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# Austria's National Inventory Report 2009

Submission under the United Nations Framework Convention on Climate Change

umweltbundesamt

# AUSTRIA'S NATIONAL INVENTORY REPORT 2009

## Submission under the United Nations Framework Convention on Climate Change

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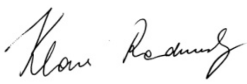
| Total number of pages<br>386 Pages (excluding Annex)<br>210 Pages Annex | <br>Dr. Klaus Radunsky<br>(Head of the inspection body) |



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# EXECUTIVE SUMMARY

## ES.1 Background Information

As a Party to the United Nations Framework Convention on Climate Change (UNFCCC), Austria is required to produce and regularly update National Greenhouse Gas Inventories. To date, National Greenhouse Gas Inventories have been produced for the years 1990 to 2007.

With decision 18/CP.8 (see document FCCC/CP/2002/8/Add.2) the Conference of the Parties (COP) adopted the UNFCCC guidelines on reporting and reviewing (FCCC/CP/2002/8), which were revised concerning the land use, land use change and forestry sector by decisions 13/CP.9 and 14/CP.11[1]. According to this decision Parties shall submit a National Inventory Report (NIR) containing detailed and complete information on their inventories, in order to ensure the transparency of the inventory (see paragraph 38 of FCCC/CP/2002/8). This is the nineth version of the National Inventory Report (NIR) submitted by Austria, it is an update of the NIR submitted in 2008[2]. This report is based on data submitted to the UNFCCC in the common reporting format (CRF submission 2008). They differ from last year's reported data as some activity data have been updated or changes in methodology have been made retrospectively to enhance the accuracy of the greenhouse gas inventory (for further information see Chapter 9 Recalculations and Improvements). The inventory as presented in the NIR 2009 and as submitted to the UNFCCC in the data submission 2009 replaces all previous versions of data submissions.

The structure of the NIR follows the proposal as included in Appendix A of document FCCC/SBSTA/2002/8. First, there is an Executive Summary that gives an overview of Austria's greenhouse gas inventory. Chapters 1 and 2 provide general information on the inventory preparation process and summarize the overall trends in emissions. Comprehensive information on the methodologies used for estimating emissions of Austria's greenhouse gas inventory is presented in the Sector Analysis Chapters 3–8. Chapter 9 gives an overview of actions planned to further improve the inventory and of changes previously made (recalculations), it also describes improvements made in response to the UNFCCC reviews.

The underlying emission data for the year 2007 as reported in the tables of the common reporting format of the data submission 2009 to the Convention are also included as well as abbreviations and references used. Furthermore detailed results from the key category analysis, detailed information on the methodology of emission estimates for the fuel combustion sector, the $CO_2$ reference approach and the National Energy Balance, as well as information on gas specific recalculations and the uncertainty assessment are presented in the Annexes. In this submission, information under Article 7.1 of the Kyoto Protocol regarding changes to the national system and registry, information on Kyoto Protocol Units[3] and methodological information concerning activities under Article 3.3 of the Kyoto Protocol is included.

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[1] For an updated version of the UNFCCC reporting guidelines on annual inventories following incorporation of the provisions of decision 14/CP.11 see FCCC/SBSTA/2006/9 http://unfccc.int/resource/docs/2006/sbsta/eng/09.pdf

[2] Austria's National Inventory Report 2008 – Submission under the United Nations Framework Convention of Climate Change. Reports, Bd. REP-0152; Umweltbundesamt, Vienna.

[3] All unit types specified in the Kyoto Protocol, which Kyoto Parties can use for their compliance. One Kyoto unit equals one tonne of carbon dioxide equivalent emissions.

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

Manfred Ritter in his function as head of the *Department of Emissions & Climate Change* of the *Umweltbundesamt* is responsible for the preparation and review of Austria's National Greenhouse Gas Inventory as well as for the preparation of the NIR.

Klaus Radunsky in his function as head of the *Inspection Body for Emission Inventories* is responsible for the content of this report and for the quality management system of the Austrian Greenhouse Gas Inventory.

Project leader for the preparation of the Austrian air pollutant inventory is Stephan Poupa.

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## ES.2 Summary of National Emission and Removal Related Trends

The most important GHG in Austria is carbon dioxide ($CO_2$), it contributed 84.3% to the total national GHG emissions expressed in $CO_2$ equivalents in 2007, followed by $CH_4$, 7.9% and $N_2O$, 6.1%. PFCs, HFCs and $SF_6$ amounted together to 1.7% of the overall GHG emissions in the country. The energy sector accounted for 75.2% of the total GHG emissions followed by Industrial Processes 12.8%, Agriculture 9.0% and Waste 2.5%.

Total GHG emissions (excluding land-use change and forestry (LULUCF)) amounted to 87 958 Gg $CO_2$ equivalents and increased by 11.3% from 1990 to 2007. The base year for all greenhouse gases is 1990.

*Table 1: Austria's greenhouse gas emissions by sector.*

| **GHG Source and Sink categories** | | Total (with emissions from LULUCF) | **Total (without emissions from LULUCF)** | 1. Energy | 2. Industrial Processes | 3. Solvent and Other Product Use | 4. Agriculture | 5. Land Use, Land Use Change and Forestry | 6. Waste |
|---|---|---|---|---|---|---|---|---|---|
| 1990* | [Gg $CO_2$ equivalent] | 65 858.99 | **79 036.84** | 55 594.99 | 10 110.82 | 511.80 | 9 170.66 | -13 177.85 | 3 648.57 |
| 1991 | | 64 038.10 | **83 121.20** | 59 509.54 | 10 152.82 | 465.98 | 9 353.59 | -19 083.10 | 3 639.26 |
| 1992 | | 62 359.28 | **76 400.94** | 54 579.42 | 8 999.19 | 417.65 | 8 868.31 | -14 041.66 | 3 536.38 |
| 1993 | | 58 384.50 | **76 307.31** | 55 009.32 | 8 750.64 | 418.48 | 8 636.40 | -17 922.81 | 3 492.47 |
| 1994 | | 60 639.38 | **77 209.93** | 55 058.97 | 9 274.83 | 403.26 | 9 136.46 | -16 570.55 | 3 336.42 |
| 1995 | | 64 495.18 | **80 506.24** | 57 929.50 | 9 729.22 | 422.45 | 9 242.05 | -16 011.06 | 3 183.01 |
| 1996 | | 72 655.75 | **83 581.17** | 61 763.26 | 9 601.24 | 405.66 | 8 771.75 | -10 925.41 | 3 039.25 |
| 1997 | | 63 276.35 | **83 132.73** | 60 859.25 | 10 192.53 | 424.37 | 8 745.25 | -19 856.37 | 2 911.33 |
| 1998 | | 64 517.55 | **82 499.73** | 60 846.33 | 9 674.37 | 406.32 | 8 748.54 | -17 982.19 | 2 824.18 |
| 1999 | | 58 555.09 | **80 925.20** | 59 823.96 | 9 391.10 | 392.26 | 8 585.15 | -22 370.12 | 2 732.74 |
| 2000 | | 64 104.18 | **81 078.39** | 59 581.92 | 10 034.18 | 425.06 | 8 386.35 | -16 974.21 | 2 650.88 |
| 2001 | | 65 420.31 | **85 082.78** | 63 829.89 | 9 907.41 | 424.79 | 8 331.73 | -19 662.47 | 2 588.95 |
| 2002 | | 71 106.01 | **87 030.88** | 65 253.03 | 10 591.37 | 428.96 | 8 211.12 | -15 924.88 | 2 546.39 |
| 2003 | | 75 807.26 | **93 111.98** | 71 412.24 | 10 662.20 | 423.34 | 8 020.07 | -17 304.72 | 2 594.13 |
| 2004 | | 74 424.84 | **91 774.79** | 71 056.08 | 9 984.86 | 379.04 | 7 872.85 | -17 349.95 | 2 481.96 |
| 2005 | | 75 679.03 | **92 832.10** | 71 905.71 | 10 306.44 | 393.53 | 7 848.10 | -17 153.07 | 2 378.32 |
| 2006 | | 74 351.94 | **91 518.47** | 70 050.88 | 10 880.85 | 412.16 | 7 880.47 | -17 166.53 | 2 294.10 |
| 2007 | | 70 835.38 | **87 958.35** | 66 146.99 | 11 277.19 | 408.80 | 7 949.49 | -17 122.97 | 2 175.87 |

**1990 = Base Year for $CO_2$, $CH_4$ and $N_2O$, HFCs, PFCs and $SF_6$*

Over the period 1990–2007 $CO_2$ emissions increased by 19.5%, mainly due to increased emissions from transport. Methane emissions decreased during the same period by 24.3% mainly due to lower emissions from solid waste disposal; $N_2O$ emissions decreased by 12.9% over the same period due to lower emissions from agricultural soils and from chemical industry. HFC emissions are 37 times higher in 2007 than in the base year, whereas PFC and $SF_6$ emissions decreased by 83% and 19% from the base year to 2007.

*Table 2: Austria's greenhouse gas emissions by gas.*

| GHG | | Total | $CO_2$ | $CH_4$ | $N_2O$ | HFCs | PFCs | $SF_6$ |
|---|---|---|---|---|---|---|---|---|
| 1990* | [Gg $CO_2$ equivalent] | **79 036.84** | 62 081.53 | 9 183.05 | 6 167.40 | 23.03 | 1 079.24 | 502.58 |
| 1991 | | **83 121.20** | 65 671.09 | 9 161.93 | 6 502.52 | 45.21 | 1 087.08 | 653.36 |
| 1992 | | **76 400.94** | 60 226.24 | 8 874.04 | 6 091.46 | 48.68 | 462.67 | 697.85 |
| 1993 | | **76 307.31** | 60 542.84 | 8 851.12 | 5 909.39 | 157.34 | 52.90 | 793.71 |
| 1994 | | **77 209.93** | 60 929.63 | 8 658.55 | 6 370.62 | 206.83 | 58.61 | 985.70 |
| 1995 | | **80 506.24** | 63 965.30 | 8 541.81 | 6 523.93 | 267.34 | 68.69 | 1 139.16 |
| 1996 | | **83 581.17** | 67 407.08 | 8 352.11 | 6 190.88 | 346.84 | 66.20 | 1 218.05 |
| 1997 | | **83 132.73** | 67 200.32 | 8 074.58 | 6 213.50 | 427.42 | 96.75 | 1 120.15 |
| 1998 | | **82 499.73** | 66 774.88 | 7 953.10 | 6 324.22 | 494.89 | 44.65 | 907.99 |
| 1999 | | **80 925.20** | 65 553.99 | 7 780.01 | 6 300.60 | 542.20 | 64.44 | 683.96 |
| 2000 | | **81 078.39** | 65 951.25 | 7 621.43 | 6 203.92 | 596.26 | 72.21 | 633.31 |
| 2001 | | **85 082.78** | 70 056.03 | 7 526.83 | 6 086.84 | 694.45 | 82.02 | 636.62 |
| 2002 | | **87 030.88** | 72 014.92 | 7 412.94 | 6 094.24 | 781.21 | 86.73 | 640.83 |
| 2003 | | **93 111.98** | 78 055.04 | 7 460.41 | 6 037.66 | 862.96 | 102.39 | 593.52 |
| 2004 | | **91 774.79** | 77 590.77 | 7 312.98 | 5 335.53 | 896.71 | 125.68 | 513.12 |
| 2005 | | **92 832.10** | 79 008.75 | 7 177.58 | 5 326.14 | 907.91 | 125.22 | 286.50 |
| 2006 | | **91 518.47** | 77 586.14 | 7 080.04 | 5 375.65 | 860.74 | 135.67 | 480.24 |
| 2007 | | **87 958.35** | 74 176.54 | 6 955.61 | 5 373.29 | 860.63 | 182.71 | 409.58 |

**1990 = Base Year for $CO_2$, $CH_4$ and $N_2O$, HFCs, PFCs and $SF_6$*

*NOTE: Emissions without LULUCF*

## ES.3 Overview of Source and Sink Category Emission Estimates and Trends

In 2007, 66 147 Gg $CO_2$ equivalents, that is 75.2% of total national emissions, arose from the energy sector. In 2007, 98.6% of these emissions arose from fuel combustion activities. The most important fuel combustion sub-sector in 2007 was transport with a share of 37%. From 1990 to 2007, emissions from the energy sector increased by 19.0%.

