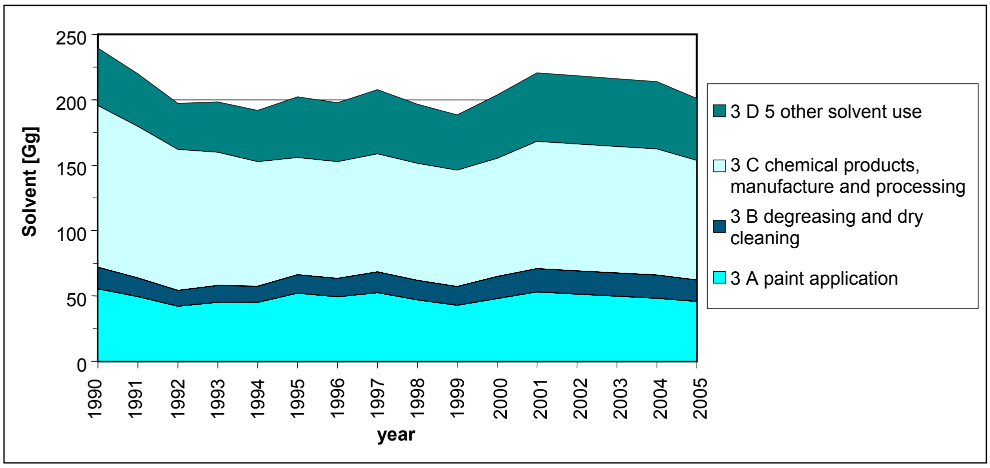


Figure 50: Activity data of Category 3 Solvent and other product use.

The inventory has been updated with data from (WINDSPERGER et al. 2004 b) since the study (WINDSPERGER et al. 2002) has been published. The data of the Austrian air emission inventory 2006 is based upon a current estimation, which is generally higher than the data of the year 2000, because in the year 2000 the use of wind screen washing fluid in housholds was not included.

The CO_2 emissions for 2002 to 2005 are calculated with the "emission factors" t CO_2/t NMVOC of the year 2000 and the NMVOC emission of the respective projection year. Compared to the data reported in the survey there is a lower reduction because of the higher estimated emissions of housholds (SNAP 060408).

Table 227: Activity data of Category 3 Solvent and other product use [Mg].

NFR	**3 A**								**3 B**				
SNAP		**060101**	**060102**	**060103**	**060104**	**060105**	**060107**	**060108**		**060201**	**060202**	**060203**	**060204**
Unit	**Mg Solvent**												
1990	**55 450**	1 811	1 009	3 882	4 600	5 706	7 103	31 339	16 472	9 391	466	2 540	4 075
1991	**49 437**	1 535	900	3 585	3 607	5 124	6 217	28 469	14 406	7 969	413	2 153	3 871
1992	**42 141**	1 240	768	3 162	2 654	4 398	5 200	24 719	12 041	6 448	350	1 740	3 503
1993	**45 302**	1 260	827	3 514	2 399	4 761	5 484	27 057	12 685	6 560	375	1 767	3 983
1994	**45 124**	1 182	824	3 614	1 938	4 775	5 356	27 435	12 378	6 164	371	1 657	4 186
1995	**52 220**	1 283	955	4 315	1 718	5 564	6 075	32 310	14 027	6 704	427	1 799	5 097
1996	**49 331**	1 304	905	4 080	1 668	5 186	5 548	30 640	14 008	6 635	418	1 697	5 258
1997	**52 586**	1 493	968	4 353	1 829	5 450	5 701	32 792	15 775	7 408	461	1 807	6 099
1998	**47 044**	1 432	869	3 897	1 683	4 803	4 902	29 458	14 902	6 941	427	1 615	5 919
1999	**42 851**	1 396	794	3 554	1 578	4 305	4 275	26 949	14 326	6 622	403	1 469	5 832
2000	**47 985**	1 671	893	3 983	1 820	4 739	4 565	30 314	16 924	7 766	468	1 643	7 047
2001	**53 155**	1 732	985	4 408	1 958	5 340	5 303	33 429	17 770	8 214	500	1 822	7 234
2002	**51 490**	1 736	978	4 355	1 950	5 346	5 243	31 882	17 765	8 148	498	1 823	7 295
2003	**49 825**	1 739	971	4 303	1 942	5 352	5 183	30 334	17 759	8 082	495	1 825	7 357
2004	**48 160**	1 743	964	4 250	1 934	5 358	5 123	28 787	17 754	8 016	493	1 826	7 418
2005	**45 731**	1 576	903	3 982	1 716	4 469	4 501	28 585	16 439	7 323	441	1 549	7 125

NFR	**3 C**									
SNAP		**060305**	**060306**	**060307**	**060308**	**060309**	**060310**	**060311**	**060312**	**060314**
Unit	**Mg Solvent**									
1990	**123 768**	991	8 391	59 952	7 173	4 203	1 348	3	159	41 548
1991	**115 918**	864	6 978	54 971	6 930	4 168	1 173	3	133	40 698
1992	**107 979**	720	5 519	49 990	6 687	4 133	975	3	105	39 847
1993	**101 904**	755	5 470	45 010	6 444	4 098	1 022	3	105	38 997
1994	**95 251**	734	4 987	40 029	6 201	4 063	991	3	96	38 147
1995	**89 617**	828	5 237	35 048	5 958	4 028	1 116	4	102	37 296
1996	**89 460**	750	5 619	34 486	5 795	4 126	989	4	89	37 602
1997	**90 263**	764	6 739	33 924	5 632	4 225	980	4	87	37 908
1998	**89 630**	650	6 729	33 362	5 469	4 323	808	4	71	38 214
1999	**89 135**	560	6 797	32 799	5 306	4 421	671	4	57	38 520
2000	**90 444**	589	8 394	32 237	5 143	4 520	674	5	56	38 826
2001	**97 371**	694	8 431	34 878	5 564	4 890	832	5	71	42 006
2002	**97 119**	666	8 432	34 761	5 592	4 864	821	5	70	41 910
2003	**96 866**	638	8 433	34 643	5 619	4 837	809	5	68	41 814
2004	**96 614**	610	8 433	34 526	5 647	4 811	798	5	67	41 718
2005	**91 501**	555	7 915	29 565	6 496	4 531	636	5	53	41 746

NFR	3 D 5								
SNAP		060403	060404	060405	060406	060407	060408	060411	060412
Unit	Mg Solvent								
1990	**43 887**	14 941	541	824	687	221	14 041	5 055	7 577
1991	**40 081**	13 214	464	709	609	199	13 460	4 633	6 793
1992	**34 983**	11 174	380	582	516	172	12 279	4 058	5 822
1993	**38 483**	11 914	392	602	552	187	14 065	4 478	6 293
1994	**39 207**	11 770	374	576	546	188	14 874	4 576	6 303
1995	**46 388**	13 509	413	639	629	221	18 214	5 430	7 333
1996	**44 909**	12 564	369	602	595	203	18 262	5 273	7 041
1997	**49 082**	13 172	370	640	636	211	20 642	5 780	7 631
1998	**45 042**	11 578	309	570	571	183	19 567	5 320	6 944
1999	**42 108**	10 350	261	518	522	162	18 871	4 987	6 437
2000	**48 417**	11 359	267	578	586	175	22 361	5 752	7 339
2001	**52 231**	12 838	323	642	647	201	23 408	6 187	7 985
2002	**51 949**	12 687	322	609	629	194	23 356	6 162	7 990
2003	**51 666**	12 537	321	575	611	187	23 305	6 137	7 995
2004	**51 384**	12 386	319	542	592	180	23 253	6 112	7 999
2005	**47 410**	10 711	252	581	553	177	22 056	5 449	7 631

Table 228: Implied NMVOC emission factors for Solvent Use 1990–2005 [kg].

NFR	3 A	3 A	3 A	3 A	3 A	3 A	3 A	3 B	3 B	3 B	3 B
SNAP	060101	060102	060103	060104	060105	060107	060108	060201	060202	060203	060204
Unit						kg					
1990	940.36	976.21	920.40	884.57	841.40	937.21	782.41	934.83	950.64	680.31	722.70
1991	880.78	973.33	904.60	885.50	789.62	892.55	700.76	859.83	937.05	642.82	717.64
1992	821.77	970.05	888.68	885.83	738.06	848.08	619.16	784.89	922.86	605.75	712.53
1993	762.70	967.35	872.51	886.62	686.20	803.43	537.53	710.06	906.67	568.19	707.51
1994	703.89	964.81	856.67	887.00	634.55	758.78	455.91	634.98	894.88	531.08	702.34
1995	644.58	961.26	840.56	887.66	582.85	714.07	374.28	560.11	880.56	493.61	697.27
1996	630.37	948.07	848.28	887.89	572.31	705.66	360.18	537.30	873.21	483.21	693.80
1997	616.21	934.92	855.96	887.37	561.47	697.25	346.09	514.71	867.68	472.05	690.28
1998	601.96	921.75	863.74	887.70	550.91	688.70	332.00	492.00	861.83	460.68	686.60
1999	588.11	908.06	871.13	887.83	540.07	680.23	317.90	469.34	856.08	449.97	682.96
2000	573.31	894.74	878.99	887.36	529.44	671.63	303.82	446.69	850.43	438.83	679.44
2001	559.47	882.23	886.57	887.64	518.91	663.21	290.35	425.01	844.00	427.55	675.84
2002	548.82	872.81	873.87	863.68	499.37	647.24	296.43	421.71	824.42	413.62	668.50
2003	538.21	863.26	860.85	839.53	479.88	630.90	303.13	418.35	804.66	399.71	661.29
2004	527.65	853.57	847.52	815.18	460.42	614.18	310.56	414.94	784.71	385.82	654.19
2005	573.31	894.74	878.99	887.36	529.44	671.63	303.82	446.69	850.43	438.83	679.44

NFR	3 C	3 C	3 C	3 C	3 C	3 C	3 C	3 C	3 C
SNAP	060305	060306	060307	060308	060309	060310	060311	060312	060314
Unit					kg				
1990	985.87	462.52	53.64	50.75	200.10	10.39	1 000.00	886.79	224.37
1991	981.48	420.46	52.63	50.79	200.10	10.23	1 000.00	879.70	219.10
1992	976.39	378.51	51.61	50.70	200.10	10.26	666.67	885.71	213.84
1993	973.51	336.75	50.59	50.74	200.10	9.78	1 000.00	885.71	208.55
1994	968.66	294.77	49.56	50.80	200.10	10.09	1 000.00	885.42	203.29
1995	963.77	252.82	48.56	50.69	200.10	9.86	750.00	882.35	198.01
1996	958.67	253.96	45.93	50.73	199.95	10.11	750.00	887.64	190.57
1997	952.88	254.93	43.30	50.78	200.00	10.20	1 000.00	885.06	183.13
1998	946.15	255.91	40.70	50.65	200.09	9.90	1 000.00	873.24	175.67
1999	941.07	256.88	38.08	50.70	199.95	10.43	1 000.00	894.74	168.20
2000	935.48	257.92	35.46	50.55	200.00	10.39	800.00	892.86	160.74
2001	930.84	258.93	33.03	50.68	200.00	9.62	1 000.00	887.32	153.62
2002	922.74	258.87	32.39	52.51	197.40	9.32	938.59	847.22	153.73
2003	913.93	258.80	31.76	54.31	194.76	9.02	877.19	805.56	153.85
2004	904.31	258.74	31.11	56.10	192.10	8.71	815.78	762.27	153.96
2005	935.48	257.92	35.46	50.55	200.00	10.39	800.00	892.86	153.62

NFR	3 D 5	3 D 5	3 D 5	3 D 5	3 D 5	3 D 5	3 D 5	3 D 5
SNAP	060403	060404	060405	060406	060407	060408	060411	060412
Unit					kg			
1990	859.05	192.24	860.44	989.81	846.15	838.54	940.85	916.72
1991	824.81	193.97	826.52	990.15	849.25	838.93	940.86	818.93
1992	790.50	194.74	792.10	990.31	848.84	839.32	940.86	721.40
1993	756.17	196.43	759.14	990.94	850.27	839.67	940.82	623.71
1994	721.92	197.86	723.96	990.84	851.06	840.06	941.00	525.94
1995	687.54	200.97	690.14	990.46	850.68	840.40	940.88	428.34
1996	681.47	200.54	679.40	991.60	852.22	840.65	940.83	411.59
1997	675.37	200.00	668.75	992.14	848.34	840.96	940.83	395.10
1998	669.29	200.65	659.65	991.24	852.46	841.16	940.79	378.46
1999	663.19	199.23	648.65	990.42	845.68	841.40	941.05	361.81
2000	657.10	202.25	638.41	991.47	851.43	841.69	940.72	345.28
2001	651.11	201.24	629.28	992.27	845.77	841.93	940.84	329.37
2002	632.82	191.05	650.27	983.56	851.25	831.55	916.49	329.32
2003	614.09	180.79	673.69	974.34	857.13	821.13	891.93	329.28
2004	594.91	170.45	700.00	964.54	863.47	810.65	867.17	329.24
2005	657.10	202.25	638.41	991.47	851.43	841.69	940.72	345.28

6.3.5 Uncertainty Assessment

The comparison of the results of the top-down approach (import-export statistics, substances and products, production statistics, non solvent application) and these of the bottom-up approach showed a gap of less than 10% (difference between 2 and 14 kt/a) (WINDSPERGER et al. 2004).

Table 229 presents the uncertainties of data sources of the top down approach.

The top-down approach was mainly based on the import-export statistics. The uncertainty of the statistical data was assumed to be negligible compared to the other uncertainties. The method of the import-export statistics between 1980 and 2001 varied and to harmonise the time series it was necessary to adjust data. The current import-export statistics are more detailed in regard of the products and substances. Hence the uncertainty is assumed to be in the order of 0.5 and 10% whereas it is higher in 1990 than in 2000.

Another important data source on top-down level was the survey on "non-solvent-application" in the 20 most relevant companies. The companies reported data in different quality: partly they reported data for all years partly just for the pillar years. Generally due to increasing electronic data storage the data quality is in the last years better than in earlier years. Altogether it was assumed that the uncertainty is between 1.5% and 5%. As for the statistical data, the uncertainty is higher in 1990 than in 2000.

Table 229: Uncertainties of Top-down approach.

	Data source	1990	1995	2000	Uncertainty source
Substances	national statistics foreign trade balance	+ 2.5 to – 2.5%	+ 1.5 to – 1.5%	+ 0.5 to – 0.5%	Expert judgement (WINDSPERGER et al. 2004)
Products	national statistics foreign trade balance	+ 10 to – 10%	+ 5 to – 5%	+ 2.5 to – 2.5%	Expert judgement (WINDSPERGER et al. 2004)
Solvent Production	National production statistics	0	0	0	Assumed to be negligible (see above)
Non solvent applications	Surveys in relevant companies	+ 5 to – 5%	+ 2.5 to – 2.5%	+ 1.5 to – 1.5%	Expert judgement (WINDSPERGER et al. 2004)

Table 230 presents the uncertainties of the emission factors that were obtained by expert judgement. A sensitivity analysis (WINDSPERGER et al. 2002a) showed a variation of 5% of the emission factors of solvent application in the year 2000.

Table 230: Uncertainties of Bottom-up approach.

	1990	1995	2000	Data and uncertainty source
Emissions factor	86%	63%	58%	(WINDSPERGER et al. 2004)
Uncertainty – emissions factor	+ 10 to – 10%	+ 7 to – 7%	+ 5 to – 5%	Expert judgement (WINDSPERGER et al. 2004)

For calculation of the overall uncertainties of Sector 6 the upper and lower limit of activity data and emission factors was taken into account.

Table 231: Uncertainties of Sector 6 Solvent and other product use.

	1990	1995	2000	Data source
Uncertainty solvent emissions	– 21 to + 24%	– 18 to + 21%	– 13 to + 14%	(WINDSPERGER et al. 2004)

6.4 Recalculation for Emissions from Solvent and Other Product Use

The reasons for recalculation are updates of activity data:

3 A, 3 B, 3 C and 3 D 5:
NMVOC emissions from solvent use have been interpolated between 2001 and 2005; this results in a decrease of NMVOC emissions from solvent use for the years 2002–2004 compared to the previous submission, where emission data were extrapolated from 2002 onwards.

The tables below show the recalculation difference of emissions from Sector 3 Solvent and Other Product Use and its sub categories with respect to the previous submission.

Table 232: Recalculation difference with respect to submission 2005.

NMVOC Emission		Absolute difference [Gg]			Relative difference [Δ%]	
		2002	2003	2004	1990	2004
3	Solvent and Other Product Use	-1.28	-2.56	-3.84	=	-5%
3 A	Paint application	-0.48	-0.96	-1.45	=	-6%
3 B	Degreasing and dry cleaning	-0.08	-0.16	-0.23	=	-2%
3 C	Chemical products, manufacture and processing	-0.07	-0.14	-0.21	=	-2%
3 D	Other solvent use	-0.65	-1.30	-1.94	=	-5%

7 AGRICULTURE (NFR SECTOR 4)

7.1 Sector Overview

This chapter includes information on the estimation of the emissions of NEC gases, CO, particle matter (PM), heavy metals (HM) and persistent organic pollutant (POP) of the sector *Agriculture* in Austria corresponding to the data reported in Category 4 of the NFR format. It describes the calculations of source categories *4 B Manure Management, 4 D Agricultural Soils, 4 F Field Burning of Agricultural Residues* and *4 G Other.*

The Sector *Agriculture* is the most important source regarding NH_3 emissions in Austria; they make up about 94% of national total emissions (see Table 233). It is also an important source regarding particulate matter, where it contributes to about 35%, 21% and 8%, respectively, to national total TSP, PM10 and PM2.5 emissions. Furthermore it contributes each with about 2% to national total PAH emissions and national total NO_x emissions, and 1.2% to national total NMVOC emissions (in the year 2005).

The following table presents the source categories from the agricultural sector which are key sources of the Austrian inventory with regard to the contribution to national total emissions (for details of the key source analysis see Chapter 1.4).

Table 233: Key Source in NFR sector 4 Agriculture.

	Source category									
	4 B 1	**4 B 3**	**4 B 4**	**4 B 6**	**4 B 8**	**4 B 9**	**4 B 13**	**4 D**	**4 F**	**4 G**
Pollutant	**Cattle**	**Sheep**	**Goats**	**Horses**	**Swine**	**Poultry**	**Other**	**Agricultural Soils**	**Field Burning[(1)]**	**Agriculture – Other**
SO_2									0.0%	
NO_x								2.3%	0.0%	
NMVOC								1.1%	0.1%	
NH_3	57.3%	1.3%	0.2%	1.1%	14.7%	8.1%	0.2%	11.5%	0.1%	
CO									0.2%	
Cd									0.2%	
Hg									0.0%	
Pb									0.1%	
PAH									2.3%	
Diox									0.4%	
HCB									0.1%	
TSP								30.1%		4.7%
PM10								12.7%		7.9%
PM2.5								5.2%		3.0%

Note: grey shaded are key sources

[(1)] Complete Description: 4 F Field Burning of Agricultural Residues

For the other pollutants the agricultural sector is only a minor source: emissions of SO_2, CO, heavy metals and POPs exclusively 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 0.4% for the whole time series.

In the following a brief description of Austria's farm structure is given according to the report „Grüner Bericht 2006“ (BMLFUW 2006).

Generally it is to remark that Austria is an Alpine country and the highest tiers of Alpine cultural landscapes are the seasonally used Alpine pastures. According to the agricultural structure survey 2003 the number of agricultural and forestry enterprises in Austria was totally 190 382. There were 176 808 holdings with agriculturally used area and 15 797 holdings with areas used for forestry, of which 13 273 were pure forest enterprises. Austria's agriculture is small-structured: 61% of the farms have a size of less than 20 hectares cultivated area each and just only 4% of the farms have a size of more than 100 hectares. The average size of farms is about 18.4 hectares agriculturally used area and 34.0 hectares of cultivated area. In 2003 42% of all farms were full-time farms with 3.13 mio. hectares (42%) farm land. The big amount of Austrian farms (share of 54%) are part-time farms with 1.46 mio. hectares (20%) farm land, 3% are farms operated by companies with 2.47 mio. hectares (33%) farm land.

In Austria, 2.39 million ha of land were used for agricultural purposes and 3.96 hectares of land were forest. The shares of the different agricultural activities are as follows (BMLFUW 2006):

- 1.38 million hectares for arable farming;
- 1.44 million hectares for permanent grassland;
- 43 533 hectares for vineyards;
- 12 512 hectares for orchards, and
- 1 174 hectares for other purposes (house gardens, as well as vine and tree nurseries).

In 2005 about 72.340 holdings of all Austrian farms were classified as Alpine farmers, „Bergbauern”, and were situated in less favoured areas. Mountainous areas account for 70% of Austria's federal territory, which is the highest share of all EU countries.

In 2005 the weather was affected on the one hand by drought in early sommer with impairment of agricultural use and pasture farming and on the other hand by flood and mudflow in July and August.

7.2 Emission trend

In Table 234, Table 235 and Table 236 the emissions and trends from Sector 4 Agriculture and sub sectors for the key sources NO_x, NH_3 and PAH as well as TSP, PM10 and PM2.5 for the year 1990 to 2005 are presented.

PM, POPs and Heavy metals are emitted by different operation steps and various production processes but the whole extent and exposure of these emissions are widely unknown. This is subject to research. The reported emission data are calculated to the best standard of knowledge.

7.2.1 NEC Gases and CO

NH_3 (key source)

In 1990 national NH_3 emissions from the Sector *Agriculture* amounted to 66 Gg; emissions have decreased since then and by the year 2005 emissions were reduced by 9% to 60 Gg mainly due to reduced dairy cattle rearing (see Table 236 and Figure 51). In the year 2005 the sector *Agriculture* contributed 94% to Austria's NH_3 emissions. Within this sector

- *Manure Management* (NFR 4 B) with a share of 83% has the highest contribution to total NH_3 emissions in 2005 (see Table 234). The agricultural NH_3 emissions result from animal husbandry, the storage of manure as well as the application of organic manure.
- *Agricultural Soils* (NFR 4 D) has a share of 12% in total NH_3 emissions in 2005. These emissions result from fertilisation with mineral N-fertilisers. Other sources of NH_3 emissions are biological nitrogen fixation (legume crops) and manure excreted on pastures by grazing animals.
- *Field burning of agricultural residues* (NFR 4 F): NO_X emissions are negligible low (0.01% to total NO_x emissions in 2005).

NO_x (key source)

In 1990 national NO_x emissions of the Sector *Agriculture* amounted to 6.1 Gg, which is a share of about 3% of the Austrian total NO_x emissions. Until 2005 emissions have decreased by 14% and amounted to 5.2 Gg, which is a share in national total NO_x emissions of 2%. This downwards-trend is mainly due to reduced use of synthetic N-fertilizers. Within this sector

- *Agricultural Soils* (NFR 4 D) has with a share of 2% to total NO_x emissions. Emissions result from nitrogen inputs into Agricultural soils.
- *Field burning of agricultural residues* (NFR 4 F) has a share of less than 1% to total NO_x emissions in 2005.

Table 234: Emissions and trends from Sector 4 Agriculture by gas (NO_x, NH_3 and PAH) and source categories 1990–2005.

Year	NO_x [Gg]			NH_3 [Gg]				PAH [Mg]	
	4	4 D	4 F	4	4 B	4 D	4 F	4	4 F
1990	**6.09**	6.06	0.03	**66.12**	58.00	8.08	0.05	**0.241**	0.241
1991	**6.32**	6.28	0.03	**66.78**	57.89	8.85	0.04	**0.241**	0.241
1992	**5.96**	5.93	0.03	**64.40**	56.05	8.31	0.04	**0.241**	0.241
1993	**5.72**	5.69	0.03	**64.34**	56.71	7.59	0.04	**0.239**	0.239
1994	**6.13**	6.10	0.03	**65.27**	56.51	8.72	0.04	**0.239**	0.239
1995	**6.19**	6.15	0.03	**66.86**	57.96	8.86	0.04	**0.238**	0.238
1996	**5.86**	5.83	0.03	**65.08**	56.82	8.22	0.04	**0.238**	0.238
1997	**5.92**	5.89	0.04	**65.35**	56.93	8.38	0.05	**0.234**	0.234
1998	**5.92**	5.89	0.03	**65.40**	56.79	8.57	0.05	**0.234**	0.234
1999	**5.76**	5.73	0.04	**64.15**	55.76	8.34	0.05	**0.233**	0.233
2000	**5.61**	5.58	0.03	**62.68**	54.59	8.05	0.04	**0.233**	0.233
2001	**5.57**	5.54	0.04	**62.47**	54.69	7.74	0.05	**0.233**	0.233
2002	**5.51**	5.47	0.04	**61.38**	53.47	7.87	0.05	**0.233**	0.233
2003	**5.41**	5.38	0.03	**61.19**	53.90	7.25	0.04	**0.229**	0.229

Year	NO_x [Gg]			NH_3 [Gg]				PAH [Mg]	
	4	4 D	4 F	4	4 B	4 D	4 F	4	4 F
2004	**5.26**	5.21	0.05	**60.72**	53.50	7.15	0.07	**0.292**	0.292
2005	**5.22**	5.19	0.03	**60.39**	53.03	7.32	0.04	**0.205**	0.205
Trend									
1990–2005	***-14.2%***	*-14.3%*	*-5.0%*	***-8.3%***	*-8.6%*	*-9.4%*	*-7.0%*	***-14.9%***	*-14.9%*
2004–2005	***-0.7%***	*-0.3%*	*-39.3%*	***-1.3%***	*-0.9%*	*2.4%*	*-35.9%*	***-29.8%***	*-29.8%*
Share in Sector Agriculture									
1990		*99.4%*	*0.6%*		*87.7%*	*12.2%*	*0.1%*		*100%*
2005		*99.4%*	*0.6%*		*87.8%*	*12.1%*	*0.1%*		*100%*
Share in National Total									
1990	***2.9%***	*2.9%*	*0.02%*	***96.1%***	*84.3%*	*11.7%*	*0.1%*	***1.4%***	*1.4%*
2005	***2.3%***	*2.3%*	*0.01%*	***94.4%***	*82.9%*	*11.5%*	*0.1%*	***2.3%***	*2.3%*

NMVOC (key source)

In 2005 NMVOC emissions of sector *Agriculture* only contribute 1.2% (1.9 Gg) to the Austrian total NMVOC emissions. From 1990 to 2005 NMVOC from agricultural vegetation – Sector *Agricultural Soils* (NFR 4 D) – increased by 1% due to an increased harvest of agricultural crops.

SO_2

Field Burning of Agricultural Waste (NFR 4 F) is the only emission source for SO_2 emissions of the Sector *Agriculture*. In 2005, emissions only contribute less than 0.01% to national total SO_2 emissions. Emissions vary on a very small scale following the area of stubble fields burnt each year.

CO

Field Burning of Agricultural Waste (NFR 4 F) is the only emission source for CO emissions of the Sector *Agriculture*. In 2005, emissions only contribute 0.2% (1.12 Gg) to national total emissions. Emissions vary on a very small scale with the area of stubble fields burnt each year.

7.2.2 Persistent organic pollutants – POPs

Except of PAH, which is a key category, the emission of dioxin and HCB are not a key category.

PAH (key source)

As shown in Figure 54, Table 234 and Table 236 in 2005 in national PAH emissions of the sector *Agriculture* amounted to 0.205 Mg, which is a share of 2.3% of total PAH emission; emissions decreased by 15% mainly due to reduced burning of agricultural wastes (straw, residual wood) on fields. From 2004 to 2005 there was a decrease of 30% which is a consequence of decreasing area of stubble fields burnt in 2005. Within this source *Field burning of agricultural residues* (NFR 4 F) is the only source.

Dioxin/Furan and HCB

As shown in Figure 54, and Table 234 in the period from 1990 to 2005

- **dioxin/furan** emissions decreased by 15% to 0.151g, which is a share of less than 0.4% in total dioxin emission. The emission trend from 2004 to 2005 amounts to -29%.
- **HCB** emissions decreased by 15% to 0.03 kg, which is a share of less than 0.1% in total HCB emission. The emission trend from 2004 to 2005 amounts to -29%.

7.2.3 Heavy Metals – Cd, Hg, Pb

As shown in Table 236 and Figure 53 in the period from 1990 to 2005

- **Cd** emissions decreased by 11% to 1.9 kg, which is a share of 0.2% in total Cd emission. The emission trend from 2004 to 2005 amounts to -27%.
- **Hg** emissions decreased by 10% to 0.3 kg, which is a share of 0.03% in total Hg emission. The emission trend from 2004 to 2005 amounts to -30%.
- **Pb** emissions increase by 12% to 11 kg, which is a share of about 0.1% in total Pb emission. The emission trend from 2004 to 2005 amounts to -26%.

From 2004 to 2005 there was a decrease in emission which is the consequence of decreasing area of stubble fields burnt in 2005.

The emissions of heavy metals are not key categories.

7.2.4 Particulate matter (PM) – TSP, PM10, PM2.5 (key sources)

As sources for PM tillage operation, harvesting activities, transportation and stock transfer, animal husbandry and other operations were identified. Emissions of all three particulate matter sizes of PM are rated as key sources. As shown in Figure 52 und Table 235 in the period from 1990 to 2005

- **TSP** emissions decreased by 5% to 31 841 Gg, which is a share of 35% in total TSP emission. The emission trend from 2004 to 2005 amount to -6%.
- **PM10** emissions decreased slightly by about 1% to 9 379 Gg, which is a share of 21% in total PM10 emission. The emission trend from 2004 to 2005 amount to 4%.
- **PM2.5** emissions decreased by 5% to 2 144 Gg, which is a share of 8% in total PM2.5 emission. The emission trend from 2004 to 2005 amount to -5%.

Tillage operations and harvesting activities are the main sources for PM emissions. With a share of 30% Source Category *Agricultural Soils* (NFR 4 D) had a high contribution to total TSP emissions in 2005. Whereas 86% of the agricultural TSP emissions resulted from source category 4 D, the share of PM10 emissions within Sector Agriculture was 62% and 63% for PM2.5.

A comparatively small amount of about one-third of the agricultural PM10 emissions and PM2.5 emission, respectively, result from animal husbandry (NFR 4 G). Dust particle of this source category result from for example feed, litter, hair, plumes and excrements.

Table 235: Emissions and trends from Sector 4 Agriculture by gas (TSP, PM10, PM2.5) and source categories 1990–2005.

Year	TSP [Mg]			PM10 [Mg]			PM2.5 [Mg]		
	4	4 D	4 G	4	4 D	4 G	4	4 D	4 G
1990	33 603	29 725	3 877	9 440	6 209	3 231	2 256	1 465	791
1995	29 325	25 249	4 077	8 728	5 331	3 397	2 033	1 242	792
1999	31 903	27 121	4 783	9 678	5 693	3 985	2 188	1 336	852
2000	29 145	25 430	3 715	8 457	5 361	3 096	1 989	1 251	738
2001	31 137	27 226	3 910	8 971	5 712	3 258	2 094	1 341	753
2002	30 635	26 787	3 847	8 832	5 626	3 206	2 057	1 319	738
2003	28 365	24 123	4 242	8 639	5 104	3 535	1 964	1 186	778
2004	33 995	29 723	4 272	9 761	6 201	3 560	2 249	1 466	783
2005	31 841	27 508	4 333	9 379	5 767	3 611	2 144	1 355	789
Trend									
1990–2005	*-5.2%*	*-7.5%*	*11.8%*	*-0.7%*	*-7.1%*	*11.8%*	*-5.0%*	*-7.5%*	*-0.2%*
2004–2005	*-6.3%*	*-7.5%*	*1.4%*	*-3.9%*	*-7.0%*	*1.4%*	*-4.7%*	*-7.6%*	*0.7%*
Share in Sector Agriculture									
1990		*88.5%*	*11.5%*		*65.8%*	*34.2%*		*65.0%*	*35.0%*
2005		*86.4%*	*13.6%*		*61.5%*	*38.5%*		*63.2%*	*36.8%*
National Share									
1990	*36.7%*	*32.5%*	*4.2%*	*19.8%*	*13.0%*	*6.8%*	*7.9%*	*5.1%*	*2.8%*
2005	*34.9%*	*30.1%*	*4.7%*	*20.6%*	*12.7%*	*7.9%*	*8.2%*	*5.2%*	*3.0%*

Table 236: Emissions and trends from Sector 4 Agriculture 1990–2005.

Year	SO_2	NO_x	NMVOC	CO	NH_3	TSP	PM10	PM2.5	Cd	Hg	Pb	PAH	Dioxin	HCB
			[Gg]				[Mg]			[Mg]		[Mg]	[g]	[kg]
1990	0.002	6.09	1.85	1.20	66.12	33 603	9 440	2 256	0.002	0.0003	0.013	0.241	0.178	0.036
1991	0.002	6.32	1.84	1.19	66.78	NR	NR	NR	0.002	0.0003	0.012	0.241	0.178	0.036
1992	0.001	5.96	1.78	1.13	64.40	NR	NR	NR	0.002	0.0003	0.012	0.241	0.178	0.036
1993	0.001	5.72	1.75	1.12	64.34	NR	NR	NR	0.002	0.0003	0.012	0.239	0.176	0.035
1994	0.002	6.13	1.81	1.17	65.27	NR	NR	NR	0.002	0.0003	0.012	0.239	0.176	0.035
1995	0.002	6.19	1.82	1.18	66.86	29 325	8 728	2 033	0.002	0.0003	0.012	0.238	0.175	0.035
1996	0.002	5.86	1.80	1.16	65.08	NR	NR	NR	0.002	0.0003	0.012	0.238	0.175	0.035
1997	0.002	5.92	1.88	1.24	65.35	NR	NR	NR	0.002	0.0003	0.012	0.234	0.172	0.034
1998	0.002	5.92	1.84	1.20	65.40	NR	NR	NR	0.002	0.0003	0.012	0.234	0.172	0.034
1999	0.002	5.76	1.88	1.24	64.15	31 903	9 678	2 188	0.002	0.0003	0.012	0.233	0.171	0.034
2000	0.001	5.61	1.78	1.15	62.68	29 145	8 457	1 989	0.002	0.0003	0.012	0.233	0.171	0.034
2001	0.002	5.57	1.86	1.22	62.47	31 137	8 971	2 094	0.002	0.0003	0.012	0.233	0.171	0.034
2002	0.002	5.51	1.85	1.22	61.38	30 635	8 832	2 057	0.002	0.0003	0.012	0.233	0.171	0.034
2003	0.001	5.41	1.73	1.11	61.19	28 365	8 639	1 964	0.002	0.0003	0.011	0.229	0.168	0.034
2004	0.002	5.26	1.97	1.72	60.72	33 995	9 761	2 249	0.003	0.0004	0.015	0.292	0.213	0.043
2005	0.001	5.22	1.87	1.12	60.39	31 841	9 379	2 144	0.002	0.0003	0.011	0.205	0.151	0.030
Trend														
1990–2005	*-7.6%*	*-14.2%*	*1.3%*	*-7.4%*	*-8.7%*	*-5.2%*	*-0.7%*	*-5.0%*	*-11.2%*	*-10.0%*	*-11.8%*	*-14.9%*	*-15.0%*	*-15.0%*
2004–2005	*-35.0%*	*-0.7%*	*-4.9%*	*-35.3%*	*-0.5%*	*-6.3%*	*-3.9%*	*-4.7%*	*-27.2%*	*-30.0%*	*-25.6%*	*-29.8%*	*-29.1%*	*-29.1%*
National Share														
1990	*0.002%*	*2.9%*	*0.6%*	*0.1%*	*96.1%*	*36.7%*	*19.8%*	*7.9%*	*0.14%*	*0.02%*	*0.01%*	*1.4%*	*0.1%*	*0.04%*
2005	*0.005%*	*2.3%*	*1.2%*	*0.2%*	*94.4%*	*34.9%*	*20.6%*	*8.2%*	*0.18%*	*0.03%*	*0.08%*	*2.3%*	*0.4%*	*0.07%*

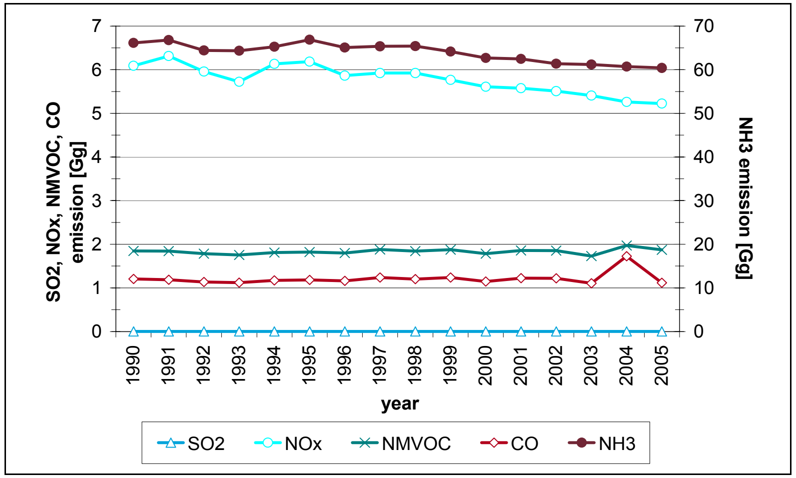


Figure 51: NEC gas emissions and CO emission from NFR Category 4 Agriculture 1990–2005.

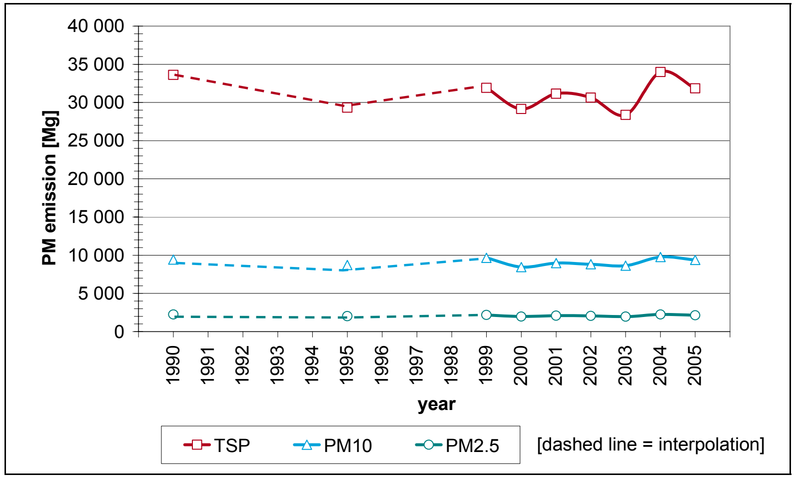


Figure 52: PM emissions from NFR Category 4 Agriculture 1990–2005.

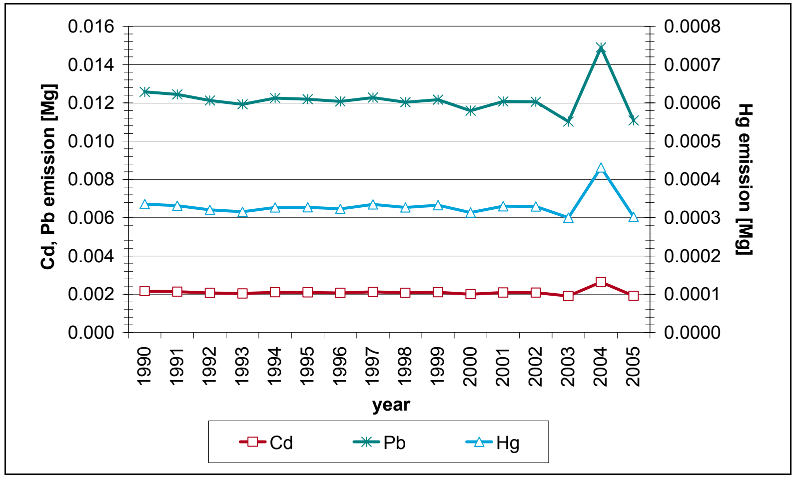


Figure 53: Heavy metal emissions from NFR Category 4 Agriculture 1990–2005.

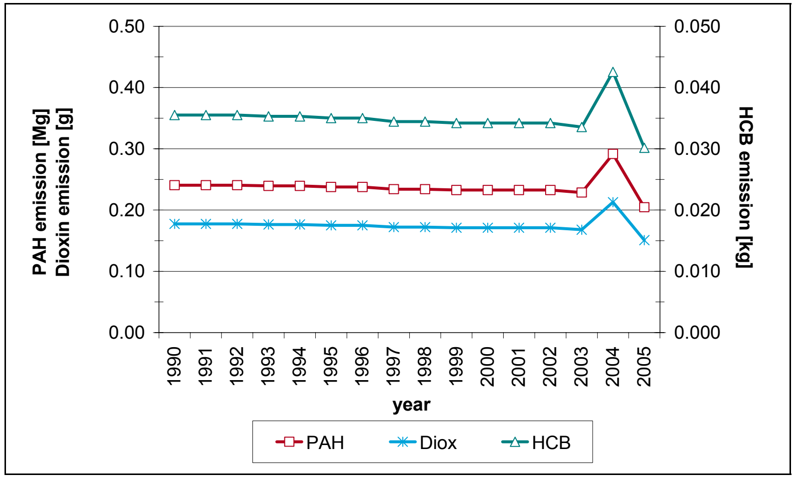


Figure 54: POP emissions from NFR Category 4 Agriculture 1990–2005.

7.3 General description

7.3.1 Methodology

Source Category 4 B

For the calculation of NH_3 emissions from cattle and swine the CORINAIR detailed methodology was applied, NH_3 emissions from the remaining livestock categories were estimated using the CORINAIR simple methodology.

Source Category 4 D

The CORINAIR detailed method was applied for the estimation of NH_3 emissions from synthetic fertilizers as well as from organic fertilizers from the livestock categories cattle and swine. For the remaining livestock categories the CORINAIR simple methodology was applied.

NH_3 emissions from legume cropland were estimated according the CORINAIR detailed methodology, NH_3 emissions from grassland and pastures were calculated using the CORINAIR simple method.

For estimation of NO_x and NMVOC emissions the CORINAIR simple method was used.

Source Category 4 F

For SO_2 and NH_3 the CORINAIR detailed methodology, for CO and NO_x the IPCC default method and for NMVOC a simple national method was used. Concerning heavy metals and POPs simple national methods and national emission factors were applied.

Detailed descriptions of the methodologies applied are presented in the following Chapters.

7.3.2 Uncertainty Assessment

Table 237 presents uncertainties for emissions, for activity data and for emission factors applied. Uncertainties were estimated or provided by the CORINAIR Guidebook (where default values were used for estimating emissions).

Compared to high uncertainties of emission factors, the uncertainty of the underlying statistical activity data is relatively low.

Table 237: Uncertainties of Emissions and Emission Factors (Agriculture).

Categories		NH_3 Emissions	NO_x Emissions	EF NH_3	EF NO_x
4B1a	Dairy Cattle	--	--	+/– 30%[(2)]	--
4B1b	Non-dairy Cattle	--	--	+/– 30%[(2)]	--
4B8	Swine	--	--	+/– 30%[(2)]	--
4B 3/4/6/9	Sheep, Goats, Horses, Poultry	--	--	+/– 30%[(2)]	--
4D	Agricultural Soils	+/– 50%[(3)]	+/– 36%[(3)]	+/– 50%[(2a)]	
4F	Field Burning	--	--	--	--
Activity Data					
	Animal population		+/– 10%[(1)]		
	Agricultural used land		+/– 5%[(1)]		

[(1)] *(WINIWARTER & RYPDAL 2001)*

[(2)] *CORINAIR*

[(2a)] *overall uncertainty of CORINAIR emission factors of all fertilizer types*

[(3)] *Monte Carlo Analysis: 95% probability (GEBETSROITHER et al. 2002)*

7.3.2.1 Recalculations

Update of activity data

4 D 1 Direct Soil Emissions - urea consumption data

Revised urea application data from 2002 to 2004 have been used. In accordance with the other N mineral fertilizer application data, figures now relate to the economic year of the farmers and not to the calendar year.

4 D 1 Direct Soil Emissions – Grazing

Unfertilized grassland area data from 2003 to 2005 has been updated, which resulted in lower NH_3 emissions.

Improvements of methodologies and emission factors

4 B 1 a Dairy

As encouraged in the Draft LRTAP trial Centralized Review 2006, housing systems of dairy cattle have been reviewed: for 2005 a share of dairy cattle held in loose housing systems of 25% and a share of dairy cattle held in tied housing systems of 75% has been applied, which resulted in higher emissions from dairy cattle.

Expert Judgements:

- DI Alfred Pöllinger, Agricultural Research and Education Centre Gumpenstein. November 2006.
- Dr. Leopold Kirner, Federal Institute of Agricultural Economics. Expert judgement (November 2006) based on following study:
  Kirner, L. (2005): Sozioökonomische Aspekte der Milchviehhaltung in Österreich. Studien zu Wettbewerbsfähigkeit, Entwicklungstendenzen und Agrarreform. Schriftenreihe der Bundesanstalt für Agrarwirtschaft Nr. 95. Wien.

4 B 1 b Non-Dairy

Due to quality checks a transcription error of N excretion values from cattle < 1 year has been corrected (25.7 kg instead of 25.3 kg/animal/year). This resulted in slightly higher NH_3 emissions.

7.3.3 Completeness

Table 238 gives an overview of the NFR categories included in this chapter and provides information on the completeness of emission estimates of all sub categories. A "✓" indicates that emissions from this sub category were estimated.

Table 238: Overview of sub categories of Category Agriculture and status of estimation.

NFR Category		Status													
		NEC gases				CO	PM			Heavy metals			POPs		
		NO_x	SO_2	NH_3	NMVOC	CO	TSP	PM10	PM2.5	Cd	Hg	Pb	Dioxin	PAK	HCB
4 B	MANURE MANAGEMENT	NA	NA	✓	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4 B 1	Cattle	NA	NA	✓	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4 B 1 a	Dairy Cattle	NA	NA	✓	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4 B 1 b	Non-Dairy Cattle	NA	NA	✓	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4 B 2	Buffalo	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
4 B 3	Sheep	NA	NA	✓	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4 B 4	Goats	NA	NA	✓	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4 B 5	Camels and Lamas	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
4 B 6	Horses	NA	NA	✓	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4 B 7	Mules and Asses	IE(1)	IE (1)	IE(1)	IE(1)	IE(1)	IE(1)	IE(1)	IE(1)	IE(1)	IE(1)	IE(1)	IE(1)	IE(1)	IE(1)
4 B 8	Swine	NA	NA	✓	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4 B 9	Poultry	NA	NA	✓	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4 B 13	Other	NA	NA	✓	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4 C	RICE CULTIVATION	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
4 D	AGRICULTURAL SOILS	✓	NA	✓	✓	NA	✓	✓	✓	NA	NA	NA	NA	NA	NA
4 D 1	Direct Soil Emissions	✓	NA	✓	✓	NA	✓	✓	✓	NA	NA	NA	NA	NA	NA
4 F	FIELD BURNING OF AGRICULTURAL WASTE	✓	✓	✓	✓	✓	NE	NE	NE	✓	✓	✓	✓	✓	✓
4 G	OTHER	NA	NA	NA	NA	NA	✓	✓	✓	NA	NA	NA	NA	NA	NA

(1) included in 4 B 6 Horses

7.4 NFR 4 B Manure Management

This chapter describes the estimation of NH_3 emissions from housing, storage and spreading of animal excreta.

The sub categories cattle, swine, poultry and sheep contribute significantly to national total NH_3 emissions, and thus are key sources of the Austrian inventory (see the sector overview for emission trends): the share in national total emissions of the year 2005 from these sub categories together was 82.9%. The following table presents the emissions per sub category and their trend from 1990 to 2005.

Table 239: NH_3 emissions and trend from Manure Management 1990–2005 by sub categories and share in National Total.

Year	NH_3 Emissions [Gg] – Livestock Category									
	4 B	**4 B 1**	**4 B 1 a**	**4 B 1 b**	**4 B 3**	**4 B 4**	**4 B 6**	**4 B 8**	**4 B 9**	**4 B 13**
	TOTAL	**Cattle**	**Dairy**	**Non-Dairy**	**Sheep**	**Goats**	**Horses**	**Swine**	**Poultry**	**Other**
1990	58.00	40.53	18.21	22.32	0.79	0.10	0.41	10.59	5.48	0.09
1991	57.89	40.10	17.78	22.32	0.83	0.10	0.48	10.45	5.82	0.09
1992	56.05	38.36	17.23	21.13	0.80	0.10	0.52	10.68	5.50	0.09
1993	56.71	38.27	17.09	21.18	0.85	0.12	0.54	10.97	5.87	0.09
1994	56.51	38.29	16.89	21.40	0.87	0.13	0.56	10.81	5.74	0.10
1995	57.96	39.73	15.72	24.00	0.93	0.14	0.61	10.85	5.60	0.10
1996	56.82	39.18	15.69	23.49	0.97	0.14	0.61	10.59	5.22	0.11
1997	56.93	38.52	16.49	22.04	0.98	0.15	0.62	10.61	5.90	0.14
1998	56.79	38.33	17.00	21.32	0.92	0.14	0.63	10.93	5.71	0.13
1999	55.76	38.34	16.60	21.74	0.90	0.15	0.68	9.85	5.74	0.10
2000	54.59	38.49	15.07	23.42	0.87	0.14	0.68	9.56	4.75	0.10
2001	54.69	37.94	14.85	23.08	0.82	0.15	0.68	9.99	5.01	0.10
2002	53.47	37.21	14.84	22.38	0.78	0.15	0.68	9.54	5.01	0.10
2003	53.90	37.21	14.33	22.88	0.83	0.14	0.73	9.70	5.18	0.11
2004	53.50	37.39	14.11	23.28	0.84	0.14	0.73	9.11	5.18	0.11
2005	53.03	36.65	14.06	22.60	0.83	0.14	0.73	9.38	5.18	0.11
Trend 1990–2005	*-8.6%*	*-9.6%*	*-22.8%*	*1.2%*	*5.1%*	*47.6%*	*77.0%*	*-11.4%*	*-5.4%*	*11.0%*
Share in National Total	***82.9%***	*57.3%*	*22.0%*	*35.3%*	*1.3%*	*0.2%*	*1.1%*	*14.7%*	*8.1%*	*0.2%*

7.4.1 Methodological Issues

Ammonia emissions from cattle and swine are estimated with the CORINAIR detailed methodology, as these are the most important livestock categories. Due to a lack in data availability, NH_3 emissions from the remaining livestock categories were estimated with the CORINAIR simple methodology.

Activity data

Livestock Numbers

The Austrian official statistics (STATISTIK AUSTRIA 2004) provides national data of annual livestock numbers on a very detailed level. These data are based on livestock counts held in December each year[93]. The inherent uncertainty is estimated to be about 5% (FREIBAUER & KALTSCHMITT 2001).

In Table 240 and Table 241 applied animal data are presented. Background information to the data is listed below:

From 1990 onwards
The strong 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. The increased financial support for *suckling cows* results in a shift from dairy to suckling cows (numbers of suckling cows strongly increase).

1991
A minimum counting threshold for *poultry* was introduced. Farms with less than 11 poultry were not counted any more.

The marked 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 (EEA) and the EU guidelines for farm animal population categories. This is the reason why the 1993 data are not fully comparable with the previous data. For example, in 1993 part of the "*Young cattle < 1 yr*" category was included in the "*Young cattle 1–2 yr*". The same cause is the main reason of the shift from "*Young swine < 50 kg*" to "*Fattening pigs > 50 kg*" (before 1993 the limits were 6 months and not 50 kg which led to the shift). Following the recommendations of the Centralized Review 2003, to ensure consistency the age class split for *swine* categories of the years 1990–1992 was adjusted using the split from 1993.

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.

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[93] 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).

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 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 increase of *dairy cattle* numbers is connected with a decrease of *suckling cows* in this period: Statistik Austria derives the *suckling cow* numbers from premium data. The total cow number (dairy + mother cows > 2yr) is based on livestock counts held in December each year. Total cow number less a decreasing suckling cow number from 1996 to 1998 resulted in an increasing dairy cattle number for this period. Reasons are multifarious: BSE epidemic in Europe, changing market prices, 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 240: Domestic livestock population and its trend 1990-2005 (I).

Year	**Population size [heads] ***							
	Livestock Category							
	Dairy	**Non Dairy**	**Suckling Cows > 2yr**	**Young Cattle < 1yr**	**Young Cattle 1–2yr**	**Cattle > 2yr**	**Sheep**	**Goats**
1990	904 617	1 679 297	47 020	925 162	560 803	146 312	309 912	37 343
1991	876 000	1 658 088	57 333	894 111	555 432	151 212	326 100	40 923
1992	841 716	1 559 009	60 481	831 612	521 078	145 838	312 000	39 400
1993	828 147	1 505 740	69 316	705 547	572 921	157 956	333 835	47 276
1994	809 977	1 518 541	89 999	706 579	573 177	148 786	342 144	49 749
1995	706 494	1 619 331	210 479	691 454	564 352	153 046	365 250	54 228
1996	697 521	1 574 428	212 700	670 423	537 382	153 923	380 861	54 471
1997	720 377	1 477 563	170 540	630 853	514 480	161 690	383 655	58 340
1998	728 718	1 442 963	154 276	635 113	496 159	157 415	360 812	54 244
1999	697 903	1 454 908	176 680	630 586	488 283	159 359	352 277	57 993
2000	621 002	1 534 445	252 792	655 368	466 484	159 801	339 238	56 105
2001	597 981	1 520 473	257 734	658 930	455 712	148 097	320 467	59 452
2002	588 971	1 477 971	244 954	640 060	449 932	143 025	304 364	57 842
2003	557 877	1 494 156	243 103	641 640	446 121	163 292	325 495	54 607
2004	537 953	1 513 038	261 528	646 946	441 397	163 167	327 163	55 523
2005	534 417	1 476 263	270 465	628 426	436 303	141 069	325 728	55 100
Trend	**-40.9%**	**-12.1%**	**475.2%**	**-32.1%**	**-22.2%**	**-3.6%**	**5.1%**	**47.6%**

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. It was decided to use the Statistik Austria data, because they are the best available.

Table 241: Domestic livestock population and its trend 1990-2005 (II).