Industrial processes was the second largest sector in Austria with 12.8% of total GHG emissions in 2007 (11 227 Gg $CO_2$ equivalents). The main source of greenhouse gas emissions from industrial processes was metal production, which caused 49% of the emissions from this sector in 2007. From the base year to 2007, emissions from industrial processes increased by 11.5%.

In 2007, 0.5% of total GHG emissions in Austria (409 Gg $CO_2$ equivalent) arose from solvent and other product use. From 1990 to 2007, emissions from this category decreased by 20%.

Emissions from agriculture amounted to 7 949 Gg $CO_2$ equivalent in 2007, which corresponded to 9.0% of total national emissions. In 2007 the most important sub-sector enteric fermentation contributed with 40% to total greenhouse gas emissions from the agriculture sector. In 2007 emissions from this category were 13.3% below the level of the base year.

In 2007 the greenhouse gas emissions from the waste sector amounted to 2 176 Gg $CO_2$ equivalents which corresponded to 2.5% of the total national emissions. The main source of greenhouse gas emissions in this sector was solid waste disposal on land, which caused 80.1% of emissions. In 2007 emissions from this category were 40% below emissions in the base year.

## ES.4 Overview of Emission Estimates and Trends of Indirect GHGs and $SO_2$

Emission estimates of indirect GHGs and $SO_2$ are presented in Table 3.

*Table 3: Emissions of indirect GHGs and $SO_2$ 1990–2007.*

| | | NOx | CO | NMVOC | $SO_2$ |
|---|---|---|---|---|---|
| 1990 | [Gg] | 192.17 | 1 432.19 | 273.51 | 74.32 |
| 1991 | | 201.92 | 1 502.78 | 265.13 | 71.42 |
| 1992 | | 190.92 | 1 469.75 | 239.55 | 55.02 |
| 1993 | | 185.08 | 1 437.13 | 239.68 | 53.38 |
| 1994 | | 178.56 | 1 367.51 | 221.81 | 47.77 |
| 1995 | | 178.68 | 1 256.43 | 221.81 | 47.37 |
| 1996 | | 200.65 | 1 235.75 | 213.60 | 44.62 |
| 1997 | | 188.75 | 1 143.85 | 199.43 | 40.15 |
| 1998 | | 203.73 | 1 099.46 | 184.15 | 35.58 |
| 1999 | | 196.06 | 1 026.09 | 170.82 | 33.81 |
| 2000 | | 203.85 | 954.35 | 175.74 | 31.59 |
| 2001 | | 214.44 | 946.35 | 180.02 | 32.73 |
| 2002 | | 224.51 | 930.16 | 185.03 | 31.63 |
| 2003 | | 236.04 | 952.86 | 188.41 | 32.56 |
| 2004 | | 234.96 | 911.04 | 170.06 | 27.50 |
| 2005 | | 238.79 | 868.66 | 178.31 | 27.11 |
| 2006 | | 226.67 | 837.52 | 186.30 | 28.87 |
| 2007 | | 219.22 | 767.56 | 179.38 | 25.52 |

Emissions of indirect greenhouse gases except $NO_x$ decreased in the period from 1990 to 2007: for NMVOCs by 34%, for CO by 46% and for $SO_2$ emissions by 66%; NOx emissions increased by 14% over the considered period.

The most important emission source for $NO_x$, $SO_2$ and CO is fuel combustion. The most important emission source for NMVOC is Solvent and other Product Use.

# 1 INTRODUCTION

## 1.1 Background Information

### Global Warming

By deforestation people have influenced the local and regional climate at all times. But since the beginning of industrialization in the middle of the 18th century mankind has influenced the climate also globally by emitting greenhouse gases like carbon dioxide, methane, nitrous oxide as well as various fluorinated and chlorinated gases.

The average surface temperature of the earth has risen by about 0.6–0.9°C in the past 100 years and, according to the fourth assessment report of the IPCC, will rise by another 1.8–4.0°C in the next 100 years, depending on the emission scenario.

The increase of the average surface temperature of the earth will lead, with the increase of the surface temperature of the oceans and the continents, to changes in the hydrologic cycle as well as to modification of the albedo (total reflectivity of the earth) and to significant changes of the atmospheric circulation which drives rainfall, wind and temperature on the regional scale. This will increase the risk of extreme weather events such as hurricanes, typhoons, tornadoes, severe storms, droughts and floods.

### Climate Change in Austria

The effects of global warming in Austria are manifold because the Alps as well as the region along the Danube have a very high vulnerability to climate change, which is reflected in the overall change in temperature of the Alps of +1.8° C in the past 150 years. That is significantly higher than the global average (which is about 0.7°C).

Even more important than the average temperature for agriculture, energy production, tourism etc. is precipitation. So far experts think that north of the Alps rainfall will increase, possibly leading to a higher frequency of extreme floods, whereas south of the Alps there could be a higher risk for droughts. An exact regionalization of these trends is substantial for adjustments in spatial planning, agriculture and forestry, tourism, flood control measures etc. Being aware of the need for further research in this matter, Austria launched StartClim and FloodRisk as well as ProVision, three research programmes, in 2003 and 2005 respectively.

### The Convention, its Kyoto Protocol and the flexible mechanisms thereunder

In 1992 Austria signed the United Nations Framework Convention on Climate Change (UNFCCC) which sets an ultimate objective of stabilizing atmospheric concentrations of greenhouse gases at levels that would prevent "dangerous" human interference with the climate system. Such levels, which the Convention does not quantify, should be achieved within a time frame sufficient to allow ecosystems to adapt naturally to climate change, to ensure that food production is not threatened and to enable economic development to proceed in a sustainable manner.

The UNFCCC covers all greenhouse gases not covered by the Montreal protocol[4]: carbon dioxide ($CO_2$), methane ($CH_4$), nitrous oxide ($N_2O$) as well as hydrogenated fluorocarbons (HFCs), perfluorated halocarbons (PFCs) and sulphur hexafluoride ($SF_6$).

Five years after adoption of the Climate Change Convention in 1997, governments took a further step forward and adopted the landmark Kyoto Protocol. Building on the Convention, the Kyoto Protocol broke new ground with its legally binding constraints on greenhouse gas emissions and its innovative "mechanisms" aimed at cutting the cost of curbing emissions. Under the terms of the Protocol, the industrialised world – known as Annex 1 countries – pledged to reduce their greenhouse (GHG) emissions by 5% below 1990 levels by the period 2008–2012. The European Union is also a Party to the Convention and the KP and agreed on a reduction target of 8% below 1990 levels during the five-year commitment period from 2008 to 2012. The EU and its Member States decided to achieve this goal jointly, for Austria an emission target of minus 13% was set.

The KP entered into force on 16 February 2005, triggered by Russia's ratification in November 2004 which fulfilled the requirement that at least 55 Parties to the Convention ratified (or approved, accepted, or acceded to) the Protocol, including Annex I Parties accounting for 55% of that group's carbon dioxide emissions in 1990: by May 2008, 182 Parties had ratified the KP, accounting for 63.7% of emissions of Annex 1 Parties.

The Protocol sets out three 'flexible mechanisms' to help countries meet their obligations to cut emissions.

- *Emission Trading*: Article 17 of the Kyoto Protocol allows Annex I Parties (basically, the industrialised nations) to purchase the rights to emit greenhouse gases (GHG) from other Annex I countries which have reduced their GHG emissions below their assigned amounts. Trading can be carried out by intergovernmental emission trading, or entity-source trading where assigned amounts are allocated to sub-national entities.
- *Joint Implementation*: Article 6 allows an Annex I Party to gain a credit (converted to Assigned Amounts) by investing in another Annex I country in a project which reduces GHG emissions.
- *Clean Development Mechanism*: Article 12 allows an Annex I country (or companies in an Annex 1 country) which funds projects in developing countries (non-Annex I Party) to get credits for certified emission reductions providing that "benefits" accrue for the host country.

Tradable emission permits tie the emissions to a fixed ceiling, the costs of emission reduction being as low as possible.

### National Greenhouse Gas Inventories

As a Party to the Convention, Austria is required to produce and regularly update National Greenhouse Gas Inventories. To date, National Greenhouse Gas Inventories have been produced for the years 1990 to 2007. Furthermore Parties shall submit a National Inventory Report (NIR) containing detailed and complete information on their inventories, in order to ensure the transparency of the inventory.

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[4] The Montreal Protocol sets the elimination of ozone-depleting substances as its final objective and covers chloro and bromo fluorocarbons.

Responsible for the preparation of Austria's National Greenhouse Gas Inventory as well as the preparation of the NIR is the *Department of Air Emissions* of the Umweltbundesamt in Vienna; since 2005 it is accreditated as *Inspection Body for Emission Inventories* according to ISO/IEC 17020.

For the purpose of Quality Assurance, resulting from increased requirements of transparency, consistency, comparability, completeness and accuracy of the national greenhouse gas inventory as set by the new standards defined in the KP, the inventories have been annually reviewed by international experts managed by the Climate Secretariat in Bonn (expert review team ERT) since 2003. To date, Austria's Greenhouse Gas Inventory was reviewed by an in-country review and a centralized review in 2001 during the trial period of the review process as well as during the centralized reviews in 2003, 2004, 2005 and 2008. In February 2007 the in-country review of the initial report of Austria took place, it included the review of assigned amount, the national inventory system and the national registry. The reports on these reviews can be found on the UNFCCC website[5].

## 1.2 Institutional Arrangement for Inventory Preparation

### 1.2.1 Austria's Obligations

Austria has to comply with the following obligations:

- Austria's annual obligation under the UNECE Convention on Long-range Transboundary Air Pollution (CLRTAP) and its Protocols (1979) comprising the annual reporting of national emission data on SO2, NOX, NMVOCs, NH3, CO, TSP, PM10, and PM2.5 as well as on the heavy metals Pb, Cd and Hg and persistent organic hydrocarbons (PAHs), dioxins and furans and hexachlorobenzene (HCB).
- Austria's annual obligations under the European Council Decision 280/2004/EC ("Monitoring Decision"; replacing Decision 389/1992/EEC amended by Decision 296/1999/EEC) concerning a mechanism for monitoring Community greenhouse gas emissions and for implementing the Kyoto Protocol.
- Austria's obligations under the United Nations Framework Convention on Climate Change UNFCCC and the Kyoto Protocol. Relevant COP (Conference of the Parties) or CMP (Meeting of the Parties to the Kyoto Protocol) Decisions and Guidelines are:
- Decision 11/CP.4 National communications from Parties included in Annex I to the Convention.
- Decision 3/CP.5 Guidelines for the Preparation of National Communications by Parties included in Annex I to the Convention, Part I: UNFCCC Reporting Guidelines on Annual Inventories (referring to Document FCCC/CP/1999/7) revised with Decision 18/CP.8 (referring to Document FCCC/CP/2002/8).

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[5] http://unfccc.int/resource/webdocs/iri(2)/2001/aut.pdf,
http://unfccc.int/resource/webdocs/iri(3)/2001/aut.pdf,
http://unfccc.int/files/national_reports/annex_i_ghg_inventories/inventory_review_reports/application/pdf/autrep03.pdf,
http://unfccc.int/files/national_reports/annex_i_ghg_inventories/inventory_review_reports/application/pdf/2004_irr_centralized_review_austria.pdf,
http://unfccc.int/resource/docs/2006/arr/aut.pdf
http://unfccc.int/resource/docs/2007/irr/aut.pdf and http://unfccc.int/resource/docs/2007/arr/aut.pdf

- Decision 4/CP.5 Guidelines for the Preparation of National Communications by Parties included in Annex I to the Convention, Part II: UNFCCC Reporting Guidelines on National Communications (referring to Document FCCC/CP/1999/7) revised with Decision 19/CP.8 (referring to Document FCCC/CP/2002/8).
- Decision 20/CP.7 (19/CMP.1): Guidelines for national systems under Article 5, paragraph 1, of the Kyoto Protocol;
- Decision 21/CP.7 (20/CMP.1): Good practice guidance and adjustments under Article 5, paragraph 2, of the Kyoto Protocol;
- Decision 22/C.7 (15.CMP.1): Guidance for the preparation of the information required under Article 7 of the Kyoto Protocol;
- Decision 23/CP.7 (22/CMP.1): Guidelines for review under Article 8 of the Kyoto Protocol).
- Decision 6/CMP.3 Good practice guidance for land use, land-use change and forestry activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol
- Obligation under the Austrian Ambient Air Quality Law[6] concerning the reporting of national emission data on $SO_2$, NOx, NMVOC, CO, heavy metals (Pb, Cd, Hg), benzene and particulate matter.
- Austria's obligation according to Article 15 of the European IPPC Directive 1996/61/EC is to implement a European Pollutant Emission Register (EPER). EPER was displaced and upgraded by regulation (EC) No 166/2006 concerning the establishment of a European Pollutant Release and Transfer Register (E-PRTR Regulation). EPER and E-PRTR are associated with Article 6 of the Aarhus Convention (United Nations: Aarhus, 1998) which refers to the right of the public to access environmental information and to participate in the decision-making process of environmental issues.

### 1.2.2 History of NISA

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

- Austria established estimates for $SO_2$ under EMEP in 1978 (Cooperative Programme for Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe).
- As an EFTA country Austria participated in CORINAIR 90, which was an air emission inventory for Europe. It was part of the CORINE (Coordination d'Information Environmentale) work plan set up by the European Council of Ministers in 1985. The aim of CORINAIR 90 was to produce a complete, consistent and transparent emission inventory for the pollutants: SOx as $SO_2$, $NO_X$ as $NO_2$, NMVOC, $CH_4$, CO, $CO_2$, $N_2O$ and $NH_3$.
- Austria signed the UNFCCC on June 8, 1992 and subsequently submitted its instrument of ratification on February 28, 1994.
- In 1994 the first so-called Austrian Air Emission Inventory (Österreichische Luftschadstoff-Inventur, OLI) was prepared.
- In 1997 a consistent time series for the emission data from 1980 to 1995 was reported for the first time.

[6] AUSTRIAN AMBIENENT AIR QUALITY LAW (1997): Immissionsschutzgesetz-Luft. Federal Law Gazette I 115/1997.

- In 1998 also emissions of HM, POPs and FCs were included in the inventory.
- Inventory data for particulate matter were included in the inventory in 2001.
- In 2005 accreditation according to ISO/IEC 17020 as *Inspection Body for Emission Inventories.*

### 1.2.3 Responsibilities

Austria's reporting obligations to the UNFCCC, UNECE and EC are administered by the Federal Ministry of Agriculture, Forestry, Environment and Water Management (BMLFUW). With the Environmental Control Act ("Umweltkontrollgesetz"; Federal Law Gazette 152/1998) that entered into force on the 1st of January 1999 the Umweltbundesamt has been designated as single national entity with overall responsibility for inventory preparation. This law regulates responsibilities of environmental control in Austria and lists the tasks of the Umweltbundesamt. One task is the preparation of technical expertise and the data basis for fulfilment of the obligations under the UNFCCC and the UNECE LRTAP Convention. Thus the Umweltbundesamt prepares and annually updates the Austrian air emissions inventory ("Österreichische Luftschadstoff-Inventur OLI"), which covers greenhouse gases and emissions of other air pollutants as stipulated in the reporting obligations further explained in Chapter 1.2.1.

Within the Umweltbundesamt the department of *Emissions and Climate Change* is responsible for the preparation of the Austrian Air Emission Inventory ("Österreichische Luftschadstoff-Inventur OLI") and all work related to inventory preparation. Responsibilities are divided by sectors between sector experts from Departments within the Umweltbundesamt (see Figure 1). The "*Inspection body for GHG inventory*" within the Umweltbundesamt is responsible for the compilation of the greenhouse gas inventory. The quality system is maintained and updated under the responsibility of the Quality Manager. The Quality Manager has direct access to the top management.

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

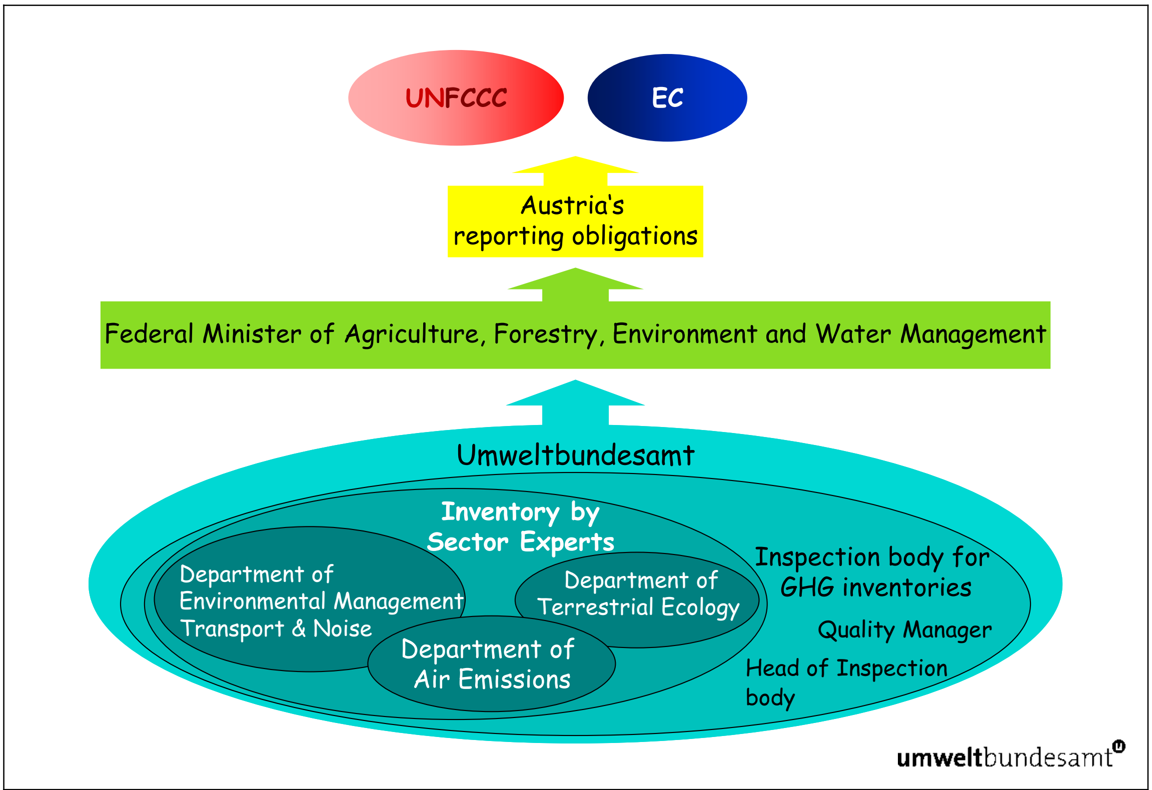


*Figure 1: Responsibilities in the Austrian National System for Greenhouse Gas Inventories.*

### 1.2.4 Institutional Arrangements in Place

Besides the Environmental Control Act there are some other legal and institutional arrangements in place as the main basis for the national system:

- Ordinance regarding Monitoring and Reporting of Greenhouse Gas Emissions[7]
- This ordinance pertains to the Austrian Emissions Certificate Trading Act[8] that regulates monitoring and reporting in the context of the EU Emissions Trading scheme (ETS) in Austria.
- Paragraph 15 of this ordinance is designed to ensure consistency of emission trading data with the national inventory. It states that the Umweltbundesamt has to incorporate, as far as necessary, the emission reports of the emissions trading scheme into the national greenhouse gas inventory in order to comply with requirements of the EU Monitoring Mechanism Decision (280/2004/EC) and the UNFCCC. This is not only important for emissions from combustion of fuels, where more detailed information than provided in the national energy balance is available, but also for emissions from industrial processes, where the ordinance ensures data availability for most key categories (see Chapter 4 for details). First data from the EU ETS were available for the year 2005; since then ETS data were considered in the submissions.
- The Austrian statistical office (Statistik Austria) is required by contract with the Federal Ministry of Agriculture, Forestry, Environment and Water Management (BMLFUW) and with the Federal Ministry of Economics and Labour (BMWA) to annually prepare the national energy

[7] „*Verordnung des Bundesministers für Land- und Forstwirtschaft, Umwelt und Wasserwirtschaft über die Überwachung und Berichterstattung betreffend Emissionen von Treibhausgasen*", Federal Law Gazette II No. 458/2004

[8] "*Emissionszertifikate-Gesetz*", Federal Law Gazette I No. 46/2004

balance (the contracts also cover some quality aspects). The energy balance is prepared in line with the methodology of the Organisation for Economic Co-operation and Development (OECD) and is submitted annually to the International Energy Agency (IEA) (IEA/EUROSTAT Joint Questionnaire (JQ) Submission). The national energy balance is the most important data basis for the Austrian Air Emissions Inventory.

- According to national legislation (Bundesstatistikgesetz[9]), the Austrian statistical office has to prepare annual import/export statistics, production statistics and statistics on agricultural issues (livestock counts etc.), providing an important data basis for calculating emissions from the sectors *Industrial Processes*, *Solvents and Other Product Use* and *Agriculture*.
- In order to comply with the reporting obligations, the Umweltbundesamt has the possibility to obtain confidential data from the national statistical institute (of course these data have to be treated confidentially). The legal basis for this data exchange is the "Bundesstatistikgesetz"[9] (federal statistics law), which allows the national statistical office to provide confidential data to authorities that have a legal obligation for the processing of these data.
- According to para 17 (1) of the (EG-K)[10] each licencee of an operating boiler with a thermal capacity of 2 megawatts (MW) or more is obligated to report the emissions to the competent authority. The Umweltbundesamt can request copies of these emission declarations. These data are used to verify the data from the national energy balance for the Energy sector.
- According to the Landfill Ordinance (Deponieverordnung)[11], which came into force in 1997, the operators of landfill sites have to report their activity data annually to the Umweltbundesamt, where they are stored in a landfill database for solid waste disposals (*Deponiedatenbank*). This data provide the main data basis for calculating emissions from the sector *Waste*.
- Since 2004 there is a reporting obligation to the BMLFUW under the Austrian Fluorinated Compounds (FC) Ordinance[12] for users of FCs for the following applications: refrigeration and air-conditioning, foam blowing, semiconductor manufacture, electrical equipment, fire extinguishers and aerosols. These data are used for estimating emissions from the consumption of fluorinated compounds (*IPCC sector 2 F*).

### 1.2.5 Adaptation of NISA according to the Kyoto Protocol

Regulations under the UNFCCC and the Kyoto Protocol define new standards for national emission inventories. These standards include more stringent requirements related to transparency, consistency, comparability, completeness and accuracy of inventories. Each Party shall have in place a national system, no later than one year prior to the start of the first commitment period; this means by the end of 2006. Also the European Community had to implement such a national system, and as this system is also based on the national systems of the member states, member states had to implement their national system earlier than required by the UNFCCC and the KP, namely by 31 December 2005 (Article 4 of the Monitoring Mechanism Decision 280/2004/EC).

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[9] *"Bundesstatistikgesetz"*, Federal Law Gazette I No. 163/1999

[10] „Emissionsschutzgesetz für Kesselanlagen", Federal Law Gazette I No. 150/2004

[11] *„Deponieverordnung",* Federal Law Gazette 164/1996

[12] *„Industriegas-Verordnung (HFKW-FKW-SF6-VO)";* Federal Law Gazette II No. 447/2002

This national system shall include all institutional, legal and procedural arrangements made within a Party for estimating anthropogenic emissions by sources and removals by sinks of all greenhouse gases not controlled by the Montreal Protocol, and for reporting and archiving inventory information.

Austria's aim was to set up a national system that fulfils all the requirements of the Kyoto Protocol and also works as an efficient system to fulfil all the other obligations regarding air emission inventories Austria has to comply with.

The emission inventory system has a structure as illustrated in Figure 2.