Year	Population size [heads] (1)								
	Livestock Category								
	Horses	**Swine**	**Fattening Pig > 50kg**	**Swine for breeding > 50kg**	**Young Swine < 50kg**	**Poultry**	**Chicken**	**Other Poultry**	**Other**
1990	49 200	3 687 981	1 308 525	382 335	1 997 120	13 820 961	13 139 151	681 810	37 100
1991	57 803	3 637 980	1 290 785	377 152	1 970 044	14 397 143	13 478 820	918 323	37 100
1992	61 400	3 719 653	1 319 744	385 613	2 014 296	13 683 900	12 872 100	811 800	37 100
1993	64 924	3 819 798	1 355 295	396 001	2 068 502	14 508 473	13 588 850	919 623	37 100
1994	66 748	3 728 991	1 323 145	394 938	2 010 908	14 178 834	13 265 572	913 262	37 736
1995	72 491	3 706 185	1 312 334	401 490	1 992 361	13 959 316	13 157 078	802 238	40 323
1996	73 234	3 663 747	1 262 391	398 633	2 002 723	12 979 954	12 215 194	764 760	41 526
1997	74 170	3 679 876	1 268 856	397 742	2 013 278	14 760 355	13 949 648	810 707	56 244
1998	75 347	3 810 310	1 375 037	386 281	2 048 992	14 306 846	13 539 693	767 153	50 365
1999	81 566	3 433 029	1 250 775	343 812	1 838 442	14 498 170	13 797 829	700 341	39 086
2000	81 566	3 347 931	1 211 988	334 278	1 801 665	11 786 670	11 077 343	709 327	38 475
2001	81 566	3 440 405	1 264 253	350 197	1 825 955	12 571 528	11 905 111	666 417	38 475
2002	81 566	3 304 650	1 187 908	341 042	1 775 700	12 571 528	11 905 111	666 417	38 475
2003	87 072	3 244 866	1 243 807	334 329	1 666 730	13 027 145	12 354 358	672 787	41 190
2004	87 072	3 125 361	1 159 501	317 033	1 648 827	13 027 145	12 354 358	672 787	41 190
2005	87 072	3 169 541	1 224 053	315 731	1 629 757	13 027 145	12 354 358	672 787	41 190
Trend	**77.0%**	**-14.1%**	**-6.5%**	**-17.4%**	**-18.4%**	**-5.7%**	**-6.0%**	**-1.3%**	**11.0%**

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

Manure Management Systems

In Austria national statistics on manure management systems are not available. Up to now, only one comprehensive survey has been carried out (KONRAD 1995). This manure management system distribution was used for the whole period from 1990–2004.

MMS are distinguished for *Dairy Cattle*, *Suckling Cows* and *Cattle 1–2 years* in "summer situation" and "winter situation" (Table 242). During the summer months, a part of the manure from these livestock categories is managed in "pasture/range/paddock". The value for "pasture/range/paddock" is estimated as follows: During summer, 14.1% of Austrian dairy cows and suckling cows are on alpine pastures 24 hours a day. 43.6% are on pasture for 4 hours a day and 42.3% stay in the housing for the whole year (KONRAD 1995). "Alpine pasture" and "pasture" are counted together as MMS "pasture/range/paddock". As "pasture" only lasts for about 4 hours a day, only 1/6 of the dairy cow pasture (43.6%) is added to the total number. This results in 21.3% "pasture/range/paddock" during summer. In winter, "pasture/range/paddock" does not occur in Austria. Summer and winter both last for six months.

Table 242: Manure Management System distribution in Austria: Cattle and Swine.

Livestock category	Liquid/Slurry [%]	Solid Storage [%]	Pasture/range/paddock [%]
dairy cattle summer	16.7[(1)]	62.0[(1)]	21.3[(1)]
dairy cattle winter	21.2[(1)]	78.8[(1)]	--
Dairy cattle winter/summer	18.95[(1)]	70.4[(1)]	10.65[(1)]
suckling cows summer	16.7[(1)]	62.0[(1)]	21.3[(1)]
suckling cows winter	21.2[(1)]	78.8[(1)]	--
suckling cows winter/summer	18.95[(1)]	70.4[(1)]	10.65[(1)]
cattle 1–2 years summer	7.7[(1)]	39.9[(1)]	52.4[(1)]
cattle 1–2 years winter	16.2[(1)]	83.8[(1)]	--
cattle 1–2 years winter/summer	11.95[(1)]	61.85[(1)]	26.2[(2)]
cattle < 1 year	28.75[(1)]	71.25[(1)]	--
non dairy cattle > 2 years	48.6[(1)]	51.4[(1)]	--
breeding sows	70[(2)]	30[(2)]	--
fattening pigs	71.9[(1)]	28.1[(1)]	--

[(1)] *„Die Rinder-, Schweine- und Legehennenhaltung in Österreich aus ethologischer Sicht" (KONRAD 1995)*

[(2)] *Estimation of Dipl.-Ing. Alfred Pöllinger (Agricultural Research Centre Gumpenstein) following (KONRAD 1995)*

Estimation of NH_3 emissions includes one additional aspect: the differentiation between tied and loose housing systems for dairy cattle. NH_3 emissions from tied systems are much lower than from loose housing systems.

Following (KONRAD 1995) at the beginning of the 1990ies in Austria 98% of the dairy cattle were kept in tied systems. Thus, 98% of N was excreted in tied systems and 2% in loose housing systems. As encouraged in the Draft LRTAP trial Centralized Review 2006, in this inventory housing systems of dairy cattle have been reviewed: Based on a study (KIRNER 2005) and expert judgements (Pöllinger & Kirner 2006, see below) for the year 2005 a share of dairy cattle held in loose housing systems of 25% and a share of dairy cattle held in tied housing systems of 75% has been applied. To ensure consistency of time series, the share continuously has been adjusted from 1994 onwards.

For the whole period 1990-2005 all other cattle livestock categories are assumed to be housed in loose housing systems.

As there are currently no exact data available on manure management systems in Austrian animal husbandry, manure management system distribution within these two systems (solid system, liquid system, grazing) is assumed to be the same.

Expert Judgements:

- DI Alfred Pöllinger, Agricultural Research and Education Centre Gumpenstein. Nov. 2006.
- Dr. Leopold Kirner, Federal Institute of Agricultural Economics. Expert judgement (Nov. 2006) based on (KIRNER 2005).

7.4.1.1 Cattle (4 B 1) and Swine (4 B 8)

In the detailed methodology, the flow of total ammoniacal nitrogen (TAN or mineral N) is followed through the manure management system. The relative volumes of flow through the different pathways are determined by country-specific information on animal husbandry and manure management systems, while the proportion volatilised as ammonia at each stage in the system is treated as a percentage, based on measured values and expert judgement. The detailed methodology requires input data of animal numbers, nitrogen excretion and manure management systems.

Total NH_3 emissions from Category *4 B 1* and *4 B 8* are calculated as follows:

$$NH_{3\ Total} = NH_{3\ (housing)} + NH_{3\ (storage)} + NH_{3\ (spreading)}$$

NH_3 emissions from housing

NH_3 emissions from dairy cattle are estimated by multiplying N excretion with an emission factor for solid storage and liquid slurry systems, respectively:

NH_3-N (solid storage) = Nex (solid storage) x EF(ss)

NH_3-N (liquid slurry) = Nex (liquid slurry) x EF(ls)

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

NH_3 (housing) = [NH_3-N (solid storage) + NH_3-N (liquid slurry)] x (17/14)

N excretion by manure management system

Country-specific N excretion rates for Austrian *cattle* and *swine* were calculated using following formula.

N excretion per animal waste management system:

$$\mathbf{Nex_{(AWMS)} = \sum\nolimits_{(T)} [N_{(T)} \times Nex_{(T)} \times AWMS_{(T)}]}$$

$Nex_{(AWMS)}$	=	*N excretion per animal waste management system [kg yr^{-1}]*
$N_{(T)}$	=	*number of animals of type T in the country (see Table 240 and Table 241)*
$Nex_{(T)}$	=	*N excretion of animals of type T in the country [kg N animal^{-1} yr^{-1}] (see Table 243, Table 244)*
$AWMS_{(T)}$	=	*fraction of $Nex_{(T)}$ that is managed in one of the different distinguished animal waste management systems for animals of type T in the country (see Table 248)*
(T)	=	*type of animal category*

N excretion

N excretion values as shown in Table 243 and Table 244 base on following literature: (GRUBER & POETSCH 2005), (PÖTSCH et al. 2005), (STEINWIDDER & GUGGENBERGER 2003), (UNTERARBEITSGRUPPE N-ADHOC 2004) and (ZAR 2004). Values consider the typical agricultural practice in Austria.

Year	Milk yield [kg yr^{-1}]	Nitrogen excretion [kg/animal*yr]	Year	Milk yield [kg yr^{-1}]	Nitrogen excretion [kg/animal*yr]
1980	3 518	74.16	1998	4 924	86.82
1990	3 791	76.62	1999	5 062	88.06
1991	3 862	77.26	2000	5 210	89.39
1992	3 934	77.90	2001	5 394	91.05
1993	4 005	78.54	2002	5 487	91.88
1994	4 076	79.18	2003	5 638	93.24
1995	4 619[(1)]	84.07	2004	5 802	94.72
1996	4 670	84.53	2005	5 783	94.55
1997	4 787	85.58			

Table 243: Austria specific N excretion values of dairy cows for the period 1990-2005 and for 1980.

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

According to the requirements of the European nitrate directive, the Austrian N excretion data were 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 practical farms consulting representatives of the working groups "Dairy production". These groups are managed by well-trained advisors. Their members, i.e. farmers, regularly exchange their knowledge and experience. Forage quality is based on field studies, carried out in representative grassland and dairy farm areas. The calculations depend on feeding ration, gain of weight, nitrogen and energy uptake, efficiency, duration of livestock keeping etc.

Sheep and goats

life weight, daily gain of weight, degree of pregnancy or lactating, feeding rations.

Pigs

breeding pigs, piglets, boars, fattening pigs: number and weight of piglets, daily gain of weight, energy content of feeding, energy and nitrogen uptake, N-reduced feeding.

Poultry

feeding ration, duration of keeping, nitrogen uptake, nitrogen efficiency.

Horses

feeding ration per horse category, weight of horses.

Table 244: Austria specific N excretion values of other livestock categories.

Livestock category	Nitrogen excretion [kg N per animal per yr]	Livestock category	Nitrogen excretion [kg N per animal per yr]
suckling cows[(1)]	69.5	sheep	13.1
cattle 1–2 years	53.6	goats	12.3
cattle < 1 year	25.7	horses	47.9
cattle > 2 years	68.4	Chicken[(2)]	0.52
breeding sows	29.1	other poultry [3()]	1.1
fattening pigs	10.3	other livestock/deer[(4)]	13.1

[(1)] *corresponds to an average yearly milk yield of 3 000kg (Grabner et al. 2004; Steinwidder et al. 2006)*

[(2)] *weighted average of hens and broilers*

[(3)] *weighted average of turkeys and other (ducks, gooses)*

[(4)] *N-ex value of sheep applied*

Livestock numbers per category can be found in Table 240 and Table 241, manure management system distribution for *cattle* and *swine* can be found in Table 242.

Emission Factors

Table 245 gives emission factors for NH_3 emissions from animal housing. As far as possible, Swiss default values as given in the CORINAIR guidelines have been chosen to compile the Austrian inventory. Swiss animal husbandry is closest to Austrian animal husbandry. If no CORINAIR emission factors from Switzerland were available, the CORINAIR German default values were used.

Table 245: Emission factors for NH_3 emissions from animal housing used in the Austrian inventory.

Manure management system	CORINAIR Emission factor [kg NH_3-N (kg N excreted)$^{-1}$]
Dairy cattle, tied systems, liquid slurry system	0.040[(1)]
Dairy cattle, tied systems, solid storage system	0.039[(1)]
Diary cattle, loose houses, liquid slurry system	0.118[(1)]
Diary cattle, loose houses, solid storage system	0.118[(1)]
Other cattle, loose houses, liquid slurry system	0.118[(1)]
Other cattle, loose houses, solid storage system	0.118[(1)]
Fattening pigs, liquid slurry system	0.150[(2)]
Fattening pigs, solid storage system	15% of total N + 30% of the remaining TAN[(2)]
Sows plus litter, liquid slurry system	0.167[(1)]
Sows plus litter, solid storage system	0.167[(1)]

[(1)] *DÖHLER et al. 2001*

[(2)] *EIDGENÖSSISCHE FORSCHUNGSANSTALT 1997*

NH_3 emissions from storage

NH_3 emissions from storage are estimated from the amount of N left in the manure when the manure enters the storage. This amount of N is calculated as following:

- From total N excretion the N excreted during grazing (see above) and
- the NH_3-N losses from housing (see above) are subtracted;
- the remaining N enters the store.

TAN content in excreta

The detailed method makes use of the total ammoniacal nitrogen (TAN) when calculating emissions. The initial share of TAN must be known as well as any transformation rates between organic N and TAN. TAN content for Austrian cattle and pig manure is given in SCHECHTNER 1991.

Table 246: TAN content for Austrian cattle and pig manure after (SCHECHTNER 1991).

Manure	TAN content for Austria [%]	Manure	TAN content for Austria [%]
cattle – solid storage system	15.0	pig – solid storage system	19.5
cattle – liquid slurry system	50.0	pig – liquid slurry system	65.0

Emission Factors

During manure storage, NH_3 is lost. These losses are estimated with CORINAIR default emission factors given in Table 247.

Table 247: NH_3-emission factors for manure storage.

Manure storage system	CORINAIR Emission factor [kg NH_3-N (kg TAN)$^{-1}$]
Cattle, liquid slurry system	0.15
Cattle, solid storage system	0.30
Pigs, liquid slurry system	0.12
Pigs, solid storage system	0.30

Source: EIDGENÖSSISCHE FORSCHUNGSANSTALT 1997

Emission factors only distinguish between cattle and pigs and between liquid slurry systems and solid storage systems (farmyard manure). According to the CORINAIR guidelines, uncertainties in ammonia emission factors are about ± 30%.

A more accurat estimation of NH_3 emissions only is possible when new information on Austria's agricultural practice are available. A comprehensive investigation concerning this matter currently is carried out by the University of Natural Resources and Applied Life Sciences, Vienna.

Amount of manure N left for spreading on agricultural soils

Manure application is connected with NH_3 and N_2O losses that depend on the amount of manure N. The amount of N left in the manure after housing and storage is calculated as follows.

From total N excretion by Austrian livestock the following is subtracted:

- NH_3-N losses from the housing (see above);
- NH_3-N losses during manure storage (see above);
- N_2O-N losses from manure management (see NIR 2007);
- N excreted during grazing (see formula N excretion per animal waste management system given in chapter "NH_3 emissions from housing").

The remaining N (calculated for each relevant animal category) is spread to agricultural soils ("manure N left for spreading"). In Table 248 the nitrogen left for spreading for the years 1990–2005 per animal type is presented.

Table 248: Animal manure left for spreading on agricultural soils per livestock category 1990-2005.

Year	Nitrogen left for spreading [Mg N per year]													
	IPCC Livestock Categories													
	total	dairy cattle	suckling cows	cattle 1–2 a	cattle < 1 a	cattle > 2 a	sows	fattening pigs	chicken	other poultry	sheep	goats	horses/solipeds	other animals
1990	141 271	55 395	2 398	18 215	19 501	8 193	8 525	10 334	8 100	1 057	5 909	712	2 225	708
1991	141 025	54 091	2 924	18 041	18 846	8 468	8 409	10 194	8 309	1 424	6 217	781	2 614	708
1992	136 509	52 406	3 084	16 925	17 529	8 167	8 598	10 423	7 935	1 259	5 948	752	2 776	708
1993	138 091	51 985	3 535	18 609	14 872	8 845	8 829	10 704	8 377	1 426	6 365	902	2 935	708
1994	137 708	51 217	4 589	18 617	14 893	8 332	8 806	10 450	8 178	1 416	6 523	949	3 018	720
1995	140 276	47 351	10 733	18 330	14 575	8 570	8 952	10 364	8 111	1 244	6 964	1 034	3 278	769
1996	137 956	46 926	10 847	17 454	14 131	8 619	8 888	9 970	7 530	1 186	7 261	1 039	3 311	792
1997	138 344	48 985	8 697	16 711	13 297	9 054	8 868	10 021	8 600	1 257	7 314	1 113	3 354	1 073
1998	137 656	50 182	7 867	16 116	13 387	8 815	8 613	10 860	8 347	1 189	6 879	1 035	3 407	961
1999	135 142	48 665	9 010	15 860	13 292	8 924	7 666	9 878	8 506	1 086	6 716	1 106	3 688	746
2000	131 602	43 884	12 891	15 152	13 814	8 949	7 453	9 572	6 829	1 100	6 468	1 070	3 688	734
2001	130 925	42 967	13 143	14 802	13 889	8 293	7 808	9 985	7 339	1 033	6 110	1 134	3 688	734
2002	127 928	42 636	12 491	14 614	13 491	8 009	7 604	9 382	7 339	1 033	5 803	1 103	3 688	734
2003	128 376	40 913	12 397	14 490	13 525	9 144	7 454	9 823	7 616	1 043	6 206	1 042	3 937	786
2004	127 360	40 008	13 337	14 337	13 636	9 137	7 069	9 157	7 616	1 043	6 237	1 059	3 937	786
2005	126 065	39 606	13 792	14 171	13 246	7 900	7 040	9 667	7 616	1 043	6 210	1 051	3 937	786

Calculation of NH_3 emissions from manure application on agricultural soils

For *cattle and swine* the CORINAIR detailed methodology was applied.

This method distinguishes between the kind of waste produced by each animal sub category: solid manure and liquid slurry. This is relevant, because TAN contents and therefore NH_3 emissions are highly dependent on the quality of waste and organic matter content in slurry. Furthermore, the detailed methodology suggests different NH_3-emission-factors depending on the target of land spreading: emissions are thought to be higher on grassland soils than on cropland soils, due to infiltration of applied animal waste being slower there.

$$NH_3\text{-}N_{spread} = N_{exLFS} * (Frac_{SS} * F_{TAN\ SS} * EF\text{-}NH_{3\ spread\ SS} + Frac_{LS} * F_{TAN\ LS} * EF\text{-}NH_{3\ spread\ LS})$$

NH_3-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 <u>not</u> include nitrogen from grazing animals*
$Frac_{SS}$	=	*Fraction of nitrogen left for spreading produced as farmyard manure in a solid waste management system*
$Frac_{LS}$	=	*Fraction of nitrogen left for spreading produced as liquid slurry in a liquid waste management system*
$F_{TAN\ SS}$	=	*Fraction of total ammoniacal nitrogen (TAN) in animal waste produced in a solid waste management system*
$F_{TAN\ LS}$	=	*Fraction of total ammoniacal nitrogen (TAN) in animal waste produced as slurry in a liquid waste management system*
EF-$NH_{3\ spread\ SS}$	=	*Emission factor for NH_3 from animal waste from solid manure system (farmyard manure) spread on agricultural soils (see below)*
EF-$NH_{3\ spread\ LS}$	=	*Emission factor for NH_3 from animal waste from liquid slurry waste management system spread on agricultural soils (see below)*

No appropriate Austrian specific data were available to use different emission factors depending on the target of spreading, i.e. whether animal waste is spread on grassland or cropland soils. Thus, following assumptions were made:

- To avoid underestimation of emissions, emission factors for spreading without incorporation were used.
- Animal waste from solid systems (farmyard manure) is spread on cropland soils only. This is in compliance with CORINAIR detailed method, which does not provide an emission factor for spreading of solid waste on grassland soils.
- For liquid slurry it was assumed, that cattle slurry is applied to grassland soils, while pig slurry is applied to arable soils. This assumption is driven by the idea, that feed for pig husbandry is produced on cropland soils, while fertilized grassland soils serve as feed producing area for cattle husbandry.

CORINAIR default NH_3 emission factors for spreading of slurry and farmyard manure (expressed as share of TAN):

- Cattle .... spreading of liquid slurry on grassland 0.60
- Pigs .... spreading of liquid slurry on arable land 0.25
- Cattle and Pigs ...... spreading of solid manure (arable land) 0.90

7.4.1.2 Sheep (4 B 3), Goats (4 B 4), Horses (4 B 6), Poultry (4 B 9) and Other Animals (4 B 13)

The CORINAIR simple methodology uses an average emission factor per animal for each livestock category and multiplies this factor by the number of animals counted in the annual agricultural census. Table 249 presents the recommended ammonia emission factors for the different livestock categories given in the CORINAIR guidelines. Emission factors include emissions from housing and storage. The calculation of NH_3 emissions from manure application on agricultural soils is described below.

Table 249: CORINAIR default ammonia emission factors (simple methodology) manure management.(1)

NFR	Livestock category	NH_3 loss housing [kg NH_3 $head^{-1}$ yr^{-1}]	NH_3 loss storage [kg NH_3 $head^{-1}$ yr^{-1}]
4 B 3	Sheep(2)	0.24	
4 B 4	Goats(2)	0.24	
4 B 6	Horses (mules and asses included)	2.9	
4 B 9	Laying hens	0.19	0.03
4 B 9	Other Poultry (ducks, geese, turkeys)	0.48	0.06
4 B 13	Other animals	0.24	

(1) *Emissions are expressed as kg NH_3 per animal, as counted in the annual agricultural census*

(2) *The emission factors are calculated for female adult animals; the emissions of the young animals are included in the given values.*

The CORINAIR guidelines do not give default values for NH_3 emissions from the livestock category *Other Animals*. In Austria deer dominates this livestock category. As sheep is the most similar livestock category to deer, for *Other Animals* the NH_3 emission factor of sheep is used.

CORINAIR distinguishes the livestock category "chicken" into "laying hens" and "broilers". In Austria chicken numbers are not distinguished. Thus, NH_3 emissions from both laying hens and broilers are estimated with the laying hen emission factor (and therefore slightly overestimated).

Amount of manure N left for spreading on agricultural soils

The amount of N left in the manure after housing and storage is presented in Table 248.

Calculation of NH_3 emissions from manure application on agricultural soils

For *Sheep, Horses* and *Poultry* the CORINAIR simple methodology is applied.

The share of mineral N (total ammoniacal nitrogen, TAN) is estimated by application of a default factor for each animal waste category. NH_3 losses are derived in a second step based on TAN values by application of a CORINAIR default emission factor ($EF\text{-}NH_{3\ spread}$), which is also dependent on the quality of animal waste.

$$NH_3\text{-}N_{spread} = N_{exLFS} * Frac_{TAN} * EF\text{-}NH_{3\ spread}$$

NH_3-N $_{spread}$	=	*Emissions of NH_3-N, driven by intentional spreading of animal waste from manure management systems on agricultural soils (droppings of grazing animals are not included) [t N]*
N_{exLFS}	=	*Annual amount of nitrogen in animal excreta left for spreading on agricultural soils, corrected for losses during manure management; it does not include nitrogen from grazing animals*
$Frac_{TAN}$	=	*Fraction of total ammoniacal nitrogen (= mineral nitrogen) in animal manure (CORINAIR 1996)*
EF-$NH_{3\ spread}$	=	*Emission factor for NH_3 volatised from spreading of mineral nitrogen (CORINAIR 1996)*

7.4.2 Uncertainties

Uncertainties are presented in Table 237.

7.4.3 Recalculations

As encouraged in the Draft LRTAP trial Centralized Review 2006, housing systems of dairy cattle have been reviewed (see chapter 7.4.1): for 2005 a share of dairy cattle held in loose housing systems of 25% and a share of dairy cattle held in tied housing systems of 75% has been applied, which resulted in higher emissions from dairy cattle. To ensure consistency of time series, the share continuously has been adjusted from 1994 onwards.

Due to quality checks a transcription error of N excretion values from cattle < 1 year has been corrected (25.7 kg instead of 25.3 kg/animal/year). This resulted in slightly higher NH_3 emissions.

Table 250: Difference to last submission of NH_3 emissions from sub categories of Category 4 B.

Year	NH_3 Emissions [Gg]		
	4 B Total	4 B 1 a Dairy	4 B 1 b Non-Dairy
1990	0.14	0.00	0.14
1991	0.14	0.00	0.14
1992	0.13	0.00	0.13
1993	0.11	0.00	0.11
1994	0.15	0.04	0.11
1995	0.23	0.12	0.11
1996	0.30	0.20	0.10
1997	0.39	0.29	0.10
1998	0.48	0.38	0.10
1999	0.55	0.46	0.10
2000	0.59	0.49	0.10
2001	0.65	0.55	0.10
2002	0.72	0.62	0.10
2003	0.76	0.67	0.10
2004	0.82	0.72	0.10

7.4.4 Planned Improvements

A comprehensive investigation on Austria's agricultural practice currently is carried out by the Department of Sustainable Agricultural Systems – Division of Agricultural Engineering, University of Natural Resources and Applied Life Sciences, Vienna. New results are planned to implement in the Austrian Air Emission Inventory.

7.5 NFR 4 D Agricultural Soils

This chapter describes the estimation of ammonia (NH_3), nitrogen oxide (NO_x), non-methane volatile organic compounds (NMVOC), and particulate matter (PM) emissions from source category *Agricultural Soils*. In the following table a short description regarding pollutant sources is given.

NH_3	• Processes of oxidation and reductation of nitrogen lead to emissions of ammonia and nitrous oxide. N-inputs play an important role in determination of N-species emissions.
NO_x	• microbiological activities • fertilizer use
NMVOC	Three categories of sources of NMVOC may be distinguished: • activities that emit NMVOCs by combustion or evaporation; • land clearing, including burning; • biogenic processes.
PM	• tillage operation and harvesting activities • transportation and stock transfer • animal husbandry • other activities

The source category *Agricultural Soils* is a key source of the Austrian inventory regarding TSP, PM10 and PM2.5 emissions with a share in national total emissions of 30.1%, 12.7% and 5.2%, NH_3 emissions with a share of 11.5% and NO_x emissions with a share of 2.3% in the year 2004 (emission trends are presented and explained in the chapter 1.

7.5.1 Methodological Issues

Emissions of NH_3, NO_x and NMVOC were calculated following the CORINAIR methodology. Wherever feasible, the „detailed methodology" as recommended by CORINAIR has been applied. Detailed descriptions of the methodologies applied are given in the following subchapters, the methodology for estimating PM emissions is presented in a separate chapter (Chapter 7.6).

Activity Data

Data for necessary input parameters (activity data) were taken from the following sources.

Table 251: Data sources for nitrogen input to Agricultural Soils.

Category	Data Sources
Synthetic Fertilizers (mineral fert.)	Mineral N fertilizer consumption: 47. Grüner Bericht (BMLFUW 2006)[(1)]; urea application in Austria: Sales data RWA, 2006[(2)]
Animal Waste applied to soils	The amount of manure left for spreading was calculated within source category 4 B following (AMON et al. 2002)
N- fixing Crops	Cropped area legume production: (BMLFUW 2006)[(1)]
Agricultural Land Use	BUNDESANSTALT FÜR AGRARWIRTSCHAFT 2006[(3)]
Grazing Animals	Calculations within source category 4 B are based on (AMON et al. 2002)

[(1)] http://www.gruenerbericht.at and http://www.awi.bmlf.gv.at

[(2)] RWA: Raiffeisen Ware Austria

[(3)] http://www.awi.bmlf.gv.at

Mineral Fertilizer Application

Detailed data about the use of different kind of fertilizers are available until 1994, because until then, a fertilizer tax („Düngemittelabgabe") had been collected. Data about the total mineral fertilizer consumption are available for amounts (but not for fertilizer types) from the statistical office (Statistik Austria) and from an agricultural marketing association (Agrarmarkt Austria, AMA). Annual sales figures about urea are available for the years 1994 onwards from a leading fertilizer trading firm (RWA). These sources were used to get a time series of annual fertilizer application distinguishing urea fertilizers and other N-fertilizers ("mineral fertilizers").

The high inter-annual variations are caused by the effect of storage: Fertilizers have a high elasticity to prices. Sales data are changing very rapidly due to changing market prices. Not the whole amount purchased is applied in the year of purchase. The fertilizer tax intensivied this effect at the beginning of the 1990s.

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 252.

Table 252: Mineral fertilizer N consumption in Austria 1990–2005 and arithmetic average of each two years.

Year	Annual Nutrient Sales Data [t N/yr]	Of which Urea	Data Source	Weighted Nutrient Consumption [t N/yr]	Weighted Urea Consumption [t N/yr]
1989	133 304	1 700	FAO		
1990	140 379	3 965	estimated, GB[(1)]	136 842	2 833
1991	180 388	3 965	GB[(1)]	160 384	3 965
1992	91 154	3 886	GB[(1)]	135 771	3 926
1993	123 634	3 478	GB[(3)], RWA[(2)]	107 394	3 682
1994	177 266	4 917	GB[(3)], RWA[(2)]	150 450	4 198
1995	128 000	5 198	GB[(4)], RWA[(2)]	152 633	5 058
1996	125 300	4 600	GB[(5)], RWA[(2)]	126 650	4 899
1997	131 800	6 440	GB[(5)], RWA[(2)]	128 550	5 520
1998	127 500	6 440	GB[(5)], RWA[(2)]	129 650	6 440

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]
1999	119 500	6 808	GB[5], RWA[2]	123 500	6 624
2000	121 600	3 848	GB[5], RWA[2]	120 550	5 328
2001	117 100	3 329	GB[5], RWA[2]	119 350	3 589
2002	127 600	4 470	GB[5], RWA[2]	122 350	3 900
2003	94 400	6 506	GB[5], RWA[2]	111 000	5 488
2004	100 800	7 293	GB[5], RWA[2]	97 600	6 900
2005	99 700	7 673	GB[5], RWA[2]	100 250	7 483

(1) (BMLFUW 2000)

(2) Raiffeisen Ware Austria, sales company

(3) (BMLFUW 2003)

(4) (BMLFUW 2005)

(5) (BMLFUW 2006)

Land use and legume production

The yearly numbers of the legume cropping areas are taken from official statistics (BMLFUW 2006). Data of agricultural land use are taken from the datapool of (BUNDESANSTALT FÜR AGRARWIRTSCHAFT 2006).

Table 253: Legume cropping areas and agricultural land use 1990–2005.

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	1 848	709

Legume harvest data were taken from (BMLFUW 2006) and are presented in Table 254.

Table 254: Legume harvest data 1990–2005.

Year	**Harvest [1000 t]**			
	clover-hey	**soja bean**	**horse-/fodder bean**	**peas**
1990	717	18	41	145
1991	797	37	37	133
1992	587	81	31	137
1993	628	103	29	107
1994	743	105	27	134
1995	823	31	17	60
1996	858	27	10	93
1997	962	34	6	162
1998	1 014	51	5	178
1999	1 025	50	6	140
2000	1 440	33	7	97
2001	1 349	34	7	112
2002	1 395	35	9	96
2003	1 425	39	9	93
2004	1 474	45	8	122
2005	1 515	61	10	90

7.5.1.1 Application of fertilizers

Synthetic fertilizers

NH_3

For the calculation of NH_3 emissions from synthetic fertilizers CORINAIR detailed methodology was applied. This method uses specific NH_3 emission factors for different types of synthetic fertilizers and for different climatic conditions (see CORINAIR Emission Inventory Guidebook, Tab 5.1, p. B1010-15; 'Group III countries'). According to CORINAIR, Austria belongs to Group III '*temperate and cool temperate countries*' with largely acidic soils.

In Austria, full time-series data only for urea and non-urea synthetic N fertilizers (see Table 252), 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, which is based on measured fertilizer losses, of 0.3% (i.e. 0.003 t NO_x-N per ton applied fertilizer-N) is used.

Organic Fertilizers

NO_x losses from animal manure spreading are not addressed explicitly in the CORINAIR Guidebook. (FREIBAUER & KALTSCHMITT 2001) suggest in their calculation of an European greenhouse gas inventory a conservative estimate of 1% of manure nitrogen being emitted in the form of NO_x-N. Following these recommendations, an emission factor of 0.01 t NO_x-N per ton of organic fertilizer-N spread on agricultural soils is used. In the Austrian inventory resulting NO_x-emissions are reported under NFR category *4 D Agricultural Soils*.

In compliance with the CORINAIR Guidelines NH_3 emissions from manure application on agricultural soils are reported under *4 B Manure Management* (see chapter 7.4.1 – land spreading of animal excreta).

NMVOC from fertilized cultures

NMVOC emissions from agricultural crops and grassland were estimated. For the calculations of NMVOC from fertilized and unfertilized vegetation the same method was applied. The method is described in chapter 7.5.1.2 under 'NMVOC emissions from vegetation'.

7.5.1.2 Unfertilized cultures

Legume cropland

NH_3

The CORINAIR detailed methodology using the CORINAIR default emission factor of 0.01 t of NH_3-N per ton of N was applied. The amount of N-input to soils via N-fixation of legumes (F_{BN}) was estimated on the basis of the cropping areas and specific consideration of nitrogen fixation rates of all relevant N-fixing crops:

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

F_{BN} = *Annual amount of nitrogen input to agricultural soils from N-fixation by legume crops [t]*

LCA = *Legume cropping area [ha]*

B_{Fix} = *Annual biological nitrogen fixation rate of legumes [kg/ha]*

Activity values (LCA) for the years 1990–2005 can be found in Table 253. Values for biological nitrogen fixation (120 kg N/ha for peas, soja beans and horse/field beans and 160 kg N/ha for clover-hey, respectively) were taken from a publication made by the Umweltbundesamt (GÖTZ 1998); these values are constant over the time series.

NO_x

According to the CORINAIR guidebook definition, unfertilized cropland includes legume production on agricultural areas. For the calculation of NO_x emissions from unfertilized cropland the CORINAIR simple methodology was applied.

Nitrogen input through legume crop residues is calculated according to the CORINAIR recommended procedure. Nitrogen fixed in biomass, given in annual harvest data (see Table 254) is multiplied with the expansion factor for crop residues (GÖTZ 1998). The same NO_x emission factor as for emissions from synthetic fertilizers was applied (0.003 t NO_x-N per ton applied fertilizer-N).

Grassland and Pastures

The CORINAIR simple methodology was applied. According to the CORINAIR Guidebook, unfertilized pasture grassland represents areas that receive nitrogen through manure from grazing animals but no fertilizer inputs. For these areas the CORINAIR default value of 4 kg NH_3-N per ha was applied.

NMVOC emissions from vegetation

CORINAIR simple methodology was applied. Biogenic emissions from vegetation canopies of natural grasslands are derived as described in the following equation (CORINAIR 1999, p. B 1104-7, Table 4.1). This method is also suggested to be applied for fertilized cultures.

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

E-NMVOC = *Annual NMVOC emissions from vegetation [t]*

CA = *Cropping area of vegetation [ha]*

ε–NMVOC = *NMVOC potential emission rate per unit of dry matter and time unit [mg/dry matter.hours]*

D = *Foliar biomass density [t dry matter/ha]*

Γ = *Time integral (over 6 or 12 months) of emission hours. This value includes a correction variable that represents the effect of short-term temperature and solar radiation changes [hours].*

Aboveground biomass of agricultural crops was calculated using official cropping area (see Table 253) and expansion factors for leaves. For simplification, wheat was considered to be representative for the vegetation cover of agricultural crop land (see Table 255).

Table 255: Cereal production in Austria [t/ha].

Year	harvest per area	Year	harvest per area
	[t/ha]		[t/ha]
1990	5.58	1998	5.70
1991	5.46	1999	5.95
1992	5.16	2000	5.42
1993	5.10	2001	5.87
1994	5.40	2002	5.85
1995	5.51	2003	5.27
1996	5.40	2004	6.53
1997	5.92	2005	6.17

Table 256: 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–isoε-mtsε-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 255)

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

7.5.2 Uncertainties

The uncertainties presented in Table 257 were calculated by Monte Carlo analysis, using a model implemented with the software @risk. The model uses a probability distribution as an input value instead of a single fixed value. Probability of results: 95%.

Table 257: Uncertainties of NH_3 and NO_x emissions from acricultural soils.

Direct soil emissions	Uncertainty	
	NH_3	NO_x
Mineral fertilizer application	102%	36%
Animal waste application	40%	
Unfertilized cultures	54%	
Total	**50%**	**36%**

The overall uncertainty for 4 D was calculated to be around 50% for NH_3 and 36% for NO_x.

7.5.3 Recalculations

Update of activity data

4 D 1 Direct Soil Emissions - urea consumption data

Revised urea application data from 2002 to 2004 have been used. In accordance with the other N mineral fertilizer application data, figures now relate to the economic year of the farmers and not to the calendar year.

4 D 1 Direct Soil Emissions – Grazing

Unfertilized grassland area data from 2003 to 2005 has been updated, which resulted in lower NH_3 emissions.

Table 258: Difference to last submission of NH_3 and NO_x emissions from Category 4 D Agricultural Soils.

Year	4 D 1 Direct Soil Emissions [Gg]		Year	4 D 1 Direct Soil Emissions [Gg]	
	NH_3	NO_x		NH_3	NO_x
1990	0.00	0.01	1998	0.00	-0.01
1991	0.00	0.01	1999	0.00	-0.01
1992	0.00	0.01	2000	0.00	-0.01
1993	0.00	0.01	2001	0.00	-0.01
1994	0.00	0.01	2002	-0.07	-0.01
1995	0.00	0.00	2003	-0.83	-0.01
1996	0.00	0.00	2004	-0.60	-0.02
1997	0.00	0.00			

Recalculations within sector *4 B Manure Management* resulted in slightly differing NO_x emissions from manure application on agricultural soils compared to the last submission (see chapter 7.4.3).

Note: Following the CORINAIR guidelines, NH_3 emissions from land spreading of animal excreta are reported under source category *4 B Manure Management* (see Chapter 7.4.1).

7.5.4 Planned Improvements

A comprehensive investigation on Austria's agricultural practice currently is carried out by the Department of Sustainable Agricultural Systems – Division of Agricultural Engineering, University of Natural Resources and Applied Life Sciences, Vienna. New results are planned to implement in the Austrian Air Emission Inventory.

7.6 NFR 4 D Particle Emissions from Arable Farming

This source includes particle emissions from arable farming producing food and non food plants and fruits. Emissions of pollens, spores and soil particles from wind erosion are not included as they are considered as natural sources. Emissions from movement on unpaved roads and emissions due to the input of agrochemicals and the consumption of fuels are not included in this source category but in NFR 3 and NFR 1 A, respectivly.

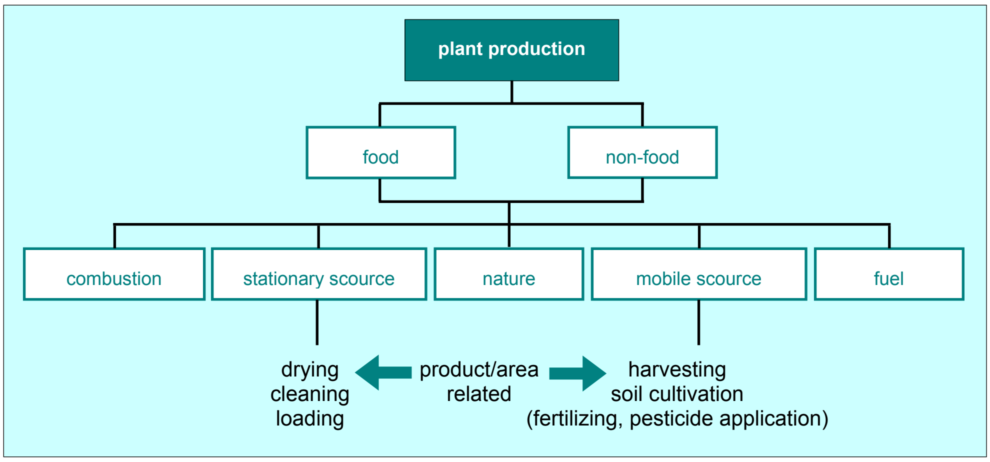


Figure 55: Types of sources of particle emissions from Agricultural Soils (NFR 4 D).

Emissions of particulate matter from arable farming are caused by several sources, which are stationary or mobile and encapsulated or diffuse sources are considered in relationship with the treated areas or the amount of products.

The following sources for PM emissions from NFR *4 D Agriculture Soils* were identified:

- tillage operation: ploughing, harrowing, drilling, manuring, …;
- harvesting activities: threshing, hay and straw harvesting, drying, …;
- transportation and stock transfer of dusting agricultural good: cereals and fertilizer, feed and litter, …;
- post-harvest treatment;
- animal husbandry: dust from hay, straw, wood chips, animal scalls and hair, spores, …; (these emissions belong to NFR 4 G);
- bacteria, mite, pollen, soil particles … from wind erosion: these emissions are not included in the national total as tey are considered in natural sources;
- exhaust gas emissions of tractors (these emissions belong to NFR 1A4).

7.6.1 Methodological Issues

Due to lack of data PM emission estimations were only a method following the "First estimate"-methodology (HINZ 2004, 2005):

In plant production total emissions result from emissions of certain steps of work such as harvesting, post harvest treatment and soil cultivation. The specific emission factors for the different steps can be related to the area treated or the yield; to calculate emissions per year, the different specific emission factors for each production/ treatment step are summed up to give product (or area) related emissions of a year.

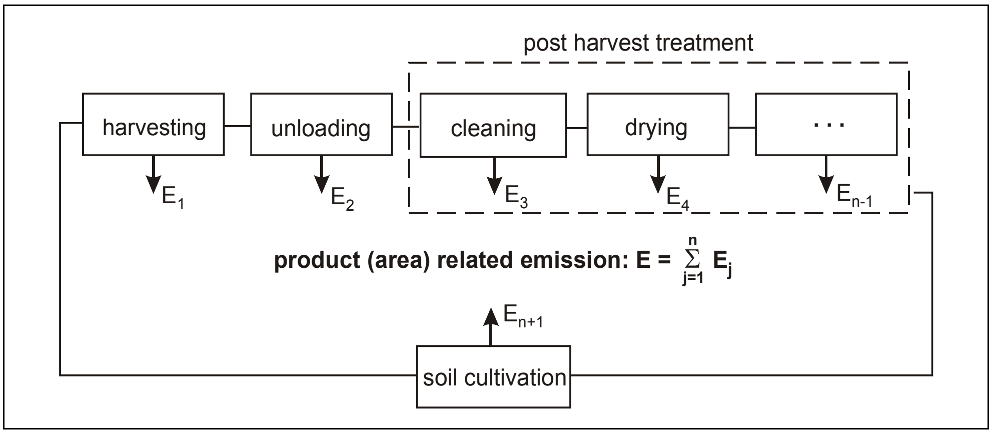


Figure 56: Scheme for PM emissions from plant production.

Not for all particulate matter fractions emission factors were available. Following factors have been used for conversion:

Harvesting and stationary plants: PM2.5 .... TSP * 5% (HINZ 2002)

Soil Cultivation: TSP .... PM10 / 45% (WINIWARTER et al. 2001)
PM2.5 .... TSP * 3.6% (WINIWARTER et.al. 2001)

Harvesting

A major source of PM emissions in plant production are harvest activities. Table 259 gives the mean emission factors taken from (HINZ 2005) used in the Austrian Air Emission Inventory. Emission factors are based on measures of dust emissions of a combined harvester with working conditions of one ha/h and a 6 t yield (HINZ 2005).

Table 259: Mean emission factors of combine harvesting of cereals.

	TSP	PM10	PM2.5
Emission Factor [g/t]	5 128	924	256

Post harvest treatment

Stationary sources for PM in post harvest treatment are unloading, drying and cleaning. Mean emission factors listed in following table were taken from (HINZ 2005).

Table 260: Mean emission factors of stationary units in crop production.

Source	EF TSP [g/t]	EF PM10 [g/t]	EF PM2.5 [g/t]
unloading	38.0	19.0	1.9
drying	120.0	77.5	6.0
cleaning	52.0	26.0	2.6

Soil cultivation

Soil cultivation gives a further part of emissions. Specific plume model based emission factors (HINZ 2005) are listed in following table.

Table 261: EF for Soil Cultivation: Plume Model.

	TSP	PM10	PM2.5
Emission Factor [g/t]	1.057	0.48	0.038

Activity Data

Agricultural land use and harvest data are taken from the datapool of (BUNDESANSTALT FÜR AGRARWIRTSCHAFT 2006).

Table 262: Arable Farm Land and Harvest of Cereals in Austria 1990–2005.

Arable Farm Land and Cereal Production					
Year	**arable farm land [1000 ha]**	**cereal harvest [1000 t]**	**Year**	**arable farm land [1000 ha]**	**cereal harvest [1000 t]**
1990	1 408	5 290	1998	1 386	4 771
1991	1 427	5 045	1999	1 386	4 806
1992	1 418	4 323	2000	1 382	4 490
1993	1 402	4 206	2001	1 380	4 827
1994	1 403	4 436	2002	1 379	4 745
1995	1 403	4 452	2003	1 380	4 246
1996	1 403	4 493	2004	1 379	5 295
1997	1 386	5 009	2005	1 380	4 880

7.6.2 Uncertainties

No uncertainty can be given for the first estimates.

7.6.3 Recalculations

In this inventory for the calculation of emissions from soil cultivation the total arable farm land area has been used as activity data (instead of cereal area only). This resulted in higher emissions of TSP, PM10 and PM2.5.

Table 263: Difference to last submission of TSP and PM emissions from Category 4 D Agricultural Soils.

4 D 1 Direct Soil Emissions [Gg]							
Year	**TSP**	**PM10**	**PM2.5**	**Year**	**TSP**	**PM10**	**PM2.5**
1990	485.38	220.51	17.47	2001	588.84	267.51	21.20
1995	629.21	285.85	22.65	2002	600.09	272.62	21.60
1999	610.74	277.46	21.99	2003	607.09	275.80	21.86
2000	585.29	265.90	21.07	2004	600.53	272.82	21.62

7.7 NFR 4 F Field Burning of Agricultural Waste

This category comprises burning straw from cereals and residual wood of viniculture on open fields in Austria.

Burning agricultural residues on open fields in Austria is legally restricted by provincial law and since 1993 additionally by federal law and is only occasionally permitted on a very small scale. Therefore the contribution of emissions from the category *Field Burning of Agricultural Waste* to total emissions is very low (below 0.5%), except for PAH emissions where this source category is a key source with a contribution of 2.3% to national total emissions in 2005.

7.7.1 Methodological Issues

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 (IPCC 1997). For residue/crop product the default ratio of 1.3 (wheat) was taken (IPCC GPG 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 1996, 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}
- Pb ....0.48 mg/kg dm_{straw}
- Hg ....0.013 mg/kg dm_{straw}.

The fraction of dry matter burned was estimated by applying the residue/crop product ratio of 1.3 (wheat) taken from (IPCC GPG Table 4-16). For the dry matter content of cereals an Austrian specific value of 0.86 was used (LÖHR 1990).

POPs (PAH, HCB, dioxin/furan)

A country specific method was applied (HÜBNER 2001b). National emission factors were taken from HÜBNER (2001b):

- PAH ....70 000 mg/ha
- PCDD/F ..50 µgTE/ha
- HCB ....10 000 µg/ha.

Viniculture

SO_2, NO_x, NMVOC and NH_3

A country specific method was applied. National emission factors for SO_2, NO_x and NMVOC were taken from (JOANNEUM RESEARCH 1995). A calorific value of 7.1 MJ/kg burnt wood which corresponds to burning wood logs in poor operation furnace systems was used to convert the emission factors from [kg/TJ] to [kg/Mg]. The NH_3 emission factor of 1.9 kg per ton burnt wood was taken from (CORINAIR 1996). Table 264 presents the resulting emission factors.

Table 264: 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}
- Pb ....2.35 mg/kg dm_{wood}
- Hg ....0.038 mg/kg dm_{wood}.

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.

Activity Data

According to the *Presidential Conference of the Austrian Chambers of Agriculture* (personal communication to Dr. Reindl 2004 & 2006), 2004 about 3 400 ha and 2005 about 2 160 ha of straw fields were burnt. This corresponds to about 0.3% of total area under cereals 2005. For the years before an average value of 2 500 ha was indicated. Cereal crop yield data per ha is given in Table 255.

Activity data of viniculture area are taken from the Statistical Yearbooks 1992–2002 (Statistik Austria) and (BMLFUW 2006). 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 265: Activity data for 4 F Field Burning of Agricultural Waste 1990–2005.

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	47 572	3 568

7.7.2 Uncertainities

No uncertainty can be given.

7.8 NFR 4 G Particle Emissions from Animal Husbandry

Particle Matter (PM) Emissions from Animal Husbandry (Dairy cattle, Other cattle, Fattening pigs, Sows, Horses, Laying hens, Broilers)

7.8.1 Source Category Description

Emissions of particulate matter (PM) occur from both housed and free-range livestock animals. According to the CORINAIR Guidelines the following calculation provides an estimation of primary particle emissions from (forced and natural) ventilated animal housing systems. Due to the lack of reliable data, emissions from free-range animals, and storage and application of solid and liquid animal manures are not yet included.

7.8.2 Methodological Issues

The CORINAIR first estimate methodology was used (EEA 2005).

Particle emissions can be related to the number of animal places according to

$$E_{PM} = \sum_{ij} n_{ij} \cdot x_{t,i} \cdot EF_{PM,ij}$$

E_{PM}	*emission of PM from animal husbandry (in kg a^{-1} PM)*
n_{ij}	*number of animal places in an animal category i according to the census (in places) in a housing type j*
$x_{t,I}$	*time fraction, during which animals of category i are housed (in a a^{-1})*
$EF_{PM,ij}$	*emission factor for a given animal category i and housing type j (in kg $place^{-1}$ a^{-1} PM)*

For grazing periods, particle emissions from cattle, pigs, sheep and horses are considered to be negligible. The emissions are to be calculated assuming that the emissions are directly related to the time the animals are housed.

In the CORINAIR Guidebook, only PM10 and PM2.5 EF are available. The TSP EF was derived using a conversion factor of 1.2 to transform amounts of PM10 yields into total dust concentrations (SEEDORF 2004).

Table 266: CORINAIR first estimate emission factors for particle emissions from animal husbandry.

		Emission Factor		
Animal Category	**Housing Type**	**PM10 [kg/animal/year]**	**PM2.5 [kg/animal/year]**	**TSP [kg/animal/year]**
Dairy Cattle	Tied or litter	0.36	0.23	0.432
	Cubicles (slurry)	0.70	0.45	0.84
Beef Cattle	Solid	0.24	0.16	0.288
	Slurry	0.32	0.21	0.384
Calves	Solid	0.16	0.10	0.192
	Slurry	0.15	0.10	0.18
Sows	Solid	0.58	0.094	0.696
	Slurry	0.45	0.073	0.54
Fattening pigs	Solid	0.50	0.081	0.60
	Slurry	0.42	0.069	0.504
Horses	Solid	0.18	0.12	0.216
Laying hens	Cages	0.017	0.0021	0.0204
	Perchery	0.27	0.052	0.324
Broilers	Solid	0.35	0.045	0.42

Activity data

Livestock Numbers

The Austrian official statistics (STATISTIK AUSTRIA 2005) provides national data of annual livestock numbers on a very detailed level (see Table 240and Table 241).

Housing Type

Housig types and grazing periods for *Cattle* and *Swine* were taken from (KONRAD 1995, see Table 242). Data of laying hens husbandry were derived from the (AUSTRIAN CHAMBER OF AGRICULTURE 2006) and (STATISTIK AUSTRIA 2006).

7.8.3 Uncertainties

No uncertainty can be given for this first estimate methodology. The emission factors are a first estimate only.

8 WASTE (NFR SECTOR 6)

8.1 Sector Overview

This chapter includes information on and descriptions of methodologies applied for estimating emissions of NEC gases, CO, heavy metals, persistent organic pollutants (POPs) and particulate matter (PM), as well as references for activity data and emission factors concerning waste management and treatment activities reported under NFR Category *6 Waste* for the period from 1990 to 2005.

Emissions addressed in this chapter include emissions from the sub categories

- *Solid Waste Disposal on Land* (NFR Sector 6 A);
- *Wastewater Handling* (NFR Sector 6 B), where no emissions were reported;
- *Waste Incineration* (NFR Sector 6 C), which comprises the incineration of corpses, municipal waste, and waste oil;
- *Other* (NFR Sector 6 D), which comprises sludge spreading and compost production.

NH_3 and CO emissions of this source have been identified as key category. The following Table 267 presents the results of the key source analysis of the Austrian inventory with regard to the contribution to national total emissions (for details of the key source analysis see Chapter 1.4).

Table 267: Contribution to National Total Emissions from NFR sector 6 Waste in 2005.

Pollutant	Source Category: 6 Waste	Pollutant	Source Category: 6 Waste
SO_2	0.2%	PAH	< 0.1%
NO_x	< 0.1%	Diox	0.4%
NMVOC	0.1%	HCB	0.1%
NH_3	**1.6%**	TSP	0.2%
CO	**0.9%**	PM10	0.2%
Cd	0.1%	PM2.5	0.1%
Hg	2.1%		
Pb	0.1%		

8.2 Emission trend

In Figure 57 to Figure 60 and in Table 268 to Table 272 the emissions and trends from NFR Sector 6 *Waste* and sub-sectors for the year 1990 to 2005 are listed.

The overall noted emission trend reflects changes in waste management policies and changes in waste treatment facilities. Especially the Landfill Ordinance[94] shows its impact. Waste has to be treated before landfilled (in order to reduce the organic carbon content) which causes higher amounts of waste being incinerated or undergoing a biological treatment and results in decreasing amounts of waste going to landfills. That's why NH_3 emissions from category 6 A are decreasing. NO_x, NMVOC

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

and NH_3 emissions from Waste Incineration without energy recovery are decreasing although amounts of incinerated waste increases but the resulting emissions are taken into account in Sector 1 (as energy is recovered). The increase of NH_3 emissions from category 6 D compost is due to an increase in separate collection of organic waste and in mechanical biological treatment of waste.

- Primary measures
  - waste avoidance in housholds: 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; subsititution 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;
  - fermantation of biogenic material;
  - energetic use in waste incineration.

8.2.1 NEC Gases and CO

8.2.1.1 SO_2

In 1990 national SO_2 emissions of the Sector *Waste* amounted to 0.07 Gg; emissions have decreased since then and by the year 2005 emissions were reduced by about 20% to 0.06 Gg.

In the year 2005 the *Sector Waste* contributed only 0.2% to Austria's SO_2 emissions. NFR Sector 6 C *Waste incineration* is the only source of SO_2 emissions.

8.2.1.2 NO_x

The share of NO_x emissions from this sector in national total emissions was about less than 0.1% in 1990 as well as in 2005. As shown in the tables mentioned above, NO_x emissions from the w*aste* sector decreased by about 50% over the period from 1990 to 2005 to 0.05 Gg.

The only source for NO_x emissions of NFR Category *6 Waste* is NFR Sector 6 C *Waste Incineration*.

8.2.1.3 NMVOC

In 2005, NMVOC emissions of sector *Waste* only contribute less than 0.1% (0.09 Gg) to Austrian total NMVOC emissions. From 1990 to 2005 NMVOC from NFR Sector 6 *Waste* decreased by 47%.

In 2005, 97% of the NMVOC emissions from the Sector W*aste* arose from NFR Sector 6 A, and 3% from NFR Sector 6 C.

Table 268: Emissions and trends from Sector 6 Waste by gas (SO_2, NO_x and NMVOC) and source categories 1990–2005.