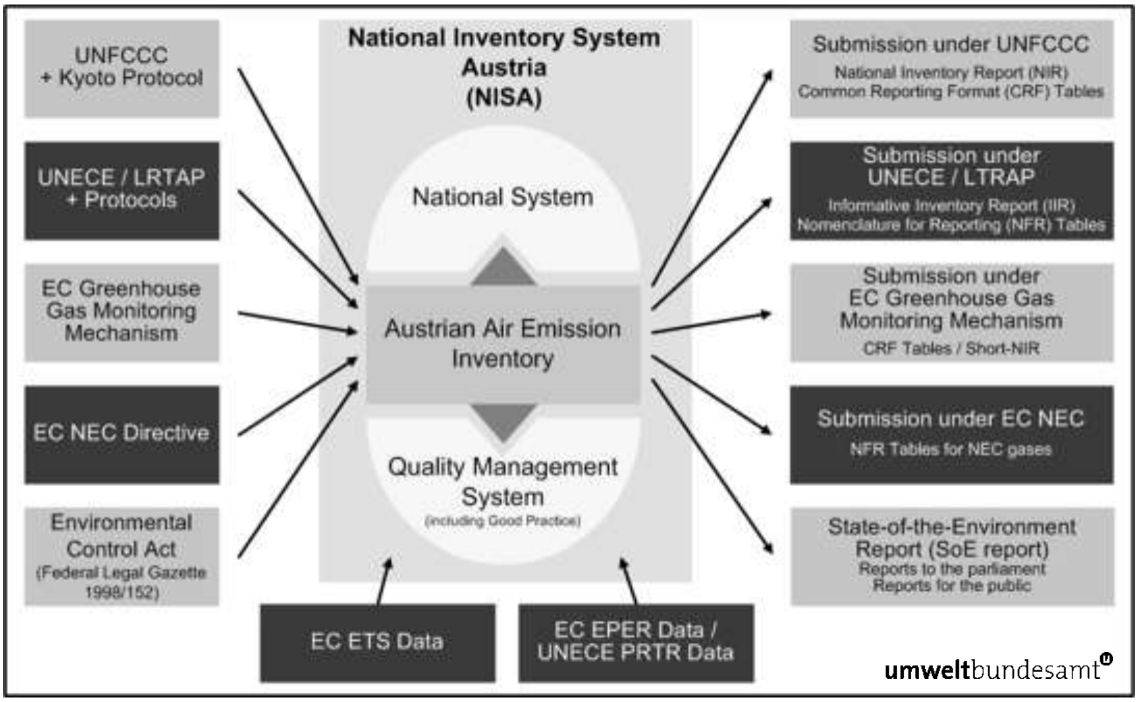


*Figure 2: Structure of the emission inventory system in Austria (NISA).*

The Austrian Air Emission Inventory, comprising all air pollutants stipulated in the various national and international obligations, is at the centre of NISA. The national system and the quality management system have been incorporated into NISA as complementary sections.

The Guidelines for National Systems for the Estimation of Anthropogenic Greenhouse Gas Emissions by Sources and Removals by Sinks under Article 5.1 of the Kyoto Protocol (Decision 19/CMP.1) describe the elements to be included in a national system.

The overall goal of National Systems is to ensure the quality of the inventory through planning, preparation and management of inventory activities. National Systems should enable Parties to estimate emissions in accordance with the relevant inventory guidelines [IPCC Guidelines and Good Practice Guidance (GPG)] to comply with the requirements of the Kyoto Protocol.

The general principles for National Inventories are transparency, consistency, comparability, completeness and accuracy of inventories and the quality of inventory activities (e.g. collecting activity data, selecting methods and emission factors).

The general functions are

- to establish and maintain the institutional, legal, and procedural arrangements defined in the guidelines for national systems between the government agencies and other entities,
- to ensure sufficient capacity for timely performance,
- to designate a single national entity with overall responsibility for the national inventory,
- to prepare national annual inventories and supplementary information in a timely manner and
- to provide information necessary to meet the reporting requirements.

Specific functions stipulated in these guidelines are inventory planning, preparation and management.

Austria has taken significant steps to establish a high-quality emission inventory in which uncertainties are reduced as far as feasible and in which data are developed in a transparent, consistent, complete, comparable and accurate manner.

The following steps have been taken to prepare NISA to meet the requirements of the Kyoto Protocol:

- the Umweltbundesamt has been designated as the single national entity with the overall responsibility for the national inventory by law: the Environmental Control Act ("Umweltkontrollgesetz"; Federal Law Gazette I No. 152/1998) regulates responsibilities of environmental control in Austria and lists the tasks of the Umweltbundesamt. One task is the preparation of technical expertise and basic data for the fulfilment of the obligations under the UNFCCC and the UNECE LRTAP Convention. For further institutional arrangements, please refer to subchapter 1.2.4)
- The responsibilities for inventory planning, preparation and management are specified and allocated within the Umweltbundesamt. Following internal Umweltbundesamt quality management regulation, a yearly plan is implemented to ensure capacity for timely performance of the functions defined in the guidelines for national systems. The technical competence of the staff involved in the inventory preparation process is ensured by arrangements according to the internal Umweltbundesamt training plan.
- The inventory preparation, including identification of key categories, uncertainty estimates and QC procedures, is performed according to the 2000 Intergovernmental Panel on Climate Change (IPCC) Good Practice Guidance (GPG) and Uncertainty Management of Greenhouse Gas Inventories and to the 2003 IPCC GPG for Land Use, Land-Use Change and Forestry.
- A Quality Management System (QMS) has been developed and implemented.
- The national greenhouse gas inventory is prepared by the inspection body for GHG inventories within the Umweltbundesamt which is accredited as inspection body according to the International Standard ISO/IEC 17020 General Criteria for the operation of various types of bodies performing inspections. The accreditation audit of the Umweltbundesamt as inspection body took place in September 2005. The accreditation was completed officially in December 2005.
- The QMS also includes the necessary procedures to ensure quality improvement of the emission inventory. They comprise documentation of allocated responsibilities, of any discrepancies and of the findings by UNFCCC review experts in particular.
- The inventory management as part of the QMS includes a control system for data and calculations, for records and their archiving as well as documentation of QA/QC activities. This ensures the necessary documentation and archiving for future reconstruction of the inventory and for the timely response to requests during the review process.

- Part of the legal and institutional arrangements in place to provide a basis for the national system pertains to data availability for the annual compilation of the GHG inventory. The main data source for the Austrian inventory preparation is the Austrian statistical office (Statistik Austria). The compilation of several statistics is regulated by law; the compilation of the national energy balance is regulated by contracts. Other data sources include reporting obligations under national and European regulations and reports of companies and associations.
- A process for official consideration and approval of the inventory prior to its submission is established. The inventory information is provided by the Umweltbundesamt to the Federal Ministry of Agriculture, Forestry, Environment and Water Management, where the National Focal Point for the UNFCCC is established. The inventory is then submitted by the Ministry to the UNFCCC secretariat.

The Austrian national system was reviewed during the in-country review of the initial report of Austria (February 2007). Para 10 of the review report (FCCC/IRR/2007/AUT) states that the national system has been developed in line with the relevant guidelines and can fulfil the requirements of the Kyoto Protocol as well as other obligations regarding its air emissions inventory that Austria has to comply with.

## 1.3 Inventory Preparation Process

The present Austrian greenhouse gas inventory for the period 1990 to 2007 was compiled according to the recommendations for inventories set out in the UNFCCC reporting guidelines according to Decision 18/CP.8, the Common Reporting Format (CRF)[13] (version 1.01), Decision 13/CP.9, the new CRF for the Land Use Change and Forestry Sector, the IPCC 1996 Guidelines for National Greenhouse Gas Inventories, which specify the reporting obligations according to Articles 4 and 12 of the UNFCCC (IPCC Guidelines, 1997) as well as the IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories (IPCC GPG, 2000) and the IPCC Good Practice Guidance for Land Use, Land-Use Change and Forestry (IPCC GPG-LULUCF, 2003).

The preparation of the inventory includes the following three stages:

(i) inventory planning,

(ii) inventory preparation and

(iii) inventory management.

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

In Austria, emissions of greenhouse gases are estimated together with emissions of air pollutants in a single database based on the CORINAIR (CORe INventory AIR)/SNAP (Selected Nomenclature for sources of Air Pollution) nomenclature. This nomenclature was designed by the ETC/AE (European Topic Centre on Air Emissions) to estimate not only emissions of greenhouse gases but all kind of air pollutants.

[13] http://www.unfccc.de/resource/CRFV1_01o01.zip

During 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 also have specific responsibilities regarding the choice of methods, data processing and archiving and for contracting studies, if needed. As part of the quality management system the head of the "Inspection body for GHG inventory" approves the methodological choices. Sector experts are also responsible for performing Quality Control (QC) activities that are incorporated in the Quality Management System (QMS). All data collected together with emission estimates are fed into a database (see below), where data sources are well documented for future reconstruction of the inventory.

As mentioned above, the Austrian Inventory is based on the SNAP nomenclature, and has to be transformed according to the IPCC Guidelines into the UNFCCC Common Reporting Format to comply with the reporting obligations under the UNFCCC. In addition to the actual emission data, the background tables of the CRF are filled in by the sector experts, and finally QA/QC procedures as defined in the QA/QC plan are carried out before the data are submitted to the UNFCCC.

For the inventory management a reliable data management to fulfil the data collecting and reporting requirements is needed. As mentioned above, data are collected 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 are stored in a central network server which is backed up daily for the needs of data security. Furthermore, as part of the QMS, backups of the entire inventory information are made twice a year on write-protected DVDs. The inventory management as part of the QMS includes a control system for all documents and data, for records and their archives as well as documentation on QA/QC activities (see Chapter 1.6).

This ensures the necessary documentation and archiving for future reconstruction of the inventory and for the timely response to requests during the review process.

## 1.4 Methodologies and Data Sources Used

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

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

| Sector | Data Sources for Activity Data | Emission Calculation |
|---|---|---|
| Energy | Energy Balance from Statistik Austria; EU-ETS; Steam boiler database; | Umweltbundesamt, plant operators |
| Transport | Energy Balance from Statistik Austria | Umweltbundesamt (Aviation), Technical University Graz (Road and Off-road transport) |
| Industry | National production statistics, import/export statistics; EU-ETS; direct information from industry or associations of industry; | Umweltbundesamt, plant operators<br>F-gases based on a study by: EcoEfficient Technologies, Vienna |
| Solvent | Short term statistics for trade and services<br>Austrian foreign trade statistics<br>Structural business statistics<br>Surveys at companies and associations | Umweltbundesamt, based on studies by:<br>Institut für industrielle Ökologie and Forschungsinstitut für Energie und Umweltplanung, Wirtschaft und Marktanalysen GmbH[1] |
| Agriculture | National Studies, national agricultural statistics obtained from Statistik Austria; | Umweltbundesamt, based on studies by:<br>University of Natural Resources and Applied Life Sciences, Research Center Seibersdorf |
| LULUCF | National forest inventory obtained from the Austrian Federal Office and Research Centre for Forest | Umweltbundesamt |
| Waste | Database on landfills | Umweltbundesamt |

Detailed information on data sources for activity and emission data or emission factors used by sector can be found in the Chapters 3–8.

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

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

The main sources for emission factors are:

- National studies for country specific emission factors
- IPCC GPG
- Revised IPCC 1996 Guidelines
- EMEP/CORINAIR Guidebook

Table *Summary 3* of the CRF (Summary Report for Methods and Emission Factors Used) in Annex 7 presents the methods applied and the origin of emission factors used for the greenhouse gas source and sink categories in the IPCC format for the present Austrian inventory.

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

For key source categories (see Chapter 1.5) the most accurate methods for the preparation of the greenhouse gas inventory should be used. Required methodological changes and planned improvements are described in the corresponding sector analysis chapters (Chapters 3–8).

**Main Data Suppliers**

The main data supplier for the Austrian Air Emission Inventory is Statistik Austria, providing the underlying energy source data. The Austrian energy balances are based on several databases mainly prepared by the Ministry of Economic Affairs and Labour, "Bundeslastverteiler" and Statistik Austria. Their methodology follows the IEA and Eurostat conventions. The aggregated balances, for example transformation input and output or final energy use, are harmonised with the IEA tables as well as their sectoral breakdown which follows the NACE classification.