Year	SO_2 [Gg]		NO_x [Gg]		NMVOC [Gg]		
	6	6 C	6	6 C	6	6 A	6 C
1990	0.071	0.071	0.103	0.103	0.161	0.150	0.011
1991	0.057	0.057	0.087	0.087	0.160	0.150	0.011
1992	0.037	0.037	0.060	0.060	0.149	0.146	0.003
1993	0.041	0.041	0.052	0.052	0.146	0.144	0.003
1994	0.048	0.048	0.045	0.045	0.138	0.136	0.002
1995	0.049	0.049	0.046	0.046	0.131	0.128	0.002
1996	0.051	0.051	0.046	0.046	0.124	0.122	0.002
1997	0.053	0.053	0.047	0.047	0.118	0.116	0.002
1998	0.055	0.055	0.048	0.048	0.114	0.112	0.002
1999	0.057	0.057	0.049	0.049	0.109	0.107	0.003
2000	0.057	0.057	0.049	0.049	0.105	0.102	0.003
2001	0.057	0.057	0.049	0.049	0.101	0.098	0.003
2002	0.057	0.057	0.049	0.049	0.099	0.096	0.003
2003	0.057	0.057	0.050	0.050	0.100	0.097	0.003
2004	0.057	0.057	0.051	0.051	0.093	0.090	0.003
2005	0.057	0.057	0.052	0.052	0.086	0.083	0.003
Trend							
1990–2005	*-20.4%*	*-20.4%*	*-49.6%*	*-49.6%*	*-46.5%*	*-44.3%*	*-75%*
2004–2005	*< 0.1%*	*< 0.1%*	*0.8%*	*0.8%*	*-7.1%*	*-7.4%*	*1.5%*
Share in Sector Waste							
1990		*100%*		*100%*		*93%*	*7%*
2005		*100%*		*100%*		*97%*	*3%*
Share in National Total							
1990	*0.10%*	*0.10%*	*0.05%*	*0.05%*	*0.06%*	*0.05%*	*< 0.01%*
2005	*0.21%*	*0.21%*	*0.02%*	*0.02%*	*0.06%*	*0.10%*	*0.01%*

8.2.1.4 CO

In 2005, CO emissions of sector *Waste* only contribute about 1% (6.3 Gg) to the Austrian total CO emissions. From 1990 to 2005, CO emissions from NFR Sector 6 *WASTE* decreased by about 45%.

In 2005, within this source NFR Sector 6 A *Managed Waste Disposal* has a share of 99.5% in total CO emissions. NFR Sector 6 C *Waste incineration* has a share of 0.5% in total CO emissions.

8.2.1.5 NH_3

In 1990 national NH_3 emissions of the Sector *Waste* amounted to about 0.4 Gg; emissions increased by about 163% to about 1 Gg in 2005 mainly due to increasing compost production. In the year 2005 the Sector W*aste* contributed 1.7% to Austria's NH_3 emissions.

Within this source NFR Sector 6 A *Managed Waste Disposal* and NFR Sector 6 C *Waste incineration* have each a share of less than 0.1% in total NH_3 emissions. NFR Sector 6 D *Other* (compost production) has a share of about 1.6% in total NH_3 emissions.

Table 269: Emissions and trends from Sector 6 Waste for NH_3 and CO and source categories 1990–2005.

Year	CO [Gg]			NH_3 [Gg]			
	6	6 A	6 C	6	6 A	6 C	6 D
1990	11.37	11.32	0.051	0.378	0.005	0.000	0.372
1991	11.35	11.30	0.050	0.392	0.005	0.000	0.386
1992	11.01	11.00	0.010	0.449	0.005	0.000	0.444
1993	10.86	10.85	0.009	0.539	0.005	0.000	0.534
1994	10.27	10.26	0.008	0.624	0.005	0.000	0.619
1995	9.71	9.70	0.008	0.643	0.004	0.000	0.638
1996	9.19	9.18	0.008	0.666	0.004	0.000	0.662
1997	8.75	8.74	0.008	0.649	0.004	0.000	0.645
1998	8.43	8.42	0.008	0.669	0.004	0.000	0.665
1999	8.08	8.07	0.008	0.706	0.004	0.000	0.702
2000	7.73	7.72	0.008	0.729	0.003	0.000	0.726
2001	7.41	7.40	0.008	0.745	0.003	0.000	0.741
2002	7.28	7.27	0.008	0.760	0.003	0.000	0.757
2003	7.37	7.36	0.010	0.872	0.003	0.000	0.868
2004	6.82	6.80	0.012	0.802	0.003	0.000	0.799
2005	6.31	6.30	0.013	0.993	0.003	0.000	0.990
Trend							
1990–2005	*-44.5%*	*-44.3%*	*-74.9%*	*163.0%*	*-44.3%*	*33.5%*	*165.9%*
2004–2005	*-7.4%*	*-7.4%*	*4.5%*	*23.8%*	*-7.4%*	*< 0.1%*	*24.0%*
Share in Sector Waste							
1990		*99.5%*	*0.5%*		*1.3%*	*0.1%*	*98.6%*
2005		*99.8%*	*0.2%*		*0.3%*	*< 0.1%*	*99.7%*
Share in National Total							
1990	*0.93%*	*0.93%*	*< 0.01%*	*0.55%*	*0.01%*	*< 0.01%*	*0.54%*
2005	*0.88%*	*0.87%*	*< 0.01%*	*1.55%*	*<0.01%*	*< 0.01%*	*1.55%*

8.2.2 Persistent organic pollutants – POPs

Emissions of the persistent organic pollutants (POPs) PAH, dioxin/furan and HCB from Sector NFR *6 Waste* are not rated as key sources of the Austrian Inventory.

As shown in Figure 60 and Table 272 in the period from 1990 to 2005

- **PAH** emissions decreased by about 89% to 0.028 kg, which is a share of less than 0.1% in total PAH emissions;
- **dioxin/furan** emissions decreased by about 99% to 0.159 g, which is a share of about 0.4% in total dioxin/furan emissions, whereas in 1990 dioxin/furan emissions still contribute 11.4% to the total dioxin/furan emissions;
- **HCB** emissions decreased by 91% to 0.032 kg, which is a share of less than 0.1% in total HCB emissions.

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

The significant decrease is a result of waste management policies, as waste has to be treated before landfilled according to the landfill directive; the amount of land filled waste has decreased during the period.

8.2.3 Heavy Metals – Cd, Hg, Pb

Emissions of the heavy metals Cd, Hg and Pb from NFR *6 Waste* are not rated as key sources of the Austrian Inventory. As shown in Figure 59, Table 270and Table 272 in the period from 1990 to 2005

- **Cd** emissions decreased by about 97% to 1.49 kg, which is a share of 0.1% in total Cd emission. The emission trend from 2004 to 2005 amount to -4%.
- **Hg** emissions decreased by about 62% to 20.61 kg, which is a share of about 2.1% in total Hg emission. The emission trend from 2004 to 2005 amount to 7%.
- **Pb** emissions decreased by about 99% to 8.76 kg, which is a share of about 0.1% in total Pb emission. The emission trend from 2004 to 2005 amount to -1%.

Within this source the NFR Sector 6 C *Waste Incineration* is the main source of POP emissions. Another but small source is NFR Sector 6 A *Solid Waste Disposal on Land.*

The significant decrease is a result of waste management policies, as waste has to be treated befor landfilled according to the landfill directive; the amount of land filled waste has decreased during the period. In the years 2004 and 2005 the amount of land filled waste increased again mainly due to clean up operations of old landfills.

Table 270: Emissions and trends from Sector 6 Waste for heavy metals and source categories 1990–2005.

Year	Cd [kg]			Hg [kg]			Pb [kg]		
	6	6 A	6 C	6	6 A	6 C	6	6 A	6 C
1990	59.18	1.50	57.68	53.59	0.01	53.58	1 015.83	1.50	1 014.33
1991	48.43	1.50	46.93	45.54	0.01	45.53	777.59	1.50	776.09
1992	5.31	1.46	3.85	23.89	0.01	23.88	488.33	1.46	486.88
1993	4.62	1.44	3.18	22.80	0.01	22.80	381.10	1.44	379.67
1994	3.90	1.36	2.54	21.43	0.01	21.42	265.71	1.36	264.35
1995	1.94	1.28	0.65	20.28	0.01	20.27	9.19	1.28	7.91
1996	1.87	1.22	0.66	18.25	0.01	18.24	9.13	1.22	7.91
1997	1.81	1.16	0.66	16.06	0.01	16.05	9.08	1.16	7.92
1998	1.77	1.12	0.66	13.97	0.01	13.96	9.04	1.12	7.92
1999	1.73	1.07	0.66	12.07	0.01	12.06	9.00	1.07	7.93
2000	1.68	1.02	0.66	10.02	0.01	10.02	8.95	1.02	7.93
2001	1.64	0.98	0.66	9.78	0.01	9.78	8.91	0.98	7.93
2002	1.62	0.96	0.66	9.95	0.01	9.94	8.89	0.96	7.93
2003	1.63	0.97	0.66	14.63	0.01	14.62	8.90	0.97	7.93
2004	1.56	0.90	0.66	19.31	0.01	19.30	8.83	0.90	7.93
2005	1.49	0.83	0.66	20.61	0.01	20.60	8.76	0.83	7.93
Trend									
1990–2005	*-97.5%*	*-44.3%*	*-98.9%*	*-61.5%*	*-44.3%*	*-61.5%*	*-99.1%*	*-44.3%*	*-99.2%*
2004–2005	*-4.3%*	*-7.4%*	*< 0.1%*	*6.7%*	*-7.4%*	*6.7%*	*-0.8%*	*-7.4%*	*< 0.1%*
Share in Sector Waste									
1990		*2.5%*	*97.5%*		*0.02%*	*99.98%*		*0.1%*	*99.9%*
2005		*55.9%*	*44.1%*		*0.03%*	*99.97%*		*9.5%*	*90.5%*
Share in National Total									
1990	*3.9%*	*0.1%*	*3.8%*	*2.5%*	*< 0.1%*	*2.5%*	*0.5%*	*< 0.1%*	*0.5%*
2005	*3.3%*	*0.1%*	*3.2%*	*1.0%*	*< 0.1%*	*1.0%*	*< 0.1%*	*< 0.1%*	*< 0.1%*

8.2.4 Particulate matter (PM) – TSP, PM10, PM2.5

Emissions of TSP, PM10, PM2.5 from NFR Sector *6 Waste* are not rated as key sources of the Austrian Inventory. As shown in Figure 58, Table 271 and Table 272 in the period from 1990 to 2005

- **TSP** emissions decrease by about 11% to about 149 Mg, which is a share of 0.2% in total TSP emission. The emission trend from 2004 to 2005 amount to 5%.
- **PM10** emissions decrease by about 12% to about 71 Mg, which is a share of 0.2% in total PM10 emission. The emission trend from 2004 to 2005 amount to 5%.
- **PM2.5** emissions decrease of about 15% to about 22 Mg, which is a share of 0.1% in total PM2.5 emission. The emission trend from 2004 to 2005 amount to about 5%.

Within this source NFR 6 A *Solid Waste Disposal on Land* is the only source, except for 1990 where 6 C contribute 1.2%, 2.5% and 5.6% to TSP, PM10 and PM2.5. Emissions vary according to underlying activity data.

Table 271: Emissions and trends from Sector 6 Waste by TSP, PM10, PM2.5 and source categories 1990–2005.

Year	TSP [Mg]			PM10 [Mg]			PM2.5 [Mg]		
	6	6 A	6 C	6	6 A	6 C	6	6 A	6 C
1990	167.89	165.94	1.95	80.26	78.50	1.76	26.17	24.71	1.46
1995	184.26	184.26		87.17	87.17		27.44	27.44	
1999	75.39	75.39		35.67	35.67		11.23	11.23	
2000	112.40	112.40		53.18	53.18		16.74	16.74	
2001	109.17	109.17		51.65	51.65		16.26	16.26	
2002	126.75	126.75		59.96	59.96		18.87	18.87	
2003	154.27	154.27		72.99	72.99		22.97	22.97	
2004	191.67	191.67		90.68	90.68		28.54	28.54	
2005	184.04	184.04		87.07	87.07		27.40	27.40	
Trend									
1990–2005	*9.6%*	*10.9%*	*-100%*	*8.5%*	*10.9%*		*4.7%*	*10.9%*	
2004–2005	*-4.0%*	*-4.0%*		*-4.0%*	*-4.0%*		*-4.0%*	*-4.0%*	
Share in Sector Waste									
1990		*98.8%*	*1.2%*		*97.8%*	*2.2%*		*94.4%*	*5.6%*
2005		*100.0%*			*100.0%*			*100.0%*	
Share in National Total									
1990	*0.2%*	*0.2%*	*< 0.1%*	*0.2%*	*0.2%*	*< 0.1%*	*0.1%*	*0.1%*	
2005	*0.2%*	*0.2%*		*0.2%*	*0.2%*		*0.1%*	*0.1%*	

Table 272: Emissions and trends from Sector 6 Waste 1990–2005.

Year	SO_2	NO_x	NMVOC	NH_3	CO	TSP	PM10	PM2.5	Cd	Hg	Pb	PAH	Dioxin	HCB
	[Gg]					[Mg]			[kg]		[Mg]	[kg]	[g]	[kg]
1990	0.071	0.103	0.161	0.378	11.37	167.89	80.26	26.17	59.18	53.59	1.016	0.246	18.190	0.392
1991	0.057	0.087	0.160	0.392	11.35				48.43	45.54	0.778	0.241	17.752	0.275
1992	0.037	0.060	0.149	0.449	11.01				5.31	23.89	0.488	0.016	0.529	0.106
1993	0.041	0.052	0.146	0.539	10.86				4.62	22.80	0.381	0.018	0.220	0.045
1994	0.048	0.045	0.138	0.624	10.27				3.90	21.43	0.266	0.021	0.082	0.017
1995	0.049	0.046	0.131	0.643	9.71	184.26	87.17	27.44	1.94	20.28	0.009	0.021	0.083	0.017
1996	0.051	0.046	0.124	0.666	9.19				1.87	18.25	0.009	0.022	0.082	0.017
1997	0.053	0.047	0.118	0.649	8.75				1.81	16.06	0.009	0.023	0.081	0.017
1998	0.055	0.048	0.114	0.669	8.43				1.77	13.97	0.009	0.023	0.080	0.017
1999	0.057	0.049	0.109	0.706	8.08	75.39	35.67	11.23	1.73	12.07	0.009	0.024	0.080	0.017
2000	0.057	0.049	0.105	0.729	7.73	112.40	53.18	16.74	1.68	10.02	0.009	0.024	0.079	0.017
2001	0.057	0.049	0.101	0.745	7.41	109.17	51.65	16.26	1.64	9.78	0.009	0.024	0.077	0.016
2002	0.057	0.049	0.099	0.760	7.28	126.75	59.96	18.87	1.62	9.95	0.009	0.024	0.078	0.016
2003	0.057	0.050	0.100	0.872	7.37	154.27	72.99	22.97	1.63	14.63	0.009	0.026	0.117	0.024
2004	0.057	0.051	0.093	0.802	6.82	191.67	90.68	28.54	1.56	19.31	0.009	0.028	0.156	0.032
2005	0.057	0.052	0.086	0.993	6.31	184.04	87.07	27.40	1.49	20.61	0.009	0.028	0.166	0.034
Trend														
1990–2005	*-20%*	*-50%*	*-47%*	*163%*	*-44%*	*10%*	*8%*	*5%*	*-97%*	*-62%*	*-99%*	*-89%*	*-99%*	*-91%*
2003–2005	*0%*	*1%*	*-7%*	*24%*	*-7%*	*-4%*	*-4%*	*-4%*	*-4%*	*7%*	*-1%*	*2%*	*7%*	*7%*
National Share														
1990	*0.1%*	*0.0%*	*0.1%*	*0.5%*	*0.9%*	*0.2%*	*0.2%*	*0.1%*	*3.8%*	*2.5%*	*0.5%*	*1.4%*	*11.4%*	*0.4%*
2005	*0.2%*	*0.0%*	*0.1%*	*1.6%*	*0.9%*	*0.2%*	*0.2%*	*0.1%*	*0.1%*	*2.1%*	*0.1%*	*0.3%*	*0.4%*	*0.1%*

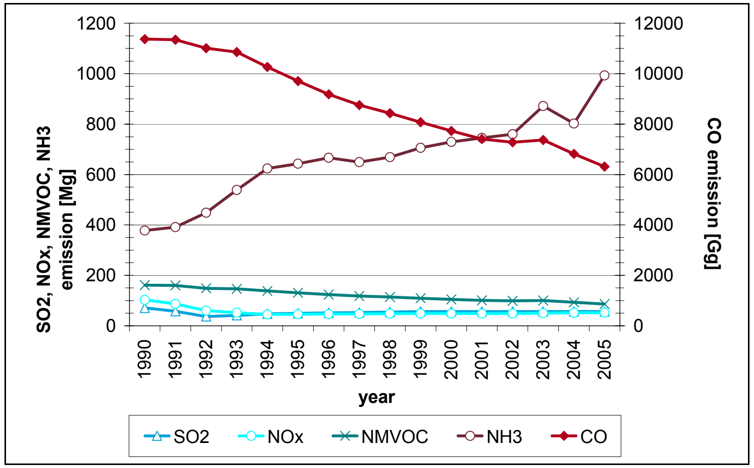


Figure 57: NEC gas emissions and CO emission from NFR Category 6 Waste 1990–2005.

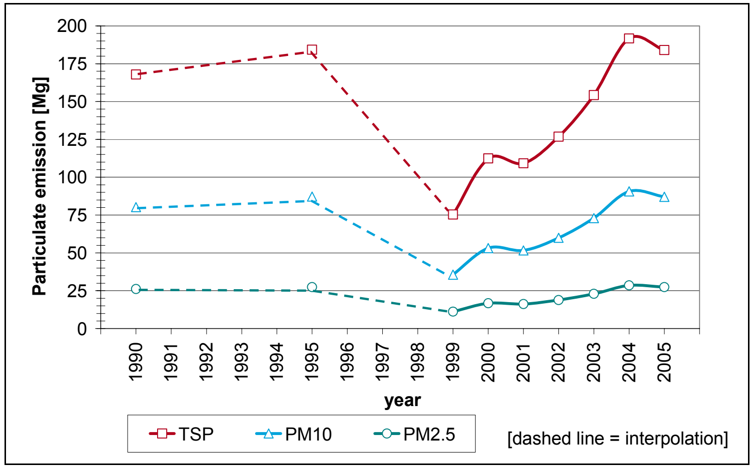


Figure 58: PM emissions from NFR Category 6 Waste 1990–2005.

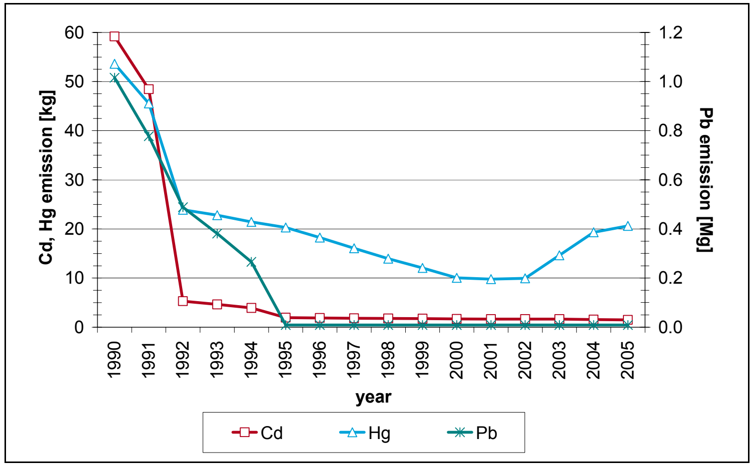


Figure 59: Heavy metal emissions from NFR Category 6 Waste 1990–2005.

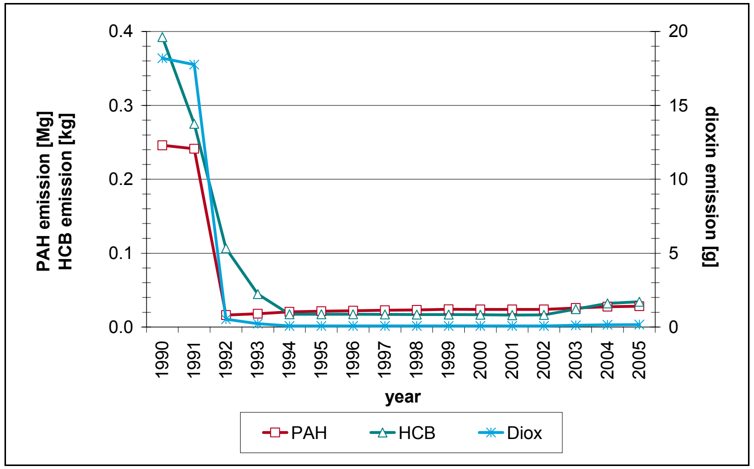


Figure 60: POP emissions from NFR Category 6 Waste 1990–2005.

8.2.5 General description

8.2.5.1 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.

8.2.5.2 Recalculations

Recalculations have been made for sub categories 6 A 1 *Managed Waste Disposal on Land,* 6 C *Waste Incineration, 6 D Other*, explanations are provided in the respective subchapters.

6 A 1 Managed Waste Disposal

Update of activity data

The Activity data for Residual Waste and Non-residual Waste has been updated. According to the Landfill Ordinance the operators of landfill sites have to report their activity data annually. Based on reports received after the due date, there are major changes for 2004 values of activity data in this submission compared to the previous submission.

During QA/QC procedures it was detected that for bio-waste, textiles and construction waste wrong DOcf values were used. The change due to correction is minor.

6 C Incineration of Corps

Update of activity data according to expert judgements.

6 D Other

Update of activity data taking into account information from the Federal Provonces of Austria.

8.2.5.3 Completeness

Table 273 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 273: Overview of sub categories of Category 6 Waste and status of estimation.

NFR Category		Status													
		NEC gas				CO	PM			Heavy metals			POPs		
		NO_x	SO_2	NH_3	NMVOC	CO	TSP	PM10	PM2.5	Cd	Hg	Pb	Dioxin	PAK	HCB
6 A	Solid Waste Disposal on Land	NA	NA	✓	✓	✓	✓	✓	✓	✓	✓	✓	NA	NA	NA
6 B	Wastewater Handling	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
6 C	Waste Incineration	✓	✓	✓	✓	✓	NE	NE	NE	✓	✓	✓	✓	✓	✓
6 D	Other Waste	NA	NA	✓	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

8.3 NFR 6 A Waste Disposal on Land

8.3.1 Managed Waste Disposal on Land (6 A 1)

Source Category Description

In Austria all waste disposal sites are managed sites (landfills).

NFR 6 A 1 *Managed waste disposal on land* accounts for the main sourceof NH_3 and NMVOC emissions of NFR Category 6 Waste.

The anaerobic degradation of land filled organic substances results in the formation of landfill gas. About 300 mg per m³ landfill gas are NMVOC and about 10 mg per m³ landfill gas are NH_3. Most active landfills in Austria have gas collection systems. According to a study (ROLLAND & OLIVA 2004), the amount of the collected and burnt landfill gas increased over the period. For example, the amount of the collected landfill gas was about 2% in 1990, and 13% in the year 2002 respectively.

Table 268 and Table 269 present NMVOC and NH_3 emissions from managed waste disposal on land for the period from 1990 to 2005. As can be seen in the tables, the trend of NMVOC and NH_3 emissions during the period is decreasing. From 1990 to 2005, both emissions decreased by 44% due to increasing amount of collected landfill-gas.

Methodological Issues

Emissions from solid waste disposal on land were calculated from the amount of directly deposited waste, reported by landfill operators for different waste categories. (Residual Waste and Non-Residual Waste).

Activity data

Activity data for residual waste and non-residual waste are presented in Table 274. As can be seen in the table, the amount of residual waste decreased until 1995, remained mainly constant until 2001, and increased substantially from 2001 to 2003. The decrease between 2003 and 2004 is due to the Austrian Landfill Ordinance, which only allows the disposal of treated waste and therefore leads to reduced waste volumens and masses, as well as decreased carbon conent in deposited waste. Non residual waste increased between 1990 and 2005 by 45%. Total waste decreased between 1990 and 2005 by 76%.

Table 274: Activity data for "Residual waste" and "Non Residual Waste" 1990–2005.

Year	residual waste [Mg]	non-residual waste [Mg]	total waste [Mg]
1990	1 995 747	664 536	2 660 283
1991	1 799 718	677 827	2 477 545
1992	1 614 157	691 383	2 305 541
1993	1 644 718	705 211	2 349 929
1994	1 142 067	719 315	1 861 382
1995	1 049 709	733 702	1 783 410
1996	1 124 169	748 376	1 872 545
1997	1 082 634	763 343	1 845 977
1998	1 081 114	778 578	1 859 692
1999	1 084 625	841 123	1 925 748
2000	1 052 061	843 780	1 895 841
2001	1 065 592	795 262	1 860 854
2002	1 374 543	808 279	2 182 822
2003	1 815 944	899 548	2 715 492
2004	282 656	367 301	649 957
2005	282 656	367 301	649 957

Residual Waste

"Residual waste" corresponds to waste from households and similar establishments after separate collection directly deposited at landfills without any treatment. It originates from private households, administrative facilities of commerce, industry and public administration, kindergartens, schools, hospitals, small enterprises, agriculture, market places and other generation points covered by the municipal waste collecting system.

Only 7.7% of residual waste was deposited in 2004. The remaining part was recycled, incinerated or treated biologically. According to the recent federal waste management plans 2001 and 2006 recycling and treatment of waste from households and similar establishments was performed according to the following routes in 1999 and 2004 respectively.

Table 275: Recycling and treatment of waste from households and similar establishments.

Treatment	1999	2004
mechanico-biological pre-treatment	16.7%	11.2%
thermal treatment (incineration)	5.9%	28.3%
treatment in plants for hazardous waste	0.4%	1.2%
recycling	12.9%	35.6%
recycling (biogenous waste)	1.0%	16.0%
direct deposition at landfills ("residual waste")	63.1%	7.7%

Source: BAWP 2006

The quantities of "residual waste"

- from 1998 to 2004 were taken from the database for solid waste disposals „Deponiedatenbank" („Austrian landfill database"). According to the Landfill Ordinance[95], which came into force in 1997, the operators of landfill sites have to report how much and what kind of waste they receive at their landfill site annually to the Umweltbundesamt, where the data are stored in the database for solid waste disposals.
- from 1989 to 1997 were taken from the respective Federal Waste Management Plan (BUNDESABFALLWIRTSCHAFTSPLAN 1995, 2001 and 2006).
- from 1950 to 1988 were taken from a national study (HACKL & MAUSCHITZ 1999).

Activity data-Non Residual Waste

"Non Residual Waste" is directly deposited waste other than residual waste but with biodegradable lots. Non residual waste comprises for example:

- bulk waste
- construction waste
- mixed industrial waste
- road sweepings
- sewage sludge
- rakings
- residual matter from waste treatment.

The quantities of "non residual waste" from 1998 to 2004 were also taken from the database for solid waste disposals "Austrian Landfill database (Deponiedatenbank)", whereas only the amount of waste with bio-degradable lots was considered.

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.

The methodology of emission calculation for the two sub categories 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 276 summarises the parameters used plus the corresponding references.

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

Table 276: Parameters for calculating methane emissions of SWDS.

Parameters	residual waste	wood	paper	sludges	bulky waste & other waste	bio-waste	textiles	construction waste	fats
Fraction of degradable organic carbon dissimilated DOC_F	0.6	0.5	0.55	0.77	0.55	0.77	0.55	0.55	0.77
	The DOC_F for residual waste reflects the recent increase of biogenic components (Table 276). IPCC default taking into account national waste expertises.								
DOC	see Table 278	0.45	0.3	0.11	0.16	0.16	0.5	0.09	0.2
	HACKL; ROLLAND[(1)]	BAUMELER et al. 1998							
Half life period	7	25	15	7	20	10	15	20	4
	National waste experts	GILBERG et al. 2005		Assumption: same as residual waste	IPCC default slow decay	Assumption: better than paper	Assumption: same as paper	IPCC default slow decay	GILBERG et al. 2005
Number of considered years	56								
	IPCC default including data for 3 to 5 half lives								

(1) HACKL & MAUSCHITZ 1999; ROLLAND & SCHEIBENGRAF 2003

Biodegradable organic carbon (DOC) of residual waste

The decrease in DOC is 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.

A study (ROLLAND & SCHEIBENGRAF 2003) was undertaken in 2003 to estimate the carbon content in residual waste. The carbon content of different fractions was estimated by viewing literature on direct waste analyses. According to the changing waste composition the carbon content of residual waste (mixture of different waste fractions) over the time was calculated until 2003. For 2004 and 2005, the same DOC values as for 2003 is used.

As can be seen Table 277 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 278). For the years before 1990, quantities according to a national study (HACKL & MAUSCHITZ 1999) were used.

Table 277: Composition of residual waste.

Residual waste	1990	1993	1996	1999	2004
	[% of moist mass]				
Paper, cardboard	21.9	18.3	13.5	14.0	11
Glass	7.8	6.3	4.4	3.0	5
Metal	5.2	4.4	4.5	4.6	3
plastic	9.8	9.3	10.6	15.0	10
Composite materials	11.3	11.3	13.8	-	8
textiles	3.3	3.1	4.1	4.2	6
Hygiene materials	-	-	-	12	11
Biogenic components	29.8	34.4	29.7	17.8	37
Hazardous household waste	1.4	1.5	0.9	0.3	2
Mineral components	7.2	7.9	3.8	-	4
Wood, leather, rubber, other components	2.3	3.6	1.1	2.6	1
Residual fraction	-	-	13.6	26.5	2

Source: ROLLAND & SCHEIBENGRAF 2003), (BUNDESABFALLWIRTSCHAFTSPLAN 2006

Table 278: Time series of bio-degradable organic carbon content of directly deposited residual waste 1950–2003.

Year	bio-degradable organic carbon [g/kg waste (moist mass)]	Year	bio-degradable organic carbon [g/kg waste (moist mass)]
1950–1959	240	1995	150
1960–1969	230	1996	140
1970–1979	220	1997	130
1980–1989	210	1998	130
1990	200	1999	120
1991	190	2000	120
1992	180	2001	120
1993	170	2002	120
1994	160	2003	120

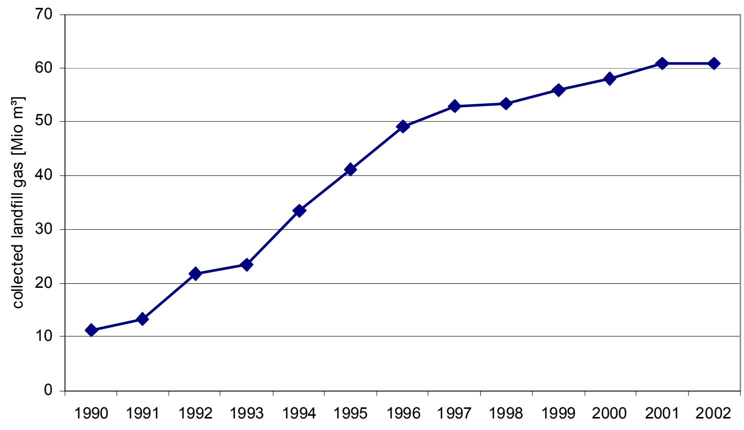
Source: up to 1990: HACKL & MAUSCHITZ (1999) and for 1990–2003: ROLLAND, SCHEIBENGRAF (2003)

Landfill gas recovery

In 2004, the Umweltbundesamt investigated the amount of annual collected landfill gas by questionnaires sent to landfill operators (ROLLAND & OLIVA 2004). The amount of collected and burnt landfill gas increased constantly over the time period (Figure 61). While for example the amount of the collected landfill gas was about 2% in 1990, this amount reached 13% in the year 2002.

As this study only covers the amount of collected landfill gas from 1990 to 2002, the 2002 data were also used for 2003 to 2005. A study to update the amounts of collected landfill gas will be undertaken in 2007.

Figure 61: Amount of collected landfill gas 1990 to 2002.



Source: (ROLLAND & OLIVIA 2004)

Emission Factors

NMVOC, CO, NH_3 and heavy metal emissions are calculated according to their content in the emitted landfill-gases (after consideration of gas recovery). [96]

Table 279: Emission factors for CO, NMVOC, NH_3 and heavy metals.

	CO	NMVOC	NH_3	Cd	Hg	Pb
	[Vol.%]	**[Vol.%]**	**[Vol.%]**	**[mg/Nm³]**	**[mg/Nm³]**	**[mg/Nm³]**
concentration in landfill gas	2	300	10	0.003	0.00002	0.003

PM emissions are calculated according (WINIWARTER et al. 2001).

Table 280: Emission factors for PM.

TSP	PM10	PM2.5
[g/Mg WASTE]	**[g/Mg waste]**	**[g/Mg waste]**
20.82	9.85	3.10

8.3.1.1 Recalculations

Improvements and recalculations made are described in Chapter 3.

[96] accordint to UMWELTBUNDESAMT (2001c)

8.4 NFR 6 C Waste Incineration

Source Description

In this category emissions are included from

- incineration of corpses
- hospital waste
- waste oil
- incineration of domestic or municipal solid waste without energy recovery.

Additionally heavy metal and POPs emissions of a single plant without emission control 1990 to 1991 are included here. From 1992 the plant was equiped with ESP. Emissions 1992 to 2000 are included in category 1 A 4 a and from 2001 on in category 1 A 1 a. Emissions from incineration of carcasses are not estimated.

In Austria waste oil is incinerated in especially designed so called "USK-facilities". The emissions of waste oil combustion for energy use (e.g. in cement industry) are reported under NFR sector 1 A Fuel Combustion.

In general, municipal, industrial and hazardous waste are combusted in district heating plants or in industrial sites and the energy is used. Therefore their emissions are reported in NFR category 1 A Fuel Combustion. There is only one waste incineration plant which has been operated until 1991 with a capacity of 22 000 tons of waste per year without energy recovery and emission controls. This plant has been rebuilt as a district heating plant starting operation in 1996. Therefore the emissions of this plant are reported under NFR category 1 A Fuel Combustion from 1996 onwards.

Methodology

The simple CORINAIR methodology is used. Emission factors are specific to type of waste and combustion techology.

Activity data

For municipal solid waste the known capacity of 22 000 tons of waste per year of one waste incineration plant was taken.

Waste oil activity data 1990 to 1999 were taken from (BOOS et al. 1995). For 2000 to 2004 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 281: Activity data for category 6 C Waste Incineration.

Year	Municipal Waste	Clinical Waste	Waste Oil	Hazardous waste	Sewage sludge	Corps
			[Mg]			
1990	22 000	9 000	2 200	71 000	62 000	9954
1991	22 000	7 525	1 500	71 000	62 000	10011
1992	0	6 050	1 800	IE	IE	9979
1993	0	4 575	2 100	IE	IE	9902
1994	0	3 100	2 500	IE	IE	9682
1995	0	3 100	2 600	IE	IE	9741
1996	0	3 100	2 700	IE	IE	9695
1997	0	3 100	2 800	IE	IE	9532
1998	0	3 100	2 900	IE	IE	9401
1999	0	3 100	3 000	IE	IE	9384
2000	0	3 100	3 000	IE	IE	9214
2001	0	3 100	3 000	IE	IE	8972
2002	0	3 100	3 000	IE	IE	9136
2003	0	3 100	3 000	IE	IE	13818
2004	0	3 100	3 000	IE	IE	18500
2005	0	3 100	3 000	IE	IE	19800
Trend						
1990–2005	*-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 282 shows emission factors of the air pollutants.

Table 282: 6 C Waste Incineration: emission factors by type of waste.

Type of waste	NO_x	CO	NMVOC	SO_2	NH_3
			[kg/kt]		
Waste oil	8 060.0	604.5	403.0	18 135.0	110.0
Municipal waste	870.0	1 740.0	330.6	1 131.0	0.2
Clinical waste	7 000.0	840.0	330.0	700.0	0.2

Municipal waste	Cd	Hg	Pb	PAH	DIOX	HCB
	[kg/kt]					
1985	2 580.0	1 800.0	30 000.0	0.7	250.0	850.0
1986	2 078.2	1 499.8	24 234.0	0.7	250.0	850.0
1987	1 576.4	1 199.6	18 468.0	0.7	250.0	850.0
1988	1 074.6	899.4	12 702.0	0.7	250.0	850.0
1989	572.8	599.2	6 936.0	0.7	250.0	850.0
1990	71.0	299.0	1 170.0	0.7	250.0	850.0
1991	59.2	263.2	966.0	0.7	250.0	850.0

Industrial Waste	Cd	Hg	Pb	PAH	DIOX	HCB
	[kg/kt]					
1985	720.0	100.0	8300.0	1.6	160.0	970.0
1986	678.0	102.4	7120.0	1.6	160.0	970.0
1987	636.0	104.8	5940.0	1.6	160.0	970.0
1988	594.0	107.2	4760.0	1.6	160.0	970.0
1989	552.0	109.6	3580.0	1.6	160.0	970.0
1990	510.0	112.0	2400.0	1.6	160.0	970.0
1991	414.0	99.4	1922.0	1.6	160.0	970.0

sludges from waste water treatment	Cd	Hg	Pb	PAH	DIOX	HCB
	[kg/kt]					
1985	6.0	3.0	280.0	1.6	1.5	300.0
1986	51.8	13.4	370.0	1.6	1.5	300.0
1987	97.6	23.8	460.0	1.6	1.5	300.0
1988	143.4	34.2	550.0	1.6	1.5	300.0
1989	189.2	44.6	640.0	1.6	1.5	300.0
1990	235.0	55.0	730.0	1.6	1.5	300.0
1991	191.8	45.8	585.2	1.6	1.5	300.0

Clinical waste	Cd	Hg	Pb	PAH	DIOX	HCB
	[kg/kt]					
1985–1990	4.77	5.76	540.00	0.00	1.08	216.00
1991	3.99	4.82	451.50	0.00	0.68	135.45
1992	3.21	3.87	363.00	0.00	0.36	72.60
1993	2.42	2.93	274.50	0.00	0.14	27.45
1994	1.64	1.98	186.00	0.00	0.00	0.19
1995–2005	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			
1995–2005	13.0		60.0			

Table 283: 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 1985-2005

[2] for 1980-1992

[3] for 1993-2005

[4] for 1985-1990

[5] for 1991

[6] for 1992-1995

[7] for 2000-2005

8.5 NFR 6 D Other Waste

8.5.1 Source Category Description

In this category compost production is addressed.

8.5.2 Compost Production

This category includes NH_3 emissions from compost production, which are presented in Table 269 for the period from 1990 to 2005.

NH_3 emissions arising from the sub category compost production increased over the time period as a result of the increasing amount of composted waste.

8.5.2.1 Methodological Issues

Emissions were estimated using a country specific methodology. To estimate the amount of composted waste it was split up into three fractions of composted waste:

- mechanical biological treated residual waste;
- bio-waste, loppings, home composting;
- sewage sludge.

NH_3 emissions were calculated by multiplying an emission factor with the quantity of waste.

Activity data

Activity data were taken from several national studies. For years where no data were available inter- or extrapolation was done.

Table 284: Activity data for NFR Category 6 D Other Waste (Compost Production).

Year	total	Bio-waste, loppings, home composting		Mechanical biological treated residual waste		Sewage sludge	
	[Gg/a]	[Gg/a]	References	[Gg/a]	References	[Gg/a]	References
1990	765.0	413.2		345.0		6.8	same as 1991
1991	800.1	448.3		345.0		6.8	(BAWP 1995)
1992	947.5	591.3		345.0	(BAUMELER et al. 1998)	11.1	
1993	1 176.7	816.2		345.0		15.5	interpolated
1994	1 393.3	1 028.5	(AMLINGER 2003) Sum of data repoted by the Autrian Federal Provinces	345.0		19.8	
1995	1 470.8	1 151.6		295.0	(ANGERER 1997)	24.2	(SCHARF et al. 1998)
1996	1 537.5	1 233.5		280.0	Expert Judgement	24.0	interpolated
1997	1 513.0	1 244.1		245.0	(LAHL et al. 1998)	23.9	
1998	1 564.7	1 300.9		240.0	(LAHL et al. 2000)	23.8	(BAWP 2001)
1999	1 659.2	1 355.7		265.0	(GRECH & ROLLAND 2001)	38.5	(AMLINGER et al. 2003)
2000	1.732.2	1 414.0		265.0		53.3	
2001	1 766.9	1 453.4	interpolated	265.0	interpolated	48.4	interpolated
2002	1 800.3	1 491.7		265.0		43.6	
2003	1 991.0	1 518.2		434.0	(DOMENIG 2004)	38.8	
2004	1 882.1	1 552.3	(BAWP 2006)	294.8	(NEUBAUER 2006)	34.0	(BAWP 2006)
2005	2 201.7	1 555.2	same as 2004	612.5	(BAWP 2006)	34.0	Same as 2004

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 285: Emission factors for IPCC Category 6 D Other Waste (Compost Production).

	NH_3 [kg/t FS]	References
mechanical biological treated residual waste	0.6	(UBA BERLIN 1999) (AMLINGER et al. 2003) (ANGERER & FRÖHLICH 2002)
Bio-waste, lopping, home composting	0.4	(AMLINGER et al. 2003)
Sewage sludge	0.02	(AMLINGER et al. 2003)

9 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/CLRTAP 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/CLRTAP 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)

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ANNEX

NFR for 2005

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

Version 2005-1

COUNTRY:	AT	(as ISO2 code)
DATE:	12.02.2007	(as DD.MM.YYYY)
YEAR:	2005	(as YYYY, year of Emissions)

NFR sectors to be reported to LRTAP			A = Allowable Aggregation	Yearly minimum reporting: Main Pollutants					Particulate Matter			Priority Heavy Metals			Persistent Organic Pollutants (POPs) Annex I (1)									POPs Annex II (2)			POPs Annex III (3)	PAH						Additional reporting: Other Heavy Metals						Other POPs (4	
				NOx	CO	NMVOC	SOx	NH3	TSP	PM10	PM2.5	Pb	Cd	Hg	Aldrin	Chlordane	Chlordeco	Dieldrin	Endrin	Heptachlo	Hexabrom	Mirex	Toxaphen	HCH	DDT	PCB	DIOX	benzo(	benzo(	benzo(	Indeno	Total 1	HCB	As	Cr	Cu	Ni	Se	Zn	PCP	SCCP
				Gg NO_2	Gg	Gg	Gg SO_2	Gg	Gg	Gg	Gg	Mg	Mg	Mg	kg	kg	kg	kg	kg	kg	kg	kg	kg	kg	kg	kg	g I-Teq	Mg	Mg	Mg	Mg	Mg	kg	Mg	Mg	Mg	Mg	Mg	Mg	kg	kg
1 A 1 a	**(a)**	**1 A 1 a Public Electricity and Heat Production**		8.90	2.91	1.19	3.55	0.22	0.86	0.79	0.67	1.13	0.08	0.19	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	0.63	NR	NR	NR	NR	0.01	0.27	NR	NR	NR	NR	NR	NR	NR	NR
1 A 1 b	**(a)**	**1 A 1 b Petroleum refining**		3.05	0.42	IE	3.35	0.08	0.10	0.10	0.08	0.24	0.18	0.01	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	0.02	NR	NR	NR	NR	0.00	0.00	NR	NR	NR	NR	NR	NR	NR	NR
1 A 1 c	**(a)**	**1 A 1 c Manufacture of Solid Fuels and Other Energy Industries**		0.74	0.05	0.00	NA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	0.00	NR	NR	NR	NR	0.00	0.00	NR	NR	NR	NR	NR	NR	NR	NR
1 A 2	**(a)**	**1 A 2 Manufacturing Industries and Construction**	A	34.73	158.83	3.02	9.19	0.27	2.57	2.40	2.15	2.98	0.18	0.24	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	4.98	NR	NR	NR	NR	0.18	1.47	NR	NR	NR	NR	NR	NR	NR	NR
1 A 2 a	(a)	1 A 2 a Iron and Steel		5.02	138.44	0.25	4.43	0.05	0.05	0.05	0.06	0.18	0.00	0.00	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	0.04	NR	NR	NR	NR	0.00	0.01	NR	NR	NR	NR	NR	NR	NR	NR
1 A 2 b	(a)	1 A 2 b Non-ferrous Metals		1.17	0.14	0.01	0.16	0.01	0.04	0.04	0.03	1.06	0.02	0.01	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	2.32	NR	NR	NR	NR	0.00	1.02	NR	NR	NR	NR	NR	NR	NR	NR
1 A 2 c	(a)	1 A 2 c Chemicals		1.29	1.40	0.22	0.67	0.03	0.47	0.42	0.35	0.39	0.02	0.01	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	0.66	NR	NR	NR	NR	0.03	0.10	NR	NR	NR	NR	NR	NR	NR	NR
1 A 2 d	(a)	1 A 2 d Pulp, Paper and Print		5.23	1.98	0.25	1.17	0.07	0.36	0.33	0.27	0.76	0.09	0.07	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	0.64	NR	NR	NR	NR	0.00	0.13	NR	NR	NR	NR	NR	NR	NR	NR
1 A 2 e	(a)	1 A 2 e Food Processing, Beverages and Tobacco		0.76	0.13	0.01	0.30	0.02	0.05	0.05	0.04	0.01	0.00	0.00	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	0.04	NR	NR	NR	NR	0.00	0.01	NR	NR	NR	NR	NR	NR	NR	NR
1 A 2 f	(a)	1 A 2 f Other (Please specify in a covering note)		21.27	16.75	2.28	2.46	0.10	1.59	1.51	1.40	0.58	0.06	0.15	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	1.28	NR	NR	NR	NR	0.14	0.21	NR	NR	NR	NR	NR	NR	NR	NR
1 A 3 a ii (i)		**1 A 3 a ii (i) Civil Aviation (Domestic, LTO)**		0.18	2.56	0.21	0.02	0.00	0.02	0.02	0.02	0.00	0.00	0.00	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NE	NR	NR	NR	NR	NE	NE	NR	NR	NR	NR	NR	NR	NR	NR
1 A 3 a ii (ii)		**1 A 3 a ii (ii) Civil Aviation (Domestic, Cruise)**		0.55	0.16	0.06	0.05	0.00	0.05	0.05	0.05	0.00	0.00	0.00	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NE	NR	NR	NR	NR	NE	NE	NR	NR	NR	NR	NR	NR	NR	NR
1 A 3 b	**(a)**	**1 A 3 b Road Transportation**	A	131.02	156.62	19.84	0.15	1.15	15.95	8.43	7.12	0.01	0.08	0.00	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	1.19	NR	NR	NR	NR	1.57	0.24	NR	NR	NR	NR	NR	NR	NR	NR
1 A 3 b i		1 A 3 b i R.T., Passenger cars		34.54	124.30	9.08	0.07	1.08	1.92	1.92	1.92	0.01	0.00	0.00	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	0.43	NR	NR	NR	NR	0.64	0.09	NR	NR	NR	NR	NR	NR	NR	NR
1 A 3 b ii		1 A 3 b ii R.T., Light duty vehicles		5.33	5.28	0.66	0.01	0.02	0.69	0.69	0.69	0.00	0.00	0.00	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	0.12	NR	NR	NR	NR	0.16	0.02	NR	NR	NR	NR	NR	NR	NR	NR
1 A 3 b iii		1 A 3 b iii R.T., Heavy duty vehicles		90.87	16.40	4.51	0.07	0.06	2.06	2.06	2.06	0.00	0.00	0.00	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	0.64	NR	NR	NR	NR	0.74	0.13	NR	NR	NR	NR	NR	NR	NR	NR
1 A 3 b iv		1 A 3 b iv R.T., Mopeds & Motorcycles		0.27	10.65	1.76	NA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	0.00	NR	NR	NR	NR	0.04	0.00	NR	NR	NR	NR	NR	NR	NR	NR
1 A 3 b v		1 A 3 b v R.T., Gasoline evaporation		NA	NA	3.83	NA	NA	NA	NA	NA	NA	NA	NA	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	IE	NR	NR	NR	NR	NA	NA	NR	NR	NR	NR	NR	NR	NR	NR
1 A 3 b vi		1 A 3 b vi R.T., Automobile tyre and brake wear		NA	NA	NA	NA	NA	11.27	3.76	2.44	NA	0.08	NA	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NA	NR	NR	NR	NR	NA	NA	NR	NR	NR	NR	NR	NR	NR	NR
1 A 3 b vii		1 A 3 b vii R.T., Automobile road abrasion		IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	IE	NR	NR	NR	NR	IE	IE	NR	NR	NR	NR	NR	NR	NR	NR
1 A 3 c	**(a)**	**1 A 3 c Railways**		1.38	0.37	0.18	0.06	0.00	1.62	0.58	0.22	0.00	0.00	0.00	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	0.02	NR	NR	NR	NR	0.02	0.00	NR	NR	NR	NR	NR	NR	NR	NR
1 A 3 d ii		**1 A 3 d ii National Navigation**		0.70	2.90	0.65	0.02	0.00	0.04	0.04	0.04	0.00	0.00	0.00	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	0.01	NR	NR	NR	NR	0.01	0.00	NR	NR	NR	NR	NR	NR	NR	NR
1 A 3 e	**(a)**	**1 A 3 e Other (Please specify in a covering note)**	A	1.47	0.10	0.00	NA	0.01	0.00	0.00	0.00	NA	NA	NA	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NE	NR	NR	NR	NR	NA	0.00	NR	NR	NR	NR	NR	NR	NR	NR
1 A 3 e i		1 A 3 e i Pipeline compressors		1.47	0.10	0.00	NA	0.01	0.00	0.00	0.00	NA	NA	NA	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NE	NR	NR	NR	NR	NA	0.00	NR	NR	NR	NR	NR	NR	NR	NR
1 A 3 e ii		1 A 3 e ii Other mobile sources and machinery		NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NO	NR	NR	NR	NR	NO	NO	NR	NR	NR	NR	NR	NR	NR	NR

Notes are listed at the end of the table.

NFR sectors to be reported to LRTAP			A = Allowable Aggregation	Yearly minimum reporting																														Additional reporting							
				Main Pollutants					Particulate Matter			Priority Heavy Metals			Persistent Organic Pollutants (POPs) Annex I (1)									POPs Annex II (2)			POPs Annex III (3)							Other Heavy Metals						Other POPs (4	
																												PAH													
				NOx	CO	NMVOC	SOx	NH3	TSP	PM10	PM2.5	Pb	Cd	Hg	Aldrin	Chlordane	Chlordeco	Dieldrin	Endrin	Heptachlo	Hexabrom	Mirex	Toxaphene	HCH	DDT	PCB	DIOX	benzo(a	benzo(l	benzo(l	Indeno	Total 1	HCB	As	Cr	Cu	Ni	Se	Zn	PCP	SCCP
				Gg NO_2	Gg	Gg	Gg SO_2	Gg	Gg	Gg	Gg	Mg	Mg	Mg	kg	kg	kg	kg	kg	kg	kg	kg	kg	kg	kg	kg	g I-Teq	Mg	Mg	Mg	Mg	Mg	kg	Mg	Mg	Mg	Mg	Mg	Mg	kg	kg
1 A 4 a	(a)	1 A 4 a Commercial / Institutional		3.41	13.61	1.46	1.43	0.12	0.36	0.33	0.29	0.31	0.04	0.02	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	1.93	NR	NR	NR	NR	0.14	1.20	NR	NR	NR	NR	NR	NR	NR	NR
1 A 4 b	(a)	1 A 4 b Residential	A	13.89	307.63	34.15	6.80	0.58	7.67	6.92	6.17	2.18	0.24	0.18	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	27.73	NR	NR	NR	NR	5.92	35.03	NR	NR	NR	NR	NR	NR	NR	NR
1 A 4 b i		1 A 4 b i Residential plants		13.09	289.67	31.29	6.79	0.58	7.52	6.76	6.01	2.18	0.24	0.18	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	27.68	NR	NR	NR	NR	5.89	35.02	NR	NR	NR	NR	NR	NR	NR	NR
1 A 4 b ii		1 A 4 b ii Household and gardening (mobile)		0.80	17.96	2.86	0.00	0.00	0.15	0.15	0.15	0.00	0.00	0.00	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	0.05	NR	NR	NR	NR	0.03	0.01	NR	NR	NR	NR	NR	NR	NR	NR
1 A 4 c	(a)	1 A 4 c Agriculture / Forestry / Fishing	A	18.28	42.11	8.12	0.34	0.05	2.67	2.62	2.56	0.16	0.05	0.01	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	2.24	NR	NR	NR	NR	0.60	3.44	NR	NR	NR	NR	NR	NR	NR	NR
1 A 4 c i		1 A 4 c i Stationary		0.96	20.73	2.34	0.29	0.04	0.56	0.51	0.45	0.16	0.05	0.01	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	2.11	NR	NR	NR	NR	0.47	3.41	NR	NR	NR	NR	NR	NR	NR	NR
1 A 4 c ii		1 A 4 c ii Off-road Vehicles and Other Machinery		17.32	21.38	5.78	0.05	0.01	2.11	2.11	2.11	0.00	0.00	0.00	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	0.13	NR	NR	NR	NR	0.13	0.03	NR	NR	NR	NR	NR	NR	NR	NR
1A 4 c iii		1A 4 c iii National Fishing		NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NO	NR	NR	NR	NR	NO	NO	NR	NR	NR	NR	NR	NR	NR	NR
1 A 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	NR	NR	NR	NR	NR	NR	IE	NR	NR	NR	NR	IE	IE	NR	NR	NR	NR	NR	NR	NR	NR
1 A 5 b	(a)	1 A 5 b Other, Mobile (Including military)		0.20	0.72	0.04	0.04	0.00	0.04	0.04	0.04	0.00	0.00	0.00	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	0.00	NR	NR	NR	NR	0.00	0.00	NR	NR	NR	NR	NR	NR	NR	NR
1B1	(a)	1B1 Fugitive Emissions from Solid Fuels	A	NA	NA	NA	NA	NA	0.61	0.29	0.09	NA	NA	NA	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NA	NR	NR	NR	NR	NA	NA	NR	NR	NR	NR	NR	NR	NR	NR
1 B 1 a	(a)	1 B 1 a Coal Mining and Handling		NA	NA	NA	NA	NA	0.61	0.29	0.09	NA	NA	NA	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NA	NR	NR	NR	NR	NA	NA	NR	NR	NR	NR	NR	NR	NR	NR
1 B 1 b	(a)	1 B 1 b Solid fuel transformation		IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	IE	NR	NR	NR	NR	IE	IE	NR	NR	NR	NR	NR	NR	NR	NR
1 B 1 c	(a)	1 B 1 c Other (Please specify in a covering note)		NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NO	NR	NR	NR	NR	NO	NO	NR	NR	NR	NR	NR	NR	NR	NR
1 B 2	(a)	1 B 2 Oil and natural gas	A	IE	IE	3.09	0.13	IE	IE	IE	IE	IE	IE	IE	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	IE	NR	NR	NR	NR	IE	IE	NR	NR	NR	NR	NR	NR	NR	NR
1 B 2 a	(a)	1 B 2 a Oil		NA	NA	2.84	NA	NA	NA	NA	NA	NA	NA	NA	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NA	NR	NR	NR	NR	NA	NA	NR	NR	NR	NR	NR	NR	NR	NR
1 B 2 a i	(a)	1 B 2 a i Exploration Production, Transport		NA	NA	0.91	NA	NA	NA	NA	NA	NA	NA	NA	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NA	NR	NR	NR	NR	NA	NA	NR	NR	NR	NR	NR	NR	NR	NR
1 B 2 a iv	(a)	1 B 2 a iv Refining / Storage		NA	NA	0.94	NA	NA	NA	NA	NA	NA	NA	NA	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NA	NR	NR	NR	NR	NA	NA	NR	NR	NR	NR	NR	NR	NR	NR
1 B 2 a v	(a)	1 B 2 a v Distribution of oil products		NA	NA	0.98	NA	NA	NA	NA	NA	NA	NA	NA	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NA	NR	NR	NR	NR	NA	NA	NR	NR	NR	NR	NR	NR	NR	NR
1 B 2 a vi	(a)	1 B 2 a vi Other		NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NE	NR	NR	NR	NR	NE	NE	NR	NR	NR	NR	NR	NR	NR	NR
1 B 2 b	(a)	1 B 2 b Natural gas		NA	NA	0.25	0.13	NA	NA	NA	NA	NA	NA	NA	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NA	NR	NR	NR	NR	NA	NA	NR	NR	NR	NR	NR	NR	NR	NR
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	NR	NR	NR	NR	NR	NR	IE	NR	NR	NR	NR	IE	IE	NR	NR	NR	NR	NR	NR	NR	NR
2 A	(a)	2 A MINERAL PRODUCTS (b)	A	NA	9.78	IE	NA	NA	23.99	11.58	3.61	NA	NA	NA	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NA	NR	NR	NR	NR	NA	NA	NR	NR	NR	NR	NR	NR	NR	NR
2 A 1	(a)	2 A 1 Cement Production		NA	NA	NA	NA	NA	0.33	0.15	0.05	NA	NA	NA	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NA	NR	NR	NR	NR	NA	NA	NR	NR	NR	NR	NR	NR	NR	NR
2 A 2	(a)	2 A 2 Lime Production		NA	NA	NA	NA	NA	0.02	0.01	0.00	NA	NA	NA	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NA	NR	NR	NR	NR	NA	NA	NR	NR	NR	NR	NR	NR	NR	NR
2 A 3	(a)	2 A 3 Limestone and Dolomite Use		NA	NA	NA	NA	NA	0.58	0.27	0.09	NA	NA	NA	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NA	NR	NR	NR	NR	NA	NA	NR	NR	NR	NR	NR	NR	NR	NR
2 A 4	(a)	2 A 4 Soda Ash Production and use		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NA	NR	NR	NR	NR	NA	NA	NR	NR	NR	NR	NR	NR	NR	NR
2 A 5	(a)	2 A 5 Asphalt Roofing		NA	9.78	IE	NA	NA	NA	NA	NA	NA	NA	NA	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NA	NR	NR	NR	NR	NA	NA	NR	NR	NR	NR	NR	NR	NR	NR
2 A 6	(a)	2 A 6 Road Paving with Asphalt		NA	NA	IE	NA	NA	NA	NA	NA	NA	NA	NA	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NA	NR	NR	NR	NR	NA	NA	NR	NR	NR	NR	NR	NR	NR	NR
2 A 7	(a)	2 A 7 Other including Non Fuel Mining & Construction (Please specify in a covering note)		NA	NA	NA	NA	NA	23.06	11.14	3.47	NA	NA	NA	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NA	NR	NR	NR	NR	NA	NA	NR	NR	NR	NR	NR	NR	NR	NR
2 B	(a)	2 B CHEMICAL INDUSTRY	A	0.57	11.12	1.32	0.77	0.07	0.46	0.27	0.14	0.00	0.00	0.00	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NA	NR	NR	NR	NR	NA	NA	NR	NR	NR	NR	NR	NR	NR	NR
2 B 1	(a)	2 B 1 Ammonia Production		0.24	0.05	IE	NA	0.01	NA	NA	NA	NA	NA	NA	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NA	NR	NR	NR	NR	NA	NA	NR	NR	NR	NR	NR	NR	NR	NR
2 B 2	(a)	2 B 2 Nitric Acid Production		0.24	NA	NA	NA	0.00	NA	NA	NA	NA	NA	NA	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NA	NR	NR	NR	NR	NA	NA	NR	NR	NR	NR	NR	NR	NR	NR
2 B 3	(a)	2 B 3 Adipic Acid Production		NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NO	NR	NR	NR	NR	NO	NO	NR	NR	NR	NR	NR	NR	NR	NR
2 B 4	(a)	2 B 4 Carbide Production		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NA	NR	NR	NR	NR	NA	NA	NR	NR	NR	NR	NR	NR	NR	NR
2 B 5	(a)	2 B 5 Other (Please specify in a covering note)		0.09	11.07	1.32	0.77	0.06	0.46	0.27	0.14	0.00	0.00	0.00	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NA	NR	NR	NR	NR	NA	NA	NR	NR	NR	NR	NR	NR	NR	NR

Notes are listed at the end of the table.