The main data suppliers are also presented in Table 4.

Information about activity data and emissions of the industry sector is obtained from *Association of the Austrian Industries* or directly from individual plants. Activity data for some sources are obtained from Statistik Austria which provides statistics on production data[14]. The methodology of the statistics changed in 1996, no data are available for that year and there are some product groups no longer reported in the new statistics.

Operators of steam boilers with more than 50 MW report their emissions and their activity data directly to the Umweltbundesamt. Data from national and sometimes international studies are also used. Operators of landfill sites report their activity data directly to Umweltbundesamt. Emissions for the years 1998–2007 are calculated on the basis of these data. Activity data needed for the calculation of non-energetic emissions are based on several statistics collected by Statistik Austria and national and international studies.

**Data from the EU Emission trading Scheme**

The European emissions trading scheme (EU-ETS) was established by Directive 2003/87/EC of the European Parliament and of the Council[15]. In the first trading phase from 2005-2007 emissions trading concerned $CO_2$ emissions from energy activities and manufacturing industries. These include combustion installations, mineral oil refineries and coke ovens as well as production and processing of ferrous metals, mineral industries and some other production activities. For more detailed information on the included activities please refer to Annex I of the above mentioned directive.

About one third of total Austrian GHG emissions result from installations under the EU-ETS (~32 Tg $CO_2$ in 2007).

Plant operators have to report their $CO_2$ emissions annually; for the first time they reported their emissions of 2005 in March 2006.

[14] "Industrie und Gewerbestatistik" published by STATISTIK AUSTRIA for the years until 1995; "Konjunkturstatistik im produzierenden Bereich" published by STATISTIK AUSTRIA for the years 1997 to 2006.

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

General rules for reporting and verification of these emissions are defined in EU directive 2003/87/EG and specific rules can be found in Commission decision 2007/589/EC[16]. In Austria member state specific regulations are defined in the Austrian Emissions Allowance Trading Act[7] and in its respective ordinance[6]. As mentioned already in chapter 1.2.4 this ordinance also states that the Umweltbundesamt has to incorporate, as far as necessary, the verified emissions of the emissions trading scheme into the national greenhouse gas inventory. For a detailed description of the sectors covered and the incorporation of these emissions in the national inventory please refer to the chapters 3 Energy (CRF Sector 1) and 4 Industrial Processes (CRF Sector 2).

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

**Data from EPER/E-PRTR**

The European Pollutant Emission Register (EPER) is the first Europe-wide register for emissions from industrial facilities both into air and water. The legal basis of EPER is Article 15 of the IPPC Directive (EPER Decision 2000/479/EG), which stipulates that information has to be provided to the public[3]. EPER was displaced by the European Pollutant Release and Transfer Register (E-PRTR), which was established by regulation (EC) No 166/2006. E-PRTR also includes emissions into soil and waste transfers.

EPER covered 50 pollutants, including $CO_2$, $CH_4$, $N_2O$, $SF_6$ and PFCs from six activity groups. E-PRTR is an extension of EPER and covers 91 pollutants from nine activity groups, including all pollutants reported already under EPER. However, emissions only have to be reported if they exceed certain thresholds.

The Umweltbundesamt implemented EPER in Austria using an electronic system enabling the facilities and the authorities to fulfil the requirements of the EPER decision electronically via the internet. E-PRTR has likewise been implemented as an electronic reporting system.

Under EPER Austrian industrial facilities had to report their annual emissions of 2001 or 2002 and 2004. There were about 400 facilities in Austria that had to report to EPER. As the thresholds for reporting emissions are relatively high, only about 130 facilities reported emissions according to the EPER Regulation. The plausibility of the reports was checked by the competent authorities. The Umweltbundesamt finally checked the data for completeness and consistency with the national inventory. In 2008 installations reported for the first time emissions from 2007 under the E-PRTR reporting obligation. However, E-PRTR data from 2007 will only be published in E-PRTR by 30 September 2009 and has thus not been available at the time of compiling the inventory.

Data from EPER could not be used as a data source for the national inventory. On the one hand this is due to the high threshold for emission reporting, e.g. only four facilities reported $N_2O$ emissions and none reported fluorinated compounds. On the other hand this is due to the fact

[16] "Commission Decision of 18 July 2007 establishing guidelines for the monitoring and reporting of greenhouse gas emissions pursuant to Directive 2003/87/EC of the European Parliament and of the Council", OJ L 229/1

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

that the EPER report only contains very little information other than emission data. Concerning methodology the only information included is whether emissions are estimated, measured or calculated. For activity data facilities report one value that is often not useful in the context of emissions and may be different between producers of the same product.

Additionally, EPER emission information is not complete for IPCC sectors, and it is difficult to include this point source information as 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 were not used as point source data for the national inventory, but for verification purposes only, where plausible.

## 1.5 Key Category Analysis

The identification of key categories is described in the IPCC Good Practice Guidance (IPCC-GPG, 2000), Chapter 7 and in the IPCC Good Practice Guidance for Land Use, Land-Use Change and Forestry (IPCC-GPG-LULUCF, 2003), chapter 5.4. It stipulates that a key category is one that is prioritised within the National System because its estimate has a significant influence on a country's total inventory of greenhouse gases in terms of the absolute level of emissions or removals, the trend in emissions or removals, or both.

All notations, descriptions of identification and results for key categories included in this chapter are based on the IPCC Good Practice Guidance.

The identification includes all reported greenhouse gases $CO_2$, $CH_4$, $N_2O$, HFC, PFC and $SF_6$, and all IPCC categories.

The presented key category analysis was performed by the Umweltbundesamt with data for greenhouse gas emissions of the submission 2009 to the UNFCCC and comprises a level assessment for the years 1990 and 2007 and a trend assessment for the trend of the year 2007 with respect to the base year emissions. As stipulated in the IPCC-GPG-LULUCF key categories were first identified for the inventory excluding LULUCF and then the key category analysis was repeated for the full inventory including LULUCF categories.

### 1.5.1 Austria's Key Categories

This chapter presents the results of Austria's key category analysis. The methodology is described in Chapter 1.5.2.

The identified key categories are listed in Table 5 and Table 6. The key categories without LULUCF comprise 85 406 Gg $CO_2$e in the year 2007, which is a share of 97.1% of Austria's total greenhouse gas emissions (without LULUCF).

*Table 5: Austrian key categories based on emission data submitted to the UNFCCC in 2009.*

| IPCC Category Description | | Gas | Emissions 2007 [Gg $CO_2$e] | Share in Total Emissions 2007 |
|---|---|---|---|---|
| 1.A.3.b diesel oil | Road Transportation | $CO_2$ | 17 157.7 | 19.5% |
| 1.A gaseous | Fuel combustion activities | $CO_2$ | 15 812.4 | 18.0% |
| 1.A.3.b gasoline | Road Transportation | $CO_2$ | 6 009.5 | 6.8% |
| 2.C.1 | Iron and Steel Production | $CO_2$ | 5 482.0 | 6.2% |
| 1.A.2 solid | Manufacturing Industries and Construction | $CO_2$ | 5 410.1 | 6.2% |
| 1.A.1.a solid | Public Electricity and Heat Production | $CO_2$ | 5 066.5 | 5.8% |
| 1.A.4 stat-liquid | Other Sectors | $CO_2$ | 4 839.4 | 5.5% |
| 4.A.1 | Cattle | $CH_4$ | 3 000.8 | 3.4% |
| 1.A.1.b liquid | Petroleum refining | $CO_2$ | 2 725.3 | 3.1% |
| 2.A.1 | Cement Production | $CO_2$ | 2 130.8 | 2.4% |
| 1.A.2 stat-liquid | Manufacturing Industries and Construction | $CO_2$ | 2 114.2 | 2.4% |
| 6.A | Solid Waste Disposal on Land | $CH_4$ | 1 744.2 | 2.0% |
| 4.D.1 | Direct Soil Emissions | $N_2O$ | 1 633.3 | 1.9% |
| 4.D.3 | Indirect Emissions | $N_2O$ | 1 104.8 | 1.3% |
| 1.A.2 other | Manufacturing Industries and Construction | $CO_2$ | 943.6 | 1.1% |
| 2.F.1/2/3/4/5 | ODS Substitutes | HFCs | 853.7 | 1.0% |
| 4.B.1 | Cattle | $N_2O$ | 788.5 | 0.9% |
| 1.A.1.a liquid | Public Electricity and Heat Production | $CO_2$ | 765.7 | 0.9% |
| 1.A.4 mobile-diesel | Other Sectors | $CO_2$ | 761.4 | 0.9% |
| 1.A.2 mobile-liquid | Manufacturing Industries and Construction | $CO_2$ | 715.3 | 0.8% |
| 1.A.1.a other | Public Electricity and Heat Production | $CO_2$ | 655.4 | 0.7% |
| 2.A.2 | Lime Production | $CO_2$ | 595.7 | 0.7% |
| 1.B.2.b | Natural gas | $CH_4$ | 581.7 | 0.7% |
| 1.A.4 solid | Other Sectors | $CO_2$ | 496.4 | 0.6% |
| 2.B.1 | Ammonia Production | $CO_2$ | 473.4 | 0.5% |
| 4.B.1 | Cattle | $CH_4$ | 452.4 | 0.5% |
| 4.B.8 | Swine | $CH_4$ | 407.5 | 0.5% |
| 2.A.7.b | Sinter Production | $CO_2$ | 329.5 | 0.4% |
| 2.A.3 | Limestone and Dolomite Use | $CO_2$ | 302.5 | 0.3% |
| 2.F.7 | Semiconductor Manufacture | FCs | 288.7 | 0.3% |
| 6.B | Wastewater Handling | $N_2O$ | 279.4 | 0.3% |
| 2.B.2 | Nitric Acid Production | $N_2O$ | 270.0 | 0.3% |
| 2.F.9 | Other Sources of $SF_6$ | $SF_6$ | 269.8 | 0.3% |
| 1.A.4 biomass | Other Sectors | $CH_4$ | 254.4 | 0.3% |
| 3 | Solvent and other Product Use | $CO_2$ | 248.5 | 0.3% |
| 4.D.2 | Animal Production | $N_2O$ | 223.0 | 0.3% |
| 1.A.4 other | Other Sectors | $CO_2$ | 153.4 | 0.2% |
| 1.A.3.a jet.kerosene | Civil Aviation | $CO_2$ | 64.7 | 0.1% |
| 2.C.3 | Aluminium production | PFCs | 0.0 | 0.0% |
| 2.C.3 | Aluminium production | $CO_2$ | 0.0 | 0.0% |
| 2.C.4 | SF6 Used in Al and Mg Foundries | $SF_6$ | 0.0 | 0.0% |

*Table 6: Austrian key categories based on emission and removal data submitted to the UNFCCC in 2009.*

| IPCC Category | Description | Gas | Emissions/Removals 2007 [Gg $CO_2$e] |
|---|---|---|---|
| 5.A.1 | Forest land remaining forest land | $CO_2$ | -16 966.8 |
| 5.A.2 | Land converted to forest land | $CO_2$ | -2 572.3 |
| 5.B.1 | Cropland remaining cropland | $CO_2$ | 53.2 |
| 5.B.2 | Land converted to cropland | $CO_2$ | 1 890.9 |
| 5.C.2 | Land converted to grassland | $CO_2$ | -1 310.7 |
| 5.D.2 | Land converted to Wetlands | $CO_2$ | 371.8 |
| 5.E.2 | Land converted to Settlements | $CO_2$ | 530.5 |
| 5.F.2 | Land converted to Other land | $CO_2$ | 470.4 |

The key category with the highest contribution to the national total emissions in 2007 is *1.A.3.b Road Transportation – diesel oil ($CO_2$).* The contribution to the national total emissions in the base year was 6.8%, whereas in the last year of the inventory, namely 2007, it was 19.5%. Furthermore, *1.A.3.b Road Transportation – diesel oil ($CO_2$)* was the most important category of GHG emissions in terms of emission trends: emissions have nearly quadrupled since the base year. This strong increase is due to the general increase of road performance, but also due to a shift from gasoline to diesel driven vehicles. *1.A.3.b Road Transportation – gasoline ($CO_2$)* was the second most important emission source in the base year and the third most important category in terms of its contribution to national total emissions in 2007. Total $CO_2$ emissions from Road Transportation amount to 26.3% in 2007 compared to 16.8% in 1990.

The second most important source for greenhouse gas emissions in 2007 in Austria is *1.A Fuel Combustion – gaseous fuels*; this source has not been further disaggregated for the key category analysis because the same emission factor is used for all sub categories. The contribution to national total emissions in the base year was 14.3% compared to 18.0% in 2007. This source is also the second most important contributer to the emission trend.

The key category with the highest contribution to national removals is *5.A.1 Forest land remaining forest land ($CO_2$)*. In the key category analysis including LULUCF it is the second important category in the level assessment and ranks number two in the trend assessment as well. Removals from this category increased from 1990 to 2007 by 47%.

**Comparison to last years' submission**

There is no difference in the identified key categories compared to the results of last year's analysis.

### 1.5.2 Description of Methodology

The method used to identify key source categories follows the Tier 1 method – quantitative approach described in the Good Practice Guidance (IPCC-GPG, 2000), Chapter 7 *Methodological Choice and Recalculation* and in the IPCC Good Practice Guidance for Land Use, Land-Use Change and Forestry (IPCC-GPG-LULUCF, 2003), Chapter 5.4 *Methodological Choice – Identification of key categories*.

The analysis includes all greenhouse gases reported under UNFCCC: $CO_2$, $CH_4$, $N_2O$, HFC, PFC and $SF_6$. All IPCC categories are included.

Key categories were first identified for the inventory excluding LULUCF and then the key category analysis was repeated for the full inventory including LULUCF categories.

The identification of key categories consists of six steps:

- Identifying categories
- Level Assessment excluding LULUCF
- Trend Assessment excluding LULUCF
- Level Assessment including LULUCF
- Trend Assessment including LULUCF
- Qualitative considerations

### Level of disaggregation and identification of key categories

To identify key categories total emissions were split into those categories that have been estimated using the same methodology and the same emission factor. LULUCF categories were split as recommended in the GPG-LULUCF, with the additional categories: total $CH_4$ from LULUCF, total $N_2O$ from LULUCF and 5 B net $CO_2$ from lime application.

Table 9 of Annex 1 presents the 151 defined source categories and their greenhouse gas emissions expressed in $CO_2$ equivalent emissions and the 12 LULUCF categories in $CO_2$ equivalent emissions/removals for the years 1990 to 2007.

Further details and a list of the source/sink categories and key categories for each sector are given in the corresponding subchapters *3 Energy – 8 Waste*.

### Level Assessment excluding LULUCF

For the Level Assessment the contribution of GHG emissions (expressed in $CO_2$ equivalent emissions) of each category to national total emissions was calculated. The calculation was performed for the years 1990 and 2007 according to Equation 7.1 of the GPG. Then the sources were ranked in descending order of magnitude according to the results of the level assessment and finally a cumulative total was calculated.

For the year 2007 30 source categories comprised > 95% of the cumulative total and were thus rated as key categories. For the year 1990 31 source categories were identified as key categories in the level assessment. The result of each level assessment is presented in Annex 1.

### Trend Assessment excluding LULUCF

The Trend Assessment identifies source categories that have a different trend from the trend of the overall inventory. As differences in trends are more significant at the overall inventory level for larger source categories, the result of the trend difference (i.e. the source category trend minus total trend) is weighted according to the sources' level assessment.

For the Trend Assessment, emissions of the year 2007 were compared with the base year emissions (1990 for all gases).

The calculation was performed according to Equation 7.2 of the GPG. For sources with zero current year emissions Equation 5.4.3 of the GPG-LULUCF was used to calculate the trend. The results were ranked in descending order of magnitude and a cumulative total was calculated. Those sources that make up > 95% of the total trend were rated key categories. 30 sources were identified as key categories in the trend assessment. Results are presented in Annex 1.

### Level Assessment including LULUCF

The level assessment was repeated for the full inventory including the LULUCF categories for the years 1990 and 2007 according to Equation 5.4.1 of the GPG-LULUCF. Eight LULUCF key categories were identified by this analysis additionally. The result of each level assessment is presented in Annex 1.

### Trend Assessment including LULUCF

Also the trend assessment was repeated for the full inventory including the LULUCF categories for the years 1990 and 2007 according to Equation 5.4.2 of the GPG-LULUCF (Equation 5.4.3 for zero current year emissions). The result of the trend assessment is presented in Annex 1.

### Qualitative criteria

If a category had been identified key by level or trend assessment in a previous submission but not in this, the category was still considered key for this submission. Because

- these categories may be categories that are close to the 95% criteria, but are not included in all years, e.g. due to fluctuating emissions/removals.
- the emission calculation of these categories might have changed due to methodological changes and thus their contribution to level or trend assessment.

Other qualitative criteria considered were: mitigation techniques, high expected growth of emissions/removals and unexpected low or high emissions/removals. No additional key source categories were identified with these qualitative criteria.

According to the GPG-LULUCF countries should identify and sum up the emission estimates associated with forest conversion to any other land category. This was done and the sum was found to be larger than the smallest category considered key in the quantitative analysis, thus it should be identified as key. The GPG-LULUCF also recommends further examining which land conversions are significant. In this examination it was found that all land conversions contribute to deforestation. Conversions to other land, to grassland and to settlements contribute with 37%, 29% and 22% in 2007. Nevertheless, $CO_2$ emissions from these categories are already identified as key categories in the quantitative analysis. There is no further guidance in the GPG how to handle this double accounting of emissions in two different categories. Thus, $CO_2$ emissions from deforestation are not considered in addition as key category, because 100% of these emissions are already covered by other key categories.

### Identification of key categories

Any category meeting the 95% threshold in any year of the Level Assessment or in the Trend Assessment and meeting the qualitative criteria as described above is considered a key category. The key categories are presented in Table 5 in descending order of magnitude of contribution to total national GHG emissions in the year 2007 and the LULUCF key categories are presented in Table 6. In Annex 1 they are presented together with their ranking of the assessments.

### Consequences of key category selection

Whenever a method used for the estimation of emissions/removals of a key category is not consistent with the requirements of the IPCC Good Practice Guidance, the method will have to be improved in order to reduce uncertainty, which is considered in the emission inventory improvement programme (see Chapter 9.4).

## 1.6 Quality Assurance and Quality Control (QA/QC)

The Umweltbundesamt is accredited as inspection body (Id.No. 241) in accordance with the Austrian Accreditation Law (AkkG), 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 2006, valid from 23 December 2005.

The requirements of EN ISO/IEC (Type A) are fulfilled.

*Figure 3: Official emblem of an Austrian accredited inspection body.*

**History of the Austrian QMS**

A quality management system (QMS) has been designed to achieve the objectives of *good practice guidance*, namely to improve transparency, consistency, comparability, completeness and confidence in national inventories of emissions estimates. After having been effectively implemented during the development of the UNFCCC submission 2004, the accreditation audit of the Umweltbundesamt as *Inspection body for Greenhouse Gas Inventories* took place in autumn 2005, accreditation was then awarded in December 2005.

Table 7 presents the timetable for the implementation of the quality management system.

*Table 7: Timetable for the implementation of the Austrian QMS.*

| | Date |
|---|---|
| Development of a quality management system including quality manual | 1999–2002 |
| Development of the quality management system<br>Implementation of the quality management system | 2003–2005 |
| Accreditation Audit<br>Accreditation as Inspection Body for Emission Inventories | September 2005<br>December 2005 |

With the start of the EU Emissions Trading system on January 1st 2005 and the entry into force of the Kyoto Protocol on February 16th 2005, greenhouse gas emissions now equal money. Pressure upon national GHG emission inventories is expected to increase, therefore a QMS is considered crucial in order to ensure the quality of emission estimates established according to the requirements of the IPCC-GPG as a basis for any kind of international emission trading.

### 1.6.1 The International Standard ISO/IEC 17020

The QMS was drawn up to meet the requirements of the International Standard ISO/IEC 17020[17]. It covers the functions of bodies whose work includes assessments of conformity, and the subsequent reporting of results of conformity assessment to clients and, when required, to supervisory authorities. Inspection parameters may include, among others, matters of quantity and/or quality.

[17] The International Standard ISO 17020 superseded the European Standard EN 45004.

The general criteria, with which these bodies are required to comply in order that their services be accepted by clients and by supervisory authorities, are harmonized in the International Standard ISO/IEC 17020:1998 *General Criteria for the operation of various types of bodies performing inspections.* This standard 17020 has been drawn up with the objective of promoting confidence in those bodies performing inspections which conform to it.

The ISO/IEC 17020 also takes into account requirements and recommendations of European and international documents such as the ISO 9000 (EN/ISO 9000) series of standards, and goes beyond: additionally to the requirements of the ISO 9000 series, the ISO/IEC 17020 also provides a clear statement of requirements regarding

- competence,
- independence, impartiality and integrity, as well as confidentiality.

**Accreditation Act**

According to the ISO 17000 series, *accreditation* is the procedure by which an authorized body (accreditation body) formally recognizes that an organisation has the competence to perform a stipulated conformity assessment activity.

The Austrian Accreditation Act ("Akkreditierungsgesetz", Federal Law Gazette 468/1992 as amended by 430/1996) regulates the accreditation of testing, inspection and certification bodies. It designates the Federal Ministry for Economic Affairs and Labour as accreditation body and defines the conditions for granting, maintaining and extending accreditation and the conditions under which accreditation may be suspended or withdrawn.

Accreditation is granted after an successful accreditation audit, where an expert nominated by the accreditation body assesses the conformity of the organization of the inspection body and its QMS with the standard, and additionally a technical expert assesses the competence of the inspection body and the conformity of the methodologies applied with specific requirements. This audit takes three days of in house inspection.

The accreditation requires re-assessment in defined intervals (in the case of an inspection body every twelve to fifteen months a one day audit takes place, and a full three day audit after five years).

*Accreditation and Certification*

A certification is the procedure by which an official – or officially recognised – body (certification body) gives written assurance that a product, process or service conforms to specified requirements. Thus, in contrast to an accreditation, the certification gives warrantee for conformity, whereas the accreditation is a warrantee for competence, as well as independence, impartiality and integrity (additionally, both require an QMS that guarantees transparency).

One example for certification is the certification of a QMS according to the ISO 9000 series. The certification is issued by a certification body. The certification body on the other side needs an accreditation, which is the warrantee that the certification body is competent to carry out ISO 9000 certifications in specific business sectors.

Figure 4 shows the inter-relationship between the Austrian Accreditation Act, the EN 45000/ISO 17000 series and the ISO 9000 series.

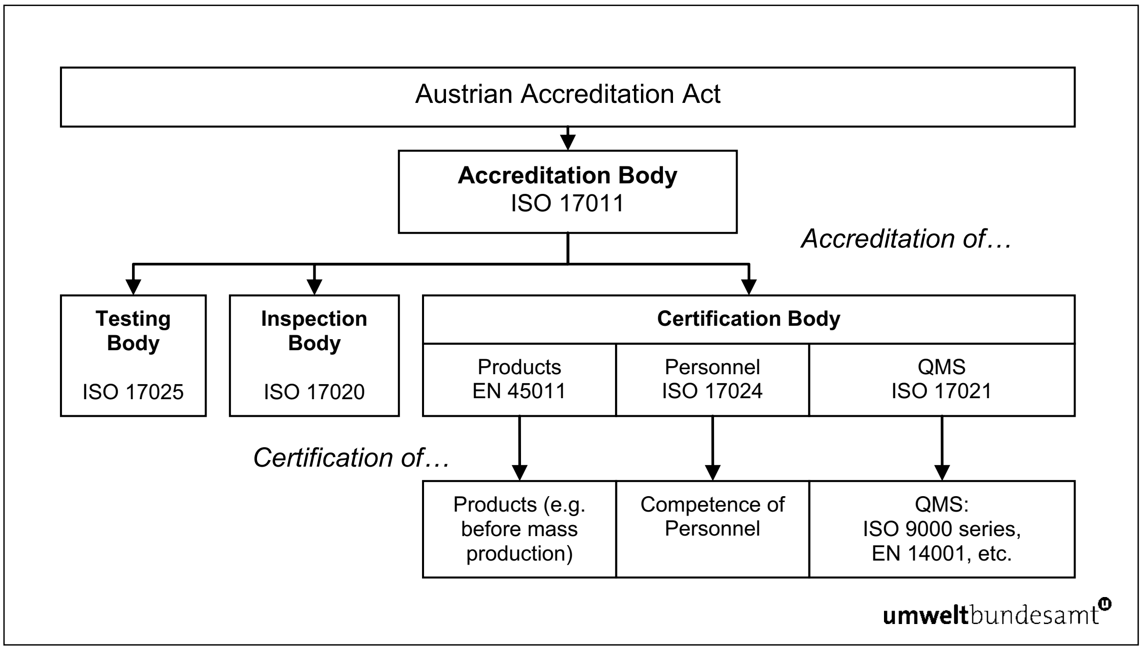


*Figure 4: Inter-relationship between the Austrian Accreditation Act, the EN 45000/ISO 17000 and the ISO 9000 series.*

Reports issued by an accredited body may carry the federal emblem in addition to the accreditation logo (see Figure 3). These reports are official documents.