NFR sectors to be reported to LRTAP			A = Allowable Aggregation	Yearly minimum reporting: Main Pollutants					Particulate Matter			Priority Heavy Metals			Persistent Organic Pollutants (POPs) Annex I (1)									POPs Annex II (2)			POPs Annex III (3)							Additional reporting: Other Heavy Metals						Other POPs (4	
				NOx	CO	NMVOC	SOx	NH3	TSP	PM10	PM2.5	Pb	Cd	Hg	Aldrin	Chlordane	Chlordeco	Dieldrin	Endrin	Heptachlo	Hexabrom	Mirex	Toxaphen	HCH	DDT	PCB	DIOX	PAH: benzo(	benzo(	benzo(	Indeno	Total 1	HCB	As	Cr	Cu	Ni	Se	Zn	PCP	SCCP
				Gg NO_2	Gg	Gg	Gg SO_2	Gg	Gg	Gg	Gg	Mg	Mg	Mg	kg	kg	kg	kg	kg	kg	kg	kg	kg	kg	kg	kg	g I-Teq	Mg	Mg	Mg	Mg	Mg	kg	Mg	Mg	Mg	Mg	Mg	Mg	kg	kg
2 C	(a)	2 C METAL PRODUCTION		0.10	2.54	0.45	0.45	IE	2.29	1.61	0.70	6.49	0.22	0.30	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	3.41	NR	NR	NR	NR	0.18	3.67	NR	NR	NR	NR	NR	NR	NR	NR
2 D	(a)	2 D OTHER PRODUCTION (b)	A	0.61	0.45	2.62	NA	NA	0.00	0.00	0.00	NA	NA	NA	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	0.13	NR	NR	NR	NR	0.04	0.03	NR	NR	NR	NR	NR	NR	NR	NR
2 D 1	(a)	2 D 1 Pulp and Paper		0.61	0.45	0.45	NA	NA	NA	NA	NA	NA	NA	NA	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NA	NR	NR	NR	NR	NA	NA	NR	NR	NR	NR	NR	NR	NR	NR
2 D 2	(a)	2 D 2 Food and Drink		NA	NA	2.17	NA	NA	0.00	0.00	0.00	NA	NA	NA	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	0.13	NR	NR	NR	NR	0.04	0.03	NR	NR	NR	NR	NR	NR	NR	NR
2 G	(a)	2 G OTHER (Please specify in a covering note)		NA	NA	NA	NA	0.00	NA	NA	NA	NA	NA	NA	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NA	NR	NR	NR	NR	NA	NA	NR	NR	NR	NR	NR	NR	NR	NR
3 A	(a)	3 A PAINT APPLICATION		NA	NA	20.81	NA	NA	NA	NA	NA	NA	NA	NA	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NA	NR	NR	NR	NR	NA	NA	NR	NR	NR	NR	NR	NR	NR	NR
3 B	(a)	3 B DEGREASING AND DRY CLEANING		NA	NA	9.17	NA	NA	NA	NA	NA	NA	NA	NA	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NA	NR	NR	NR	NR	NA	NA	NR	NR	NR	NR	NR	NR	NR	NR
3 C	(a)	3 C CHEMICAL PRODUCTS, MANUFACTURE AND PROCESSING		NA	NA	11.31	NA	NA	NA	NA	NA	0.03	0.00	NA	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NA	NR	NR	NR	NR	NA	NA	NR	NR	NR	NR	NR	NR	NR	NR
3 D	(a)	3 D OTHER including products containing HMs and POPs (Please specify in a covering note)		NA	NA	34.48	NA	NA	NA	NA	NA	NA	NA	NA	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NA	NR	NR	NR	NR	NA	NA	NR	NR	NR	NR	NR	NR	NR	NR
4 B	(a)	4 B MANURE MANAGEMENT (c)	A	NA	NA	NA	NA	53.03	NA	NA	NA	NA	NA	NA	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NA	NR	NR	NR	NR	NA	NA	NR	NR	NR	NR	NR	NR	NR	NR
4 B 1	(a)	4 B 1 Cattle		NA	NA	NA	NA	36.65	NA	NA	NA	NA	NA	NA	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NA	NR	NR	NR	NR	NA	NA	NR	NR	NR	NR	NR	NR	NR	NR
4 B 1 a	(a)	4 B 1 a Dairy		NA	NA	NA	NA	14.06	NA	NA	NA	NA	NA	NA	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NA	NR	NR	NR	NR	NA	NA	NR	NR	NR	NR	NR	NR	NR	NR
4 B 1 b	(a)	4 B 1 b Non-Dairy		NA	NA	NA	NA	22.60	NA	NA	NA	NA	NA	NA	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NA	NR	NR	NR	NR	NA	NA	NR	NR	NR	NR	NR	NR	NR	NR
4 B 2	(a)	4 B 2 Buffalo		NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NO	NR	NR	NR	NR	NO	NO	NR	NR	NR	NR	NR	NR	NR	NR
4 B 3	(a)	4 B 3 Sheep		NA	NA	NA	NA	0.83	NA	NA	NA	NA	NA	NA	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NA	NR	NR	NR	NR	NA	NA	NR	NR	NR	NR	NR	NR	NR	NR
4 B 4	(a)	4 B 4 Goats		NA	NA	NA	NA	0.14	NA	NA	NA	NA	NA	NA	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NA	NR	NR	NR	NR	NA	NA	NR	NR	NR	NR	NR	NR	NR	NR
4 B 5	(a)	4 B 5 Camels and Llamas		NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NO	NR	NR	NR	NR	NO	NO	NR	NR	NR	NR	NR	NR	NR	NR
4 B 6	(a)	4 B 6 Horses		NA	NA	NA	NA	0.73	NA	NA	NA	NA	NA	NA	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NA	NR	NR	NR	NR	NA	NA	NR	NR	NR	NR	NR	NR	NR	NR
4 B 7	(a)	4 B 7 Mules and Asses		IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	IE	NR	NR	NR	NR	IE	IE	NR	NR	NR	NR	NR	NR	NR	NR
4 B 8	(a)	4 B 8 Swine		NA	NA	NA	NA	9.38	NA	NA	NA	NA	NA	NA	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NA	NR	NR	NR	NR	NA	NA	NR	NR	NR	NR	NR	NR	NR	NR
4 B 9	(a)	4 B 9 Poultry		NA	NA	NA	NA	5.18	NA	NA	NA	NA	NA	NA	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NA	NR	NR	NR	NR	NA	NA	NR	NR	NR	NR	NR	NR	NR	NR
4 B 13	(a)	4 B 13 Other		NA	NA	NA	NA	0.11	NA	NA	NA	NA	NA	NA	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NA	NR	NR	NR	NR	NA	NA	NR	NR	NR	NR	NR	NR	NR	NR
4 C	(a)	4 C RICE CULTIVATION		NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NO	NR	NR	NR	NR	NO	NO	NR	NR	NR	NR	NR	NR	NR	NR
4 D 1	(a)	4 D 1 Direct Soil Emission		5.19	NA	1.76	NA	7.32	27.51	5.77	1.35	NA	NA	NA	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NA	NR	NR	NR	NR	NA	NA	NR	NR	NR	NR	NR	NR	NR	NR
4 F	(a)	4 F FIELD BURNING OF AGRICULTURAL WASTES		0.03	1.12	0.11	0.00	0.04	NE	NE	NE	0.01	0.00	0.00	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	0.15	NR	NR	NR	NR	0.20	0.03	NR	NR	NR	NR	NR	NR	NR	NR
4 G	(a)	4 G OTHER (d)		NA	NA	NA	NA	NA	4.33	3.61	0.79	NA	NA	NA	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NA	NR	NR	NR	NR	NA	NA	NR	NR	NR	NR	NR	NR	NR	NR
5 B	(a)	5 B FOREST AND GRASSLAND CONVERSION		NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NE	NR	NR	NR	NR	NE	NE	NR	NR	NR	NR	NR	NR	NR	NR

Notes are listed at the end of the table.

NFR sectors to be reported to LRTAP			A = Allowable Aggregation	Yearly minimum reporting																														Additional reporting							
				Main Pollutants					Particulate Matter			Priority Heavy Metals			Persistent Organic Pollutants (POPs) Annex I (1)									POPs Annex II (2)			POPs Annex III (3)							Other Heavy Metals						Other POPs (4	
																												PAH													
				NOx	CO	NMVOC	SOx	NH3	TSP	PM10	PM2.5	Pb	Cd	Hg	Aldrin	Chlordane	Chlordeco	Dieldrin	Endrin	Heptachlo	Hexabrom	Mirex	Toxaphene	HCH	DDT	PCB	DIOX	benzo(a	benzo(b	benzo(k	Indeno	Total 1	HCB	As	Cr	Cu	Ni	Se	Zn	PCP	SCCP
				Gg NO_2	Gg	Gg	Gg SO_2	Gg	Gg	Gg	Gg	Mg	Mg	Mg	kg	kg	kg	kg	kg	kg	kg	kg	kg	kg	kg	kg	g I-Teq	Mg	Mg	Mg	Mg	Mg	kg	Mg	Mg	Mg	Mg	Mg	Mg	kg	kg
6 A	(a)	6 A SOLID WASTE DISPOSAL ON LAND		NA	6.30	0.08	NA	0.00	0.18	0.09	0.03	0.00	0.00	0.00	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NA	NR	NR	NR	NR	NA	NA	NR	NR	NR	NR	NR	NR	NR	NR
6 B	(a)	6 B WASTE-WATER HANDLING		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NA	NR	NR	NR	NR	NA	NA	NR	NR	NR	NR	NR	NR	NR	NR
6 C	(a)	6 C WASTE INCINERATION (e)		0.05	0.01	0.00	0.06	0.00	NE	NE	NE	0.01	0.00	0.02	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	0.17	NR	NR	NR	NR	0.00	0.03	NR	NR	NR	NR	NR	NR	NR	NR
6 D	(a)	6 D OTHER WASTE (f)		NA	NA	NA	NA	0.99	NA	NA	NA	NA	NA	NA	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NA	NR	NR	NR	NR	NA	NA	NR	NR	NR	NR	NR	NR	NR	NR
7	(a)	7 OTHER		NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NO	NR	NR	NR	NR	NO	NO	NR	NR	NR	NR	NR	NR	NR	NR
NATIONAL TOTAL	(g)	National Total for the entire territory (2002 Guidelines)		225.06	720.31	154.14	26.41	63.94	91.34	45.53	26.12	13.57	1.08	0.98	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	42.62	NR	NR	NR	NR	8.87	45.41	NR	NR	NR	NR	NR	NR	NR	NR
Memo Items. NOT TO BE INCLUDED IN NATIONAL TOTALS IF NOT OTHERWISE STATED																																									
SNAP NATIONAL	(g)	National Total for the entire territory (1997 Guidelines)		225.06	720.31	154.14	26.41	63.94	91.34	45.53	26.12	13.57	1.08	0.98	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	42.62	NR	NR	NR	NR	8.87	45.41	NR	NR	NR	NR	NR	NR	NR	NR
GRID TOTAL	(h)	National Total for the EMEP grid domain		225.06	720.31	154.14	26.41	63.94	91.34	45.53	26.12	13.57	1.08	0.98	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	42.62	NR	NR	NR	NR	8.87	45.41	NR	NR	NR	NR	NR	NR	NR	NR
1 A 3 a i (i	(a)	International Aviation (LTO)		0.84	0.79	0.31	0.06	0.00	0.07	0.07	0.07	0.00	0.00	0.00	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NE	NR	NR	NR	NR	NE	NE	NR	NR	NR	NR	NR	NR	NR	NR
1 A 3 a i (i	(a)	International Aviation (Cruise)		4.69	0.92	0.41	0.49	0.00	0.53	0.53	0.53	0.00	0.00	0.00	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NE	NR	NR	NR	NR	NE	NE	NR	NR	NR	NR	NR	NR	NR	NR
1 A 3 d i (	(a)	International maritime Navigation		NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NO	NR	NR	NR	NR	NO	NO	NR	NR	NR	NR	NR	NR	NR	NR
1 A 3 d i (	(a)	International inland waterways (Included in NEC totals only)		NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NO	NR	NR	NR	NR	NO	NO	NR	NR	NR	NR	NR	NR	NR	NR
5 E	(a)	5 E Other		0.97	NA	124.62	NA	NA	NA	NA	NA	NA	NA	NA	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NA	NR	NR	NR	NR	NA	NA	NR	NR	NR	NR	NR	NR	NR	NR
X		X (11 08 Volcanoes)		NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NO	NR	NR	NR	NR	NO	NO	NR	NR	NR	NR	NR	NR	NR	NR

(a) Sectors already reported to UNFCCC for NOx, CO, NMVOC, SO2.
(b) Including Product handling.
(c) Including NH3 from Enteric Fermentation.
(d) Including PM sources.
(e) Excludes waste incineration for energy (this is included in 1 A 1).
(f) Includes accidental fires.
(g) National Total refers to the territory declared upon ratification of the relevant Protocol of the Convention.
(h) EMEP grid domain is defined in the Emission Reporting Guidelines (ECE/EB.AIR/80/Annex V)

Note 1: Main Pollutants should cover the time span from 1980 to latest year.
HM should cover the time span from 1990 to latest year.
POPs should cover the time span from 1990 to the latest year.
PM should cover the time span from 2000 to latest year.

Note 2: The A=Allowable Aggregation illustrates the level of aggregation that can be used if more detailed information is not available.
Grey cells show which sectors can be aggregated into the sector marked A. Black cells occur when two possible levels of aggregation are possible.

Note 3: (1) The POPs listed in annex I to the Protocol on POPs are substances scheduled for elimination; DDT and PCBs are also listed in annex I;
(2) The POPs listed in annex II to the Protocol on POPs are substances scheduled for restrictions on use;
(3) The POPs listed in annex III to the Protocol on POPs are substances referred to in article 3, para. 5 (a), of the Protocol. Polycyclic aromatic hydrocarbons (PAHs): For the purpose of the emission inventories, the following four indicator compounds should be used: benzo(b)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene and indeno(1,2,3-cd)pyrene. HCB is also included in annex I to the Protocol as a substance for elimination.
(4) See article 8 of the Protocol (Research, development and monitoring; reporting voluntary).

Footnotes to NFR

FOOTNOTES IV 1: National sector emissions: Main pollutants, particulate matter (PM), heavy metals (HM) and persistent organic pollutants (POP).

Table IV 1 F1: Definition of Notation Keys

See: Chapter 1

Table 1 F2: Explanation to the Notation key NE

NFR code	Substance(s)	Reason for reporting NE
1.A.3.a i	DIOX, PAH, HCB	No measurements or emission factors available
1.A.3.a ii	DIOX, PAH, HCB	No measurements or emission factors available.
1.A.3.e i	DIOX	No measurements or emission factors available. However, DIOX emissions from this category seem to be negligible (NA could be reported alternatively)
1.B.2.a.vi	all	No other emission sources from 1.B.2.a are known.
4.F	TSP, PM10, PM2.5	No sufficient information.
6.C	TSP, PM10, PM2.5	No sufficient information.

Table IV 1 F3: Explanation to the Notation key IE

NFR code	Substance(s)	Included in NFR code
1.A.1.b	NMVOC	1 B 2 a iv
1.B.1.b	all	1 A 2 a
1 B 2 c	all	1 B 2 a i
2 A 5	NMVOC	3
2 A 6	NMVOC	3
2 B 1	NMVOC	2 B 5
2 C	NH_3	1 A 2 a
4 B 7 Mules and Asses	NH_3	4 B 6 Horses
4 D 1 ii Animal waste applied to soil	NH_3	4 B 1 to 4 B13
4 D 2 pasture range and paddock	NO_x, NH_3, TSP, PM10, PM2.5	4 D 1

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

NFR code	Sub-source description	Substance(s) reported
1A2f		NO_x, SO_2, CO, NMVOC, NH_3, TSP, PM10, PM2.5, PAH, HCB, DIOX, Cd, Hg, Pb
1A3 e	1 A 3 e i Pipeline compressors	NO_x, CO, NMVOC, NH_3, TSP, PM10, PM2.5, PAH, HCB
1A5a		
1A5b		
1B1 c		none
1B2 a vi		none
2 A 7	diffuse emissions from construction, mining and food production	TSP, PM10, PM2.5
2 B 5	emissions from other organic and inorganic chemical industries	NO_x, CO, NMVOC, SO_x, NH_3, TSP, PM10, PM2.5, Pb, Cd, Hg
2 G	emissions from use of NH3 as refrigerant	NH_3
3 D		
4 B 13	wild animals, mainly deer (pasture)	NH_3
4 G	particle emissions from animal husbandry	TSP, PM10, PM2.5
6 D		
7		
5E		

Table IV 1 F5: Basis for estimating emissions from mobile sources. Please tick off with X.

NFR code	Description	Fuel sold	Fuel used	Comment
1 A 3 a i (i)	International Aviation (LTO)	x		
1 A 3 a i (ii)	International Aviation (Cruise)	x		
1 A 3 a ii (i)	1 A 3 a ii Civil Aviation (Domestic, LTO)	x		
1 A 3 a ii (ii)	1 A 3 a ii Civil Aviation (Domestic, Cruise)	x		
1A3b	Road transport	x		
1A3c	Railways	x		
1A3di (i)	International maritime Navigation			
1A3di (ii)	International inland waterways (Included in NEC totals only)			
1A3dii	National Navigation	x		
1A4ci	Agriculture	x		
1A4cii	Off-road Vehicles and Other Machinery	x		
1A4ciii	National Fishing	x		
1 A 5 b	Other, Mobile (Including military)	x		

Austria's emissions for SO_2, NO_x, NMVOC and NH_3 according to the submission under NEC directive

The following table presents Austria's emissions based on fuel used – thus excluding 'fuel tourism'[99] – as submitted under Directive 2001/81/EC.

Table A-1: Austria's emissions 1990–2005 without 'fuel tourism' according to Directive 2001/81/EC, Article 8 (1).

	SO_2 [Gg]	NO_x [Gg]	NMVOC [Gg]	NH_3 [Gg]
1990	74.77	220.84	285.02	68.81
1991	71.38	217.23	269.00	70.08
1992	54.96	208.13	242.06	67.85
1993	53.20	199.70	238.42	68.04
1994	47.60	195.86	220.52	69.14
1995	46.64	189.72	218.60	70.73
1996	44.17	186.71	211.15	69.05
1997	40.16	189.06	197.97	69.23
1998	35.06	182.43	181.41	69.21
1999	33.41	178.98	170.02	67.98
2000	30.96	172.70	168.45	66.27
2001	32.43	172.16	170.35	66.03
2002	31.25	168.52	163.36	64.73
2003	31.87	168.11	158.60	64.61
2004	27.20	162.04	153.18	63.86
2005	26.35	159.17	149.85	63.65
Ceilings 2010	39.00	103.00	159.00	66.00

[99] For information regarding fuel tourism please refer to Chapter 1.7 Completeness

Emission Trends per Sector

Table A-2: Emission trends for SO_2 [Gg] 1980–2005.

	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	330.27	327.71	2.56	13.14	NA	0.04	NE	0.41	NO	343.86	0.12
1981	287.92	286.02	1.89	13.02	NA	0.04	NE	0.41	NO	301.38	0.13
1982	273.70	271.96	1.75	12.89	NA	0.04	NE	0.41	NO	287.05	0.12
1983	198.96	197.37	1.59	12.77	NA	0.04	NE	0.41	NO	212.19	0.15
1984	181.82	180.15	1.67	12.65	NA	0.04	NE	0.41	NO	194.93	0.20
1985	166.33	164.80	1.53	12.07	NA	0.05	NE	0.41	NO	178.86	0.21
1986	147.78	146.32	1.46	11.28	NA	0.04	NE	0.41	NO	159.52	0.19
1987	126.88	125.36	1.52	10.28	NA	0.04	NE	0.41	NO	137.61	0.21
1988	98.44	96.80	1.65	3.92	NA	0.05	NE	0.22	NO	102.64	0.23
1989	88.68	86.95	1.73	3.31	NA	0.05	NE	0.14	NO	92.18	0.28
1990	71.92	69.92	2.00	2.22	NA	0.00	NE	0.07	NO	74.22	0.28
1991	69.39	68.09	1.30	1.90	NA	0.00	NE	0.06	NO	71.35	0.32
1992	53.20	51.20	2.00	1.67	NA	0.00	NE	0.04	NO	54.91	0.34
1993	51.85	49.75	2.10	1.42	NA	0.00	NE	0.04	NO	53.32	0.36
1994	46.09	44.81	1.28	1.42	NA	0.00	NE	0.05	NO	47.56	0.38
1995	45.39	43.86	1.53	1.37	NA	0.00	NE	0.05	NO	46.81	0.42
1996	43.31	42.11	1.20	1.29	NA	0.00	NE	0.05	NO	44.66	0.47
1997	39.03	38.97	0.07	1.27	NA	0.00	NE	0.05	NO	40.35	0.48
1998	34.33	34.29	0.04	1.18	NA	0.00	NE	0.05	NO	35.56	0.50
1999	32.56	32.42	0.14	1.12	NA	0.00	NE	0.06	NO	33.74	0.49
2000	30.27	30.12	0.15	1.09	NA	0.00	NE	0.06	NO	31.41	0.53
2001	31.75	31.59	0.16	1.21	NA	0.00	NE	0.06	NO	33.02	0.52
2002	30.65	30.51	0.14	1.21	NA	0.00	NE	0.06	NO	31.92	0.48
2003	31.36	31.21	0.15	1.21	NA	0.00	NE	0.06	NO	32.63	0.41
2004	25.98	25.84	0.14	1.22	NA	0.00	NE	0.06	NO	27.26	0.49
2005	25.13	25.00	0.13	1.22	NA	0.00	NE	0.06	NO	26.41	0.55

Table A-3: Emission trends for NO_x [Gg] 1980–2005.

	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	226.91	226.91	IE	13.98	NA	6.66	NE	0.25	NO	**247.81**	1.15
1981	213.37	213.37	IE	12.71	NA	6.63	NE	0.25	NO	**232.96**	1.25
1982	210.19	210.19	IE	11.45	NA	6.80	NE	0.25	NO	**228.70**	1.15
1983	213.55	213.55	IE	10.27	NA	6.91	NE	0.25	NO	**230.99**	1.44
1984	214.52	214.52	IE	9.07	NA	7.04	NE	0.25	NO	**230.88**	1.94
1985	219.95	219.95	IE	7.88	NA	7.06	NE	0.25	NO	**235.15**	2.11
1986	214.81	214.81	IE	6.68	NA	6.95	NE	0.25	NO	**228.70**	1.87
1987	212.94	212.94	IE	5.49	NA	7.19	NE	0.25	NO	**225.88**	2.07
1988	208.75	208.75	IE	5.27	NA	7.14	NE	0.17	NO	**221.33**	2.28
1989	203.65	203.65	IE	4.99	NA	6.92	NE	0.13	NO	**215.70**	2.79
1990	200.09	200.09	IE	4.80	NA	6.09	NE	0.10	NO	**211.07**	2.77
1991	211.45	211.45	IE	4.48	NA	6.32	NE	0.09	NO	**222.34**	3.12
1992	198.87	198.87	IE	4.55	NA	5.96	NE	0.06	NO	**209.44**	3.40
1993	194.58	194.58	IE	1.98	NA	5.72	NE	0.05	NO	**202.33**	3.61
1994	186.26	186.26	IE	1.92	NA	6.13	NE	0.04	NO	**194.36**	3.77
1995	184.38	184.38	IE	1.46	NA	6.19	NE	0.05	NO	**192.07**	4.23
1996	204.77	204.77	IE	1.42	NA	5.86	NE	0.05	NO	**212.10**	4.66
1997	191.86	191.86	IE	1.50	NA	5.92	NE	0.05	NO	**199.32**	4.85
1998	204.55	204.55	IE	1.46	NA	5.92	NE	0.05	NO	**211.98**	5.01
1999	192.58	192.58	IE	1.44	NA	5.76	NE	0.05	NO	**199.83**	4.92
2000	197.62	197.62	IE	1.54	NA	5.61	NE	0.05	NO	**204.82**	5.36
2001	206.59	206.59	IE	1.57	NA	5.57	NE	0.05	NO	**213.78**	5.21
2002	212.71	212.71	IE	1.63	NA	5.51	NE	0.05	NO	**219.90**	4.88
2003	222.48	222.48	IE	1.34	NA	5.41	NE	0.05	NO	**229.28**	4.17
2004	218.04	218.04	IE	1.28	NA	5.26	NE	0.05	NO	**224.63**	4.90
2005	218.50	218.50	IE	1.29	NA	5.22	NE	0.05	NO	**225.06**	5.53

Table A-4: Emission trends for NMVOC [Gg] 1980–2005.