## Independence

Regarding independence, ISO/IEC 17020 distinguishes between different types of inspection bodies:

The Umweltbundesamt is a Type A inspection body, which stands for "third party" services. This means that the inspection body shall be independent of the parties involved (e.g. industry, government). The inspection body and its staff responsible for carrying out the inspection shall not be the authorized representatives of any of these parties. Furthermore, the inspection body and its staff shall not engage in any activities that may be in conflict with their independence of judgement and integrity in relation to their inspection activities. Finally, all interested parties shall have access to the services of the inspection body. The procedures under which the body operates shall be administered in a non-discriminatory manner.

In contrast to this, a Type B inspection body provides "second party" services: inspection services are supplied to the organization of which the inspection body forms a part.

## Impartiality and Integrity

The personnel of the inspection body shall be free from any commercial, financial and other pressures which might affect their judgement. It has to be ensured that persons or organisations external to the inspection body cannot influence the results of inspections carried out.

We feel that such a regulation is fundamental in order to guarantee that the emission data reflect real emissions as truly as possible.

**Inspection body in the context of National Greenhouse Gas Inventory**

In the case of greenhouse gas emissions inventories, inspection covers (i) data collection (emission data and/or of data which are used to estimate emissions e.g. activity data, emission factors, conversion factors), (ii) the application of appropriate methodologies (IPCC, CORINAIR and country specific methodologies) to estimate emissions, (iii) the compilation of the emissions inventory and (iv) the assessment of conformity with national emission reduction targets. The QMS ensures that all requirements of a Type A inspection body as stipulated in ISO/IEC 17020 are met, including independence, impartiality and integrity.

When compiling emission inventories according to the standard, the methodologies applied have to be officially approved by the accreditation body.

**The Austrian Quality Management System (QMS) and requirements of IPCC GPG**

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

### 1.6.2 Design of the Austrian QMS

The design of the QMS of the *Inspection Body for Greenhouse Gas Inventories* at the Umweltbundesamt follows a *process based approach*. It is illustrated in Figure 5.

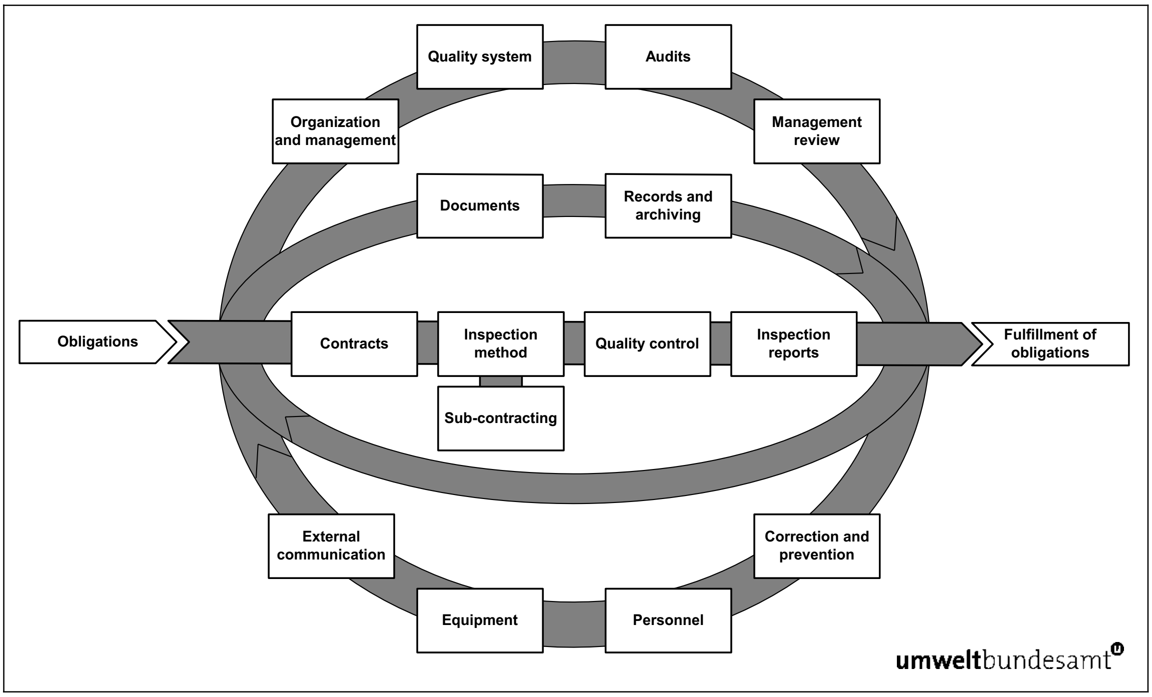


*Figure 5: Process-based QMS (the outer circle corresponds to management processes, the straight line to realisation processes and the inner circle to supporting processes).*

In the following the processes are explained:

### 1) Realisation processes (horizontal bar)

Realisation processes are the *Inspection Body for Greenhouse Gas Inventories´* core competencies as they concern the compilation of emission inventories. The first process constitutes a contract control system which ensures that methods to be used are selected in advance, taking into account that for key source categories the most accurate method, i.e. the method with the lowest uncertainty, is the most appropriate. The inspection process consists of two steps, (i) data collection and (ii) the application of methods to estimate emissions. The Umweltbundesamt uses IPCC methods, CORINAIR methods and country specific methods. Country-specific methods are thoroughly documented and validated. Emission estimates are subject to quality control checks before being published in an inspection report.

The inspection body performs the majority of inspection processes. Any subcontractor performing part of the inspection is required to work in compliance with ISO 17020.

### 2) Management processes (outer circle )

Management Processes comprise all activities necessary for management and control of an organisation: organisation and management, quality system, audits, quality management review, corrective actions and prevention, personnel, equipment, external communication.

The most important aspect with respect to organisation and management is that it has to be ensured that the personnel is free from any commercial, financial or other pressure which might affect their judgement. Such regulations are considered fundamental in order to guarantee that emission data reflect actual emissions as truly as possible.

The personnel responsible for inspection shall have appropriate qualifications, training, experience and a satisfactory knowledge of the requirements of the inspections to be carried out. They have the ability to make professional judgements as to conformity with general requirements using examination results and to report there-on.

Computers are used for the compilation of emission inventories. Procedures for protecting the integrity of data and for maintenance of data security have been established and implemented. Access authorisation is strictly limited for protecting the integrity of data and to ensure data confidentiality where necessary.

**3) Supporting processes (inner circle)**

Supporting processes support both the management and the realisation processes. They include a control system for all documents and data as well as for records and their archiving.

The QMS-Report is presented to the central executive officer every year. The QMS report includes an evaluation of the QMS, the inventory improvement plan (evaluation of fulfilment of previous plan and decision on new plan) and a plan for the QMS (evaluation of fulfilment of previous plan and decision on new plan).

### 1.6.3 Elements of QA/QC System, and Austrian approach

According to the GPG (2000) the QA/QC system that should be implemented for GHG inventories consists of:

- an inventory agency responsible for coordinating QA/QC activities
- a QA/QC plan
- general QC procedures (Tier 1)
- source category-specific QC procedures (Tier 2)
- QA review procedures
- reporting, documentation, and archiving procedures

In the following the implementation of these elements in the Austrian QMS is described.

**Responsibilities**

The Umweltbundesamt is designated as single national entity responsible for Austria's GHG inventory by law, and is thus also responsible for QA/QC activities. For more information regarding responsibilities please refer to Chapter 1.2.3.

Responsibilities of the different functions within the inspection body are defined in the QMS:

- quality coordinator
- sector expert (and deputy sector expert)
- project manager
- head of inspection body
- central executive officer

### QA/QC Plan

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

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

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

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

### QC Activities

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

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

The checklists cover questions like:

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

The checklists cover all aspects as required according to Table 8.1 of the IPCC GPG (2000).

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

Source specific QC activities are described in the sector-specific Chapters of this report.

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

### QA Activities

The following QA activities are performed:

***Second party audits for CS methodologies***, for key sources more detailed.

Country specific (CS) methodologies are defined in SOPs, before CS methods are applied they need to be

- audited (second party audit):
  - check of formal aspects (are all QMS requirements fulfilled) for all CS sources
  - additional QA for key sources: is methodology appropriate, in line with requirements
- approved by the head of inspection body
- approved by the accreditation body (after notification to the accreditation body CS methods are part of the accreditation audits, which are third party audits).

***Annual second party audits for every sector***: once a year the documentation of one emission source per sector is checked throughout the whole emission estimation and reporting process (from archiving of underlying information, emission calculation, input into the data management system, documentation, information in the NIR etc.) for transparency, reproducibility, clearness and completeness. This tool proved to be very helpful in order to further improve the documentation and the implementation of (new) QA/QC routines.

***Second party audits for work performed by sub-contractors:***

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

***Accreditation audits*** (third party audits) check conformity of QMS with ISO/IEC 17020 and of (new) methodologies with requirements of IPCC GPG.  The last audit of the accreditation body in 2008 approved the conformity with the standard, no obligatory improvement measures were issued.

### Audits of data suppliers

In 2007, the Audit of the main data supplier Statistik Austria (energy balance) in 2007 took place. In 2009, the main data supplier for estimates of the waste sector (landfill data base) was audited, another audit regarding agricultural statistical data from Statistik Austria is planned for Spring 2009. The percentage of data suppliers, that either have a certified quality or envirionmental management system or have been audited by the *Inspection Body for Emission Inventories* is 90% (including the planned audit of data suppliers for the agriculture sector; this value is related to the emissions of 2006, for which these data is the basis).

### Error correction and continuous improvement

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

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

These findings are documented including a plan to improve the inventory, a timeline and responsibilities. The improvement plan and fulfilment of planned improvements is monitored by the head of inspection body. Improvements that are relevant in terms of resources are presented in the annual management review to the central executive officer, and if additional resources are needed are notified to the Federal Ministry of Agriculture, Forestry, Environment and Water Management.

### Archiving and documentation

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

For each sector the documentation includes:

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

### Focus of QA/QC activities in the year 2008

In addition to some further improvements of the quality manual regarding management processes, the most important improvement was the introduction of a template for excel-calculations, which better defines the standard for documentation of these files. Furthermore audits of data suppliers as explained above took place.

## 1.7 Uncertainty Assessment

### 1.7.1 Introduction

A consistent assessment of uncertainties of the Austrian greenhouse gas inventory requires a detailed understanding of the uncertainties of the respective input parameters. Since the first detailed uncertainty evaluation (WINIWARTER & ORTHOFER 2000, WINIWARTER & RYPDAL 2001), the Austrian inventory compilers have spent considerable effort to also obtain uncertainties from individual contributors to the inventory. This leads to a situation where national information or at least national expert knowledge directly from the stage of inventory development may flow into the assessment of uncertainties.

The respective sectoral uncertainties are documented in detail in the sectoral chapters of this report. Specific uncertainty estimates are e.g. available for agricultural soil, for enteric fermentation from animal husbandry, for F-gases, for transport, and for land-use change and forestry.