	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	198.71	185.97	12.74	17.73	210.53	4.55	NE	0.16	NO	**431.68**	0.13
1981	198.88	186.64	12.24	17.12	187.39	4.48	NE	0.16	NO	**408.03**	0.14
1982	197.85	186.31	11.53	16.76	184.22	4.60	NE	0.16	NO	**403.60**	0.13
1983	200.06	188.71	11.35	16.24	181.11	4.51	NE	0.16	NO	**402.09**	0.16
1984	203.60	192.10	11.50	15.73	178.05	4.57	NE	0.16	NO	**402.12**	0.22
1985	203.00	191.48	11.52	15.21	172.82	4.61	NE	0.16	NO	**395.80**	0.24
1986	198.27	186.67	11.60	14.83	171.65	4.52	NE	0.16	NO	**389.42**	0.21
1987	196.85	185.09	11.76	14.36	170.50	4.54	NE	0.16	NO	**386.41**	0.23
1988	182.93	171.27	11.67	14.57	169.36	4.66	NE	0.16	NO	**371.67**	0.26
1989	171.89	159.98	11.91	14.54	148.42	4.61	NE	0.16	NO	**339.63**	0.32
1990	154.68	142.47	12.22	11.10	116.95	1.85	NE	0.16	NO	**284.74**	0.31
1991	157.33	144.16	13.16	12.58	100.08	1.84	NE	0.16	NO	**271.99**	0.35
1992	145.16	132.04	13.12	13.78	82.33	1.78	NE	0.15	NO	**243.21**	0.38
1993	139.41	126.55	12.86	15.05	82.43	1.75	NE	0.15	NO	**238.79**	0.41
1994	127.44	117.19	10.26	13.57	77.06	1.81	NE	0.14	NO	**220.02**	0.44
1995	122.55	113.73	8.83	11.95	81.75	1.82	NE	0.13	NO	**218.19**	0.48
1996	121.14	113.24	7.90	10.37	78.07	1.80	NE	0.12	NO	**211.50**	0.57
1997	103.37	96.01	7.37	9.06	82.93	1.88	NE	0.12	NO	**197.37**	0.63
1998	97.50	91.65	5.85	7.71	75.54	1.84	NE	0.11	NO	**182.71**	0.69
1999	92.48	87.35	5.13	6.04	69.96	1.88	NE	0.11	NO	**170.47**	0.67
2000	85.00	79.83	5.16	4.96	77.74	1.78	NE	0.10	NO	**169.58**	0.70
2001	83.44	80.13	3.31	4.38	82.63	1.86	NE	0.10	NO	**172.40**	0.68
2002	79.20	75.73	3.47	4.57	80.95	1.85	NE	0.10	NO	**166.68**	0.64
2003	77.35	73.91	3.44	4.26	79.27	1.73	NE	0.10	NO	**162.71**	0.54
2004	73.29	70.02	3.27	4.40	77.59	1.97	NE	0.09	NO	**157.34**	0.64
2005	72.01	68.92	3.09	4.40	75.77	1.87	NE	0.09	NO	**154.14**	0.72

Table A-5: Emission trends for NH_3 [Gg] 1980–2005.

	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	1.41	1.41	IE	0.31	NA	62.09	NE	0.01	NO	**63.81**	< 0.01
1981	1.32	1.32	IE	0.30	NA	62.88	NE	0.01	NO	**64.50**	< 0.01
1982	1.31	1.31	IE	0.29	NA	63.42	NE	0.01	NO	**65.02**	< 0.01
1983	1.28	1.28	IE	0.28	NA	64.86	NE	0.01	NO	**66.42**	< 0.01
1984	1.31	1.31	IE	0.29	NA	65.51	NE	0.01	NO	**67.11**	< 0.01
1985	1.35	1.35	IE	0.28	NA	65.14	NE	0.01	NO	**66.77**	< 0.01
1986	1.37	1.37	IE	0.26	NA	64.47	NE	0.01	NO	**66.10**	< 0.01
1987	1.37	1.37	IE	0.26	NA	64.76	NE	0.01	NO	**66.39**	< 0.01
1988	1.34	1.34	IE	0.28	NA	63.39	NE	0.01	NO	**65.02**	< 0.01
1989	1.36	1.36	IE	0.27	NA	63.54	NE	0.01	NO	**65.17**	< 0.01
1990	2.04	2.04	IE	0.27	NA	66.12	NE	0.38	NO	**68.81**	< 0.01
1991	2.50	2.50	IE	0.51	NA	66.78	NE	0.39	NO	**70.19**	< 0.01
1992	2.69	2.69	IE	0.37	NA	64.40	NE	0.45	NO	**67.91**	< 0.01
1993	2.96	2.96	IE	0.22	NA	64.34	NE	0.54	NO	**68.06**	< 0.01
1994	3.04	3.04	IE	0.17	NA	65.27	NE	0.62	NO	**69.10**	< 0.01
1995	3.08	3.08	IE	0.10	NA	66.86	NE	0.64	NO	**70.68**	< 0.01
1996	3.10	3.10	IE	0.10	NA	65.08	NE	0.67	NO	**68.94**	< 0.01
1997	2.99	2.99	IE	0.10	NA	65.35	NE	0.65	NO	**69.10**	< 0.01
1998	3.03	3.03	IE	0.10	NA	65.40	NE	0.67	NO	**69.20**	< 0.01
1999	2.93	2.93	IE	0.12	NA	64.15	NE	0.71	NO	**67.90**	< 0.01
2000	2.73	2.73	IE	0.10	NA	62.68	NE	0.73	NO	**66.24**	< 0.01
2001	2.79	2.79	IE	0.08	NA	62.47	NE	0.74	NO	**66.09**	< 0.01
2002	2.74	2.74	IE	0.06	NA	61.38	NE	0.76	NO	**64.95**	< 0.01
2003	2.76	2.76	IE	0.08	NA	61.19	NE	0.87	NO	**64.90**	< 0.01
2004	2.58	2.58	IE	0.06	NA	60.72	NE	0.80	NO	**64.16**	< 0.01
2005	2.49	2.49	IE	0.07	NA	60.39	NE	0.99	NO	**63.94**	< 0.01

Table A-6:Emission trends for CO [Gg] 1980–2005.

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	1 688.5	1 688.5	IE	52.8	NA	31.1	NA	10.7	NO	1 783.2	0.35
1981	1 647.6	1 647.6	IE	50.7	NA	28.6	NA	10.8	NO	1 737.6	0.38
1982	1 623.7	1 623.7	IE	48.3	NA	32.9	NA	10.8	NO	1 715.7	0.35
1983	1 602.8	1 602.8	IE	47.9	NA	32.8	NA	10.8	NO	1 694.2	0.44
1984	1 649.1	1 649.1	IE	48.1	NA	35.1	NA	10.8	NO	1 743.0	0.59
1985	1 618.4	1 618.4	IE	46.7	NA	36.3	NA	10.7	NO	1 712.1	0.64
1986	1 556.7	1 556.7	IE	44.7	NA	33.2	NA	10.6	NO	1 645.2	0.57
1987	1 487.9	1 487.9	IE	44.9	NA	34.2	NA	10.6	NO	1 577.7	0.63
1988	1 380.6	1 380.6	IE	45.9	NA	38.2	NA	10.9	NO	1 475.6	0.69
1989	1 327.2	1 327.2	IE	46.3	NA	36.4	NA	11.3	NO	1 421.2	0.85
1990	1 161.8	1 161.8	IE	46.4	NA	1.2	NA	11.4	NO	1 220.8	0.85
1991	1 186.9	1 186.9	IE	41.7	NA	1.2	NA	11.3	NO	1 241.1	0.93
1992	1 139.9	1 139.9	IE	45.0	NA	1.1	NA	11.0	NO	1 197.0	1.01
1993	1 095.0	1 095.0	IE	47.2	NA	1.1	NA	10.9	NO	1 154.1	1.08
1994	1 041.6	1 041.6	IE	48.6	NA	1.2	NA	10.3	NO	1 101.7	1.14
1995	954.1	954.1	IE	45.1	NA	1.2	NA	9.7	NO	1 010.1	1.26
1996	971.3	971.3	IE	39.4	NA	1.2	NA	9.2	NO	1 021.1	1.41
1997	906.3	906.3	IE	38.3	NA	1.2	NA	8.7	NO	954.6	1.52
1998	870.4	870.4	IE	34.9	NA	1.2	NA	8.4	NO	914.9	1.62
1999	826.0	826.0	IE	30.6	NA	1.2	NA	8.1	NO	865.9	1.59
2000	766.0	766.0	IE	27.4	NA	1.1	NA	7.7	NO	802.3	1.65
2001	756.5	756.5	IE	24.2	NA	1.2	NA	7.4	NO	789.3	1.61
2002	723.5	723.5	IE	23.9	NA	1.2	NA	7.3	NO	755.8	1.51
2003	728.8	728.8	IE	23.6	NA	1.1	NA	7.4	NO	760.8	1.29
2004	705.0	705.0	IE	23.9	NA	1.7	NA	6.8	NO	737.4	1.51
2005	689.0	689.0	IE	23.9	NA	1.1	NA	6.3	NO	720.3	1.71

Table A-7: Emission trends for Cd [Mg] 1985–2005.

	NFR-Sectors										
year	**1**	**1 A**	**1 B**	**2**	**3**	**4**	**5**	**6**	**7**		
	ENERGY	**FUEL COMBUSTION ACTIVITIES**	**FUGITIVE EMISSIONS FROM FUELS**	**INDUSTRIAL PROCESSES**	**SOLVENT AND OTHER PRODUCT USE**	**AGRICULTURE**	**LAND USE CHANGE AND FORESTRY**	**WASTE**	**OTHER**	**NATIONAL TOTAL**	**International Bunkers**
1985	2.08	2.08	NE	0.84	0.00	0.04	NE	0.14	NO	**3.10**	0.00
1986	1.82	1.82	NE	0.71	0.00	0.04	NE	0.12	NO	**2.70**	0.00
1987	1.41	1.41	NE	0.65	0.00	0.04	NE	0.10	NO	**2.21**	0.00
1988	1.19	1.19	NE	0.62	0.00	0.05	NE	0.08	NO	**1.94**	0.00
1989	1.06	1.06	NE	0.58	0.00	0.04	NE	0.06	NO	**1.74**	0.00
1990	1.06	1.06	NE	0.46	0.00	0.00	NE	0.06	NO	**1.57**	0.00
1991	1.09	1.09	NE	0.38	0.00	0.00	NE	0.05	NO	**1.52**	0.00
1992	0.97	0.97	NE	0.26	0.00	0.00	NE	0.01	NO	**1.24**	0.00
1993	0.93	0.93	NE	0.22	0.00	0.00	NE	0.00	NO	**1.16**	0.00
1994	0.87	0.87	NE	0.18	0.00	0.00	NE	0.00	NO	**1.06**	0.00
1995	0.80	0.80	NE	0.16	0.00	0.00	NE	0.00	NO	**0.97**	0.00
1996	0.84	0.84	NE	0.15	0.00	0.00	NE	0.00	NO	**0.99**	0.00
1997	0.81	0.81	NE	0.16	0.00	0.00	NE	0.00	NO	**0.97**	0.00
1998	0.73	0.73	NE	0.16	0.00	0.00	NE	0.00	NO	**0.89**	0.00
1999	0.81	0.81	NE	0.17	0.00	0.00	NE	0.00	NO	**0.98**	0.00
2000	0.75	0.75	NE	0.18	0.00	0.00	NE	0.00	NO	**0.93**	0.00
2001	0.80	0.80	NE	0.18	0.00	0.00	NE	0.00	NO	**0.99**	0.00
2002	0.81	0.81	NE	0.19	0.00	0.00	NE	0.00	NO	**1.00**	0.00
2003	0.83	0.83	NE	0.19	0.00	0.00	NE	0.00	NO	**1.03**	0.00
2004	0.83	0.83	NE	0.20	0.00	0.00	NE	0.00	NO	**1.03**	0.00
2005	0.86	0.86	NE	0.22	0.00	0.00	NE	0.00	NO	**1.08**	0.00

Table A-8: Emission trends for Hg [Mg] 1985–2005.

	NFR-Sectors										
year	**1**	**1 A**	**1 B**	**2**	**3**	**4**	**5**	**6**	**7**		
	ENERGY	**FUEL COMBUSTION ACTIVITIES**	**FUGITIVE EMISSIONS FROM FUELS**	**INDUSTRIAL PROCESSES**	**SOLVENT AND OTHER PRODUCT USE**	**AGRICULTURE**	**LAND USE CHANGE AND FORESTRY**	**WASTE**	**OTHER**	**NATIONAL TOTAL**	**International Bunkers**
1985	2.98	2.98	NE	0.67	NA	0.01	NE	0.09	NO	**3.74**	0.00
1986	2.60	2.60	NE	0.63	NA	0.01	NE	0.08	NO	**3.32**	0.00
1987	2.16	2.16	NE	0.61	NA	0.01	NE	0.07	NO	**2.84**	0.00
1988	1.78	1.78	NE	0.59	NA	0.01	NE	0.06	NO	**2.45**	0.00
1989	1.59	1.59	NE	0.58	NA	0.01	NE	0.06	NO	**2.24**	0.00
1990	1.56	1.56	NE	0.53	NA	0.00	NE	0.05	NO	**2.14**	0.00
1991	1.50	1.50	NE	0.49	NA	0.00	NE	0.05	NO	**2.04**	0.00
1992	1.18	1.18	NE	0.44	NA	0.00	NE	0.02	NO	**1.64**	0.00
1993	0.95	0.95	NE	0.41	NA	0.00	NE	0.02	NO	**1.39**	0.00
1994	0.76	0.76	NE	0.40	NA	0.00	NE	0.02	NO	**1.18**	0.00
1995	0.71	0.71	NE	0.47	NA	0.00	NE	0.02	NO	**1.20**	0.00
1996	0.71	0.71	NE	0.43	NA	0.00	NE	0.02	NO	**1.16**	0.00
1997	0.69	0.69	NE	0.43	NA	0.00	NE	0.02	NO	**1.14**	0.00
1998	0.60	0.60	NE	0.33	NA	0.00	NE	0.01	NO	**0.95**	0.00
1999	0.65	0.65	NE	0.28	NA	0.00	NE	0.01	NO	**0.94**	0.00
2000	0.64	0.64	NE	0.24	NA	0.00	NE	0.01	NO	**0.90**	0.00
2001	0.71	0.71	NE	0.24	NA	0.00	NE	0.01	NO	**0.96**	0.00
2002	0.67	0.67	NE	0.26	NA	0.00	NE	0.01	NO	**0.94**	0.00
2003	0.69	0.69	NE	0.26	NA	0.00	NE	0.01	NO	**0.96**	0.00
2004	0.66	0.66	NE	0.27	NA	0.00	NE	0.02	NO	**0.95**	0.00
2005	0.65	0.65	NE	0.30	NA	0.00	NE	0.02	NO	**0.98**	0.00

Table A-9: Emission trends for Pb [Mg] 1985–2005.

	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	258.11	258.11	NE	62.45	0.06	0.23	NE	5.85	NO	**326.70**	0.00
1986	255.02	255.02	NE	52.38	0.06	0.21	NE	5.27	NO	**312.94**	0.00
1987	249.21	249.21	NE	47.85	0.06	0.22	NE	4.69	NO	**302.04**	0.00
1988	224.18	224.18	NE	45.16	0.07	0.24	NE	2.59	NO	**272.23**	0.00
1989	195.69	195.69	NE	41.74	0.07	0.23	NE	1.64	NO	**239.36**	0.00
1990	173.66	173.66	NE	32.09	0.07	0.01	NE	1.02	NO	**206.85**	0.00
1991	143.23	143.23	NE	27.09	0.06	0.01	NE	0.78	NO	**171.17**	0.00
1992	100.14	100.14	NE	18.61	0.06	0.01	NE	0.49	NO	**119.30**	0.00
1993	70.19	70.19	NE	15.15	0.05	0.01	NE	0.38	NO	**85.78**	0.00
1994	47.05	47.05	NE	12.03	0.05	0.01	NE	0.27	NO	**59.40**	0.00
1995	11.33	11.33	NE	4.68	0.04	0.01	NE	0.01	NO	**16.08**	0.00
1996	11.18	11.18	NE	4.26	0.04	0.01	NE	0.01	NO	**15.50**	0.00
1997	9.69	9.69	NE	4.79	0.04	0.01	NE	0.01	NO	**14.55**	0.00
1998	8.23	8.23	NE	4.70	0.04	0.01	NE	0.01	NO	**12.99**	0.00
1999	7.67	7.67	NE	4.91	0.04	0.01	NE	0.01	NO	**12.64**	0.00
2000	6.38	6.38	NE	5.48	0.04	0.01	NE	0.01	NO	**11.91**	0.00
2001	6.92	6.92	NE	5.35	0.04	0.01	NE	0.01	NO	**12.34**	0.00
2002	6.84	6.84	NE	5.65	0.04	0.01	NE	0.01	NO	**12.55**	0.00
2003	7.05	7.05	NE	5.68	0.04	0.01	NE	0.01	NO	**12.79**	0.00
2004	7.18	7.18	NE	5.90	0.04	0.01	NE	0.01	NO	**13.14**	0.00
2005	7.02	7.02	NE	6.49	0.03	0.01	NE	0.01	NO	**13.57**	0.00

Table A-10: Emission trends for PAH [Mg] 1985–2005.

	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	11.94	11.94	NE	7.88	0.15	7.07	NE	0.00	NO	**27.04**	NE
1986	11.27	11.27	NE	7.82	0.15	7.06	NE	0.00	NO	**26.31**	NE
1987	11.08	11.08	NE	7.91	0.15	7.06	NE	0.00	NO	**26.21**	NE
1988	9.94	9.94	NE	7.46	0.15	7.06	NE	0.00	NO	**24.61**	NE
1989	9.45	9.45	NE	7.57	0.15	7.06	NE	0.00	NO	**24.23**	NE
1990	9.44	9.44	NE	7.44	0.15	0.24	NE	0.00	NO	**17.27**	NE
1991	10.29	10.29	NE	7.18	0.15	0.24	NE	0.00	NO	**17.86**	NE
1992	9.36	9.36	NE	3.59	0.11	0.24	NE	0.00	NO	**13.30**	NE
1993	9.26	9.26	NE	0.52	0.07	0.24	NE	0.00	NO	**10.10**	NE
1994	8.37	8.37	NE	0.59	0.06	0.24	NE	0.00	NO	**9.26**	NE
1995	8.83	8.83	NE	0.49	0.04	0.24	NE	0.00	NO	**9.60**	NE
1996	9.56	9.56	NE	0.90	0.02	0.24	NE	0.00	NO	**10.71**	NE
1997	8.58	8.58	NE	0.47	0.01	0.23	NE	0.00	NO	**9.29**	NE
1998	8.28	8.28	NE	0.41	NA	0.23	NE	0.00	NO	**8.93**	NE
1999	8.32	8.32	NE	0.25	NA	0.23	NE	0.00	NO	**8.80**	NE
2000	7.73	7.73	NE	0.19	NA	0.23	NE	0.00	NO	**8.16**	NE
2001	8.51	8.51	NE	0.18	NA	0.23	NE	0.00	NO	**8.93**	NE
2002	8.17	8.17	NE	0.19	NA	0.23	NE	0.00	NO	**8.60**	NE
2003	8.33	8.33	NE	0.19	NA	0.23	NE	0.00	NO	**8.75**	NE
2004	8.16	8.16	NE	0.20	NA	0.29	NE	0.00	NO	**8.65**	NE
2005	8.45	8.45	NE	0.22	NA	0.20	NE	0.00	NO	**8.87**	NE

Table A-11: Emission trends for Dioxin [g] 1985–2005.

	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	109.55	109.55	NE	51.30	5.19	5.05	NE	15.90	NO	**186.98**	NE
1986	107.67	107.67	NE	51.02	6.20	5.05	NE	15.89	NO	**185.84**	NE
1987	115.67	115.67	NE	50.81	0.24	5.05	NE	15.89	NO	**187.67**	NE
1988	109.66	109.66	NE	41.60	1.06	5.05	NE	15.48	NO	**172.85**	NE
1989	101.49	101.49	NE	41.13	1.06	5.05	NE	15.29	NO	**164.02**	NE
1990	101.56	101.56	NE	39.00	1.06	0.18	NE	18.19	NO	**159.99**	NE
1991	80.65	80.65	NE	35.15	1.04	0.18	NE	17.75	NO	**134.77**	NE
1992	53.54	53.54	NE	21.89	0.02	0.18	NE	0.53	NO	**76.15**	NE
1993	49.15	49.15	NE	17.01	0.02	0.18	NE	0.22	NO	**66.58**	NE
1994	44.38	44.38	NE	11.26	NA	0.18	NE	0.08	NO	**55.90**	NE
1995	45.68	45.68	NE	12.23	NA	0.18	NE	0.08	NO	**58.17**	NE
1996	48.19	48.19	NE	11.17	NA	0.18	NE	0.08	NO	**59.62**	NE
1997	47.15	47.15	NE	12.15	NA	0.17	NE	0.08	NO	**59.55**	NE
1998	44.42	44.42	NE	11.45	NA	0.17	NE	0.08	NO	**56.12**	NE
1999	41.01	41.01	NE	12.60	NA	0.17	NE	0.08	NO	**53.86**	NE
2000	37.29	37.29	NE	14.05	NA	0.17	NE	0.08	NO	**51.60**	NE
2001	41.04	41.04	NE	13.55	NA	0.17	NE	0.08	NO	**54.84**	NE
2002	38.83	38.83	NE	3.24	NA	0.17	NE	0.08	NO	**42.32**	NE
2003	38.98	38.98	NE	2.98	NA	0.17	NE	0.12	NO	**42.25**	NE
2004	37.67	37.67	NE	3.30	NA	0.21	NE	0.16	NO	**41.34**	NE
2005	38.76	38.76	NE	3.54	NA	0.15	NE	0.17	NO	**42.62**	NE

Table A-12: Emission trends for HCB [kg] 1985–2005.

	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	83.08	83.08	NE	13.27	7.71	1.01	NE	1.11	NO	**106.18**	NE
1986	80.12	80.12	NE	13.21	8.12	1.01	NE	1.11	NO	**103.57**	NE
1987	82.88	82.88	NE	13.18	8.11	1.01	NE	1.11	NO	**106.29**	NE
1988	76.51	76.51	NE	11.16	8.22	1.01	NE	0.70	NO	**97.61**	NE
1989	72.54	72.54	NE	11.06	9.34	1.01	NE	0.52	NO	**94.48**	NE
1990	72.31	72.31	NE	9.71	9.05	0.04	NE	0.39	NO	**91.51**	NE
1991	69.52	69.52	NE	8.03	6.39	0.04	NE	0.28	NO	**84.25**	NE
1992	56.65	56.65	NE	4.94	7.49	0.04	NE	0.11	NO	**69.22**	NE
1993	53.42	53.42	NE	3.70	6.47	0.04	NE	0.04	NO	**63.68**	NE
1994	47.90	47.90	NE	2.45	1.25	0.04	NE	0.02	NO	**51.65**	NE
1995	50.12	50.12	NE	2.67	0.00	0.04	NE	0.02	NO	**52.84**	NE
1996	53.14	53.14	NE	2.44	0.00	0.04	NE	0.02	NO	**55.64**	NE
1997	49.12	49.12	NE	2.65	0.00	0.03	NE	0.02	NO	**51.83**	NE
1998	46.43	46.43	NE	2.50	0.00	0.03	NE	0.02	NO	**48.98**	NE
1999	44.89	44.89	NE	2.76	0.00	0.03	NE	0.02	NO	**47.70**	NE
2000	40.76	40.76	NE	3.07	0.00	0.03	NE	0.02	NO	**43.89**	NE
2001	44.96	44.96	NE	2.98	0.00	0.03	NE	0.02	NO	**47.99**	NE
2002	41.99	41.99	NE	3.17	NA	0.03	NE	0.02	NO	**45.21**	NE
2003	42.03	42.03	NE	3.18	NA	0.03	NE	0.02	NO	**45.27**	NE
2004	40.22	40.22	NE	3.30	NA	0.04	NE	0.03	NO	**43.59**	NE
2005	41.65	41.65	NE	3.69	NA	0.03	NE	0.03	NO	**45.41**	NE

Table A-13: Emission trends for TSP [Mg] 1990–2005.

	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	32 631	31 984	647	25 170	NA	33 603	NE	168	NO	91 572	307
1995	32 548	32 003	545	26 579	NA	29 325	NE	184	NO	88 636	456
2000	32 609	32 110	500	29 667	NA	31 903	NE	75	NO	94 255	530
2001	31 616	31 060	556	28 743	NA	29 145	NE	112	NO	89 616	576
2002	32 845	32 258	587	28 307	NA	31 137	NE	109	NO	92 398	560
2003	32 677	32 079	598	28 172	NA	30 635	NE	127	NO	91 611	524
2004	33 078	32 423	655	27 705	NA	28 365	NE	154	NO	89 303	448
2005	32 699	32 090	609	27 733	NA	33 995	NE	192	NO	94 619	526

Table A-14: Emission trends for PM 10 [Mg] 1990–2005.

	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	24 225	23 920	305	13 846	NA	9 440	NE	80	NO	47 592	307
1995	23 575	23 318	257	13 902	NA	8 728	NE	87	NO	46 292	456
2000	23 204	22 969	236	15 246	NA	9 678	NE	36	NO	48 164	530
2001	22 196	21 934	263	14 814	NA	8 457	NE	53	NO	45 520	576
2002	23 231	22 954	277	14 615	NA	8 971	NE	52	NO	46 868	560
2003	22 955	22 673	282	14 217	NA	8 832	NE	60	NO	46 064	524
2004	23 224	22 915	309	13 989	NA	8 639	NE	73	NO	45 925	448
2005	22 761	22 473	287	13 969	NA	9 761	NE	91	NO	46 581	526

Table A-15: Emission trends for PM 2.5 [Mg] 1990–2005.

	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	21 136	21 041	95	5 189	NA	2 256	NE	26	NO	28 606	307
1995	20 608	20 528	80	4 898	NA	2 033	NE	27	NO	27 566	456
2000	20 183	20 110	74	5 150	NA	2 188	NE	11	NO	27 532	530
2001	19 254	19 172	82	5 018	NA	1 989	NE	17	NO	26 277	576
2002	20 151	20 064	87	4 957	NA	2 094	NE	16	NO	27 218	560
2003	19 898	19 810	88	4 710	NA	2 057	NE	19	NO	26 685	524
2004	20 106	20 009	97	4 640	NA	1 964	NE	23	NO	26 733	448
2005	19 663	19 572	90	4 622	NA	2 249	NE	29	NO	26 562	526