### 1.7.2 Theoretical background

The assessment and propagation of uncertainties in emission inventories has been described in detail by IPCC (IPCC 2000), (IPCC 2006). Principally, two different pathways may be taken to arrive at a total uncertainty, and to develop an inventory uncertainty. The "tier 1" approach is based on error propagation: assuming input information is available in form of normal distribution, and input uncertainties are statistically independent, the approach allows for reliable assessment of inventory uncertainty. More flexibility is possible in the "tier 2" method. The Monte-Carlo approach allows any probability distribution of input parameters, and it also enables to define statistical dependencies between parameters. The most obvious dependency is a full dependency. This occurs when two values are based on the identical set of measurements. A variation or error in one value would then be fully reflected also in the other value. While "full dependency" theoretically can also be covered in error propagation, this is normally not done and only in a very limited way possible in the IPCC spreadsheets.

The general properties of error propagation allow to combine (add up) information in a way that the relative uncertainty (as percentage of the mean value) of the combination becomes lower than the relative uncertainty of any of the input parameters. This advantage of going into detail is often implicitly taken advantage of, when a problem is disassembled into sub-problems and the sub-results are being recombined. Nevertheless it is not always the most detailed level that yields results of lowest uncertainty. If measurements or assessments at the most detailed level are difficult, a more comprehensive level of information may provide the lower overall uncertainty.

As a consequence, optimizing the approach requires collecting input information at the most detailed level an inventory is prepared at. Attaching uncertainty data then may be done at a level where greatest confidence can be expected on the data. This may be the most detailed level, but more often uncertainty data will not be available, or a "balance" approach (energy balance, solvent balance) will allow more reliability at an more aggregated level.

### 1.7.3 Procedure

For the update of the uncertainty assessment of the Austrian greenhouse gas inventory, the most detailed level of the inventory system was used as the base level. This "base level" of the inventory facilitates compilation of emission data for different purposes. Reporting on air pollution (according to UN-ECE or European Commission requirements) is performed by agglomerating the details in basically the same way as it is done for the GHG inventory according to UNFCCC procedures.

This approach of starting at the most detailed level the inventory offers facilitated an assessment of emission uncertainty at any level that the most reasonable uncertainty data are available. Very detailed information can be entered directly, for aggregate information the same uncertainty (as a statistically dependent entity) is applied for all input entries concerned.

Uncertainty information was taken from national studies, from international information (as e.g. in the IPCC reports) from variation presented in literature, and by contacting national experts. Structured interviews were not held, but information collected previously in structured interviews still could be used. The same uncertainty information was applied for a tier 1 and a tier 2 uncertainty approach. As will be explained below, considerable difference between those approaches can be explained by covariance of uncertainties between (key) source categories, which occurs when data are statistically dependent. The tier 1 approach allows considering co-variance between years for one source category, but does not cover co-variances between source categories.

In all input and output parameters, uncertainty has been expressed as normal or lognormal probability density function. In line with the IPCC requirements, the uncertainty range is presented as the range with 95% probability of a given value being within its boundaries. Thus the boundaries were given as the 2.5 and 97.5-percentiles of the respective distribution. For a normal distribution, this is +/- 2 standard deviations from the mean.

### 1.7.4 Random uncertainty vs. systematic uncertainty

In a previous study, random and systematic uncertainty were strictly separated. Systematic uncertainty was seen as composed of the errors contained and discovered in the national inventory during the analysis (WINIWARTER & RYPDAL 2001). As systematic uncertainty by the definition above is unknown at the time it occurs, its true magnitude can not be known. Previously, this magnitude of the errors still undiscovered was expected to be of similar magnitude as those identified. Such an assessment obviously refers to the inventory as a whole, and not to a single sector, as one should not expect an error always occurring in the same sector. Furthermore, it is highly questionable that the assumption, an error remaining relates to the error discovered already, can be sustained during all stages of inventory development.

Consequently here we did not perform a specific assessment of systematic uncertainty.

### 1.7.5 Data origin

Many of the uncertainties included in the tier 1 and tier 2 calculations have already been covered in the previous submissions. Nevertheless it is worthwhile to consider some of the input uncertainties in detail – especially those that contribute more to the overall uncertainty.

*Activities*: According to information from the Austrian statistical agency, the Austrian energy balance is strongly affected by inexact reporting, reporting errors or omissions/double counting due to difficult attribution of responsibilities. Detailed statistics are therefore not very reliable, but on the total energy level a number of additional plausibility checks are performed. This procedure allows to expect high quality data of low uncertainty at a rather high level of detail, to be presented separately by the specified fuel types (coal/oil/gas, and also biomass but at a higher uncertainty). Consequently, separate (independent) assessment of energy data has been applied to power plants, other combustion including industry, and transport. Within each of these ranges of sectors the specific uncertainty has been applied, but is considered statistically dependent.

Some very special fuels are also treated separately (landfill gas, black liquor). Additionally, large industrial plants are considered separately, as long as they remain sufficiently separate of the energy input. Iron and steel industry is considered dependent of energy. Non-energy sectors are assessed using the specific Austrian studies already mentioned above. These studies contain specific information on agricultural soil, enteric fermentation from animal husbandry, F-gases, transport, and on land-use change and forestry.

Activity related uncertainties for base year and target year are considered to be the same in all cases, but statistically independent. There are reports, e.g. on the solvent sector, which assume lower uncertainty for more recent data. As the solvent balance is strongly dependent on the trade statistics, which suffered heavily from the relaxation of reporting requirements after Austria's accession to the EU in 1995, such improvement was not considered.

*Carbon dioxide ($CO_2$):* The emission factor of $CO_2$ is in most cases well contained due to the carbon content of fuels or of raw materials. Still it is basically one set of measurements that is applied uniformly. A large number of single data have been applied to arrive at a reliable carbon content and consequently emission factor, but this is already factored-in in the magnitude of the uncertainty. Consequently, all energy related carbon contents by fuel type are here considered identical for all energy related activities. We assume independence of uncertainties between fuel types only. Some more independent uncertainty figures are available for source categories like solvents, chemical industry, land use change.

*Methane ($CH_4$):* Methane emissions are derived from a large variety of individual measurements of total hydrocarbon (HC) or total volatile organic compound emissions. But only the smaller part of uncertainties derives from these measurements. The larger part is caused by assumptions on the fraction of $CH_4$ in the HC mix, which ranges from 10% (coal fired large plants) to 75% (gas combustion). Therefore statistically independent numbers are no more than the $CH_4$ fractions considered separately. Such separate data is available only in combustion generally, in power plants, and in transport. Consequently we have here a very similar pattern as in activities.

Agricultural methane (enteric fermentation and manure treatment) has been assessed for Austria in specific studies, which also reported the uncertainty involved in emission factors (AMON et al. 2002, GEBETSROITHER et al. 2002). This uncertainty estimate could be applied here.

*Nitrous oxide ($N_2O$):* Very limited measurement data are available on nitrous oxide emissions. When trying to trace emission factors back to their origin, the large Austrian data collection on emission factors from combustion (STANZEL et al. 1995) refers virtually all $N_2O$ factors back to GEMIS. In line with an earlier assessment done in an Austrian $N_2O$ balance (ORTHOFER et al. 1994), uncertainties by fuel in general and uncertainties in the domestic heating sector were considered independent. Also transport was considered independently, even separated between Diesel fuel and gasoline (as only the latter is equipped with catalysts, which are responsible for the larger share of emissions).

In addition to the definition of statistically independent parameters, some of the uncertainty attributions had to be adapted. Uncertainty figures in the energy sector refer to measurements done around 1990 (VITOVEC 1991). Changes in fuel quality or in combustion equipment are not at all reflected, leading to enhanced uncertainty which we here take from international data. Furthermore (and most importantly, see below), the uncertainty estimate on $N_2O$ from soils used previously (NIR 2006) could not be sustained. A detailed investigation revealed that the source of the 48% uncertainty presented was a statement in an IPCC report (IPCC 2000) referring to a measurement uncertainty. Here we have to deal with an emission factor uncertainty, which is estimated much higher, at an order of magnitude in the latest IPCC emission inventory guidelines (IPCC 2006). This higher number which we adopt now is still much smaller than the two orders of magnitude recommended by IPCC previously (IPCC 2000), and also smaller than a previous estimate for Austria (WINIWARTER & RYPDAL 2001). The latter was considered in part systematic uncertainty, however (the random uncertainty was considered smaller than the range now used) – this is still in part true, but only reflects our lack of knowledge on soil processes. Choosing to apply a quasi-standardized value conforms to the claim of (WINIWARTER 2007) that application of similar parameters between countries allows for a smaller error in an inter-comparison, even if the difference to a "true value" might be larger.

*Fluorinated gases:* The uncertainties related to emissions of fluorinated gases (PFC, HFC and $SF_6$) have been investigated within the emission assessment (NIR 2006). Basically, emissions in areas where substances are specifically brought in, e.g. as solvents, are considered well understood, those that refer to release (refrigeration, electrodes during Al-production) are considered highly uncertain.

### 1.7.6 Results

Separate uncertainty calculations, albeit with the same (as much as possible) input information was performed using a spreadsheet prepared specifically according to the "Tier 1" approach (IPCC 2000), and with a Monte Carlo approach fully considering statistical dependence of detailed input data as described above ("Tier 2" approach). It should be noted that the "Monte-Carlo" approach, averaging a large number of randomly varied input data, may exhibit slightly different results in total and source category emissions than a direct calculation. This difference is similar to a rounding error and may be ignored.

Data are presented in Table 8 and Table 9 the key categories of the Austrian GHG inventory, except LULUCF categories. Uncertainty is presented for each category, and for the level of target year 2007 as well as for the trend in percentage points relative to the total base year (1990) emissions. One of the major problems in assigning uncertainty figures appears when introducing asymmetric distribution into Table 8, especially those that have a strong influence. Using the range of 0.3 to 3 times the emission factor for $N_2O$ from soils, we chose to apply an uncertainty of 150%. If we would have taken 200% (consistent with the factor 3 increase), the overall uncertainties would have been slightly higher for both level and trend.

Table 9 includes the same source categories and gases as Table 8, even if data are available at any desired level, for all greenhouse gases and also for non-key source categories. Uncertainty introduced by non-key sources has been included in the total uncertainties reported for the Monte-Carlo approach. Non-key sources may also be evaluated individually; here they have been aggregated by gas.

*Table 8: Tier 1 Uncertainty calculation and reporting according IPCC (2000) Table 6.1.*

| IPCC Source category | Gas | AD | EF | Combined | Combined as % of total national emissions in 2007 | Introduced into the trend in total national emissions |
|---|---|---|---|---|---|---|
| | | Uncertainty [%] | | | | |
| 1 A 1 a liquid: Public Electricity and Heat Production | $CO_2$ | 0.5 | 0.5 | 0.7 | 0.01 | 0.01 |
| 1 A 1 a other: Public Electricity and Heat Production | $CO_2$ | 10.0 | 20.0 | 22.4 | 0.17 | 0.18 |
| 1 A 1 a solid: Public Electricity and Heat Production | $CO_2$ | 0.5 | 0.5 | 0.7 | 0.04 | 0.05 |
| 1 A 1 b liquid: Petroleum refining | $CO_2$ | 0.5 | 0.3 | 0.6 | 0.02 | 0.03 |
| 1 A 2 mobile-liquid: Manufacturing Industries and Construction | $CO_2$ | 3.0 | 0.5 | 3.0 | 0.03 | 0.04 |

| IPCC Source category | Gas | AD | EF | Combined | Combined as % of total national emissions in 2007 | Introduced into the trend in total national emissions |
|---|---|---|---|---|---|---|
| | | Uncertainty [%] | | | | |
| 1 A 2 other: Manufacturing Industries and Construction | $CO_2$ | 10.0 | 20.0 | 22.4 | 0.25 | 0.24 |
| 1 A 2 solid: Manufacturing Industries and Construction | $CO_2$ | 1.0 | 0.5 | 1.1 | 0.07 | 0.10 |
| 1 A 2 stat-liquid: Manufacturing Industries and Construction | $CO_2$ | 3.0 | 0.5 | 3.0 | 0.08 | 0.12 |
| 1 A 3 a jet kerosene: Civil Aviation | $CO_2$ | 3.0 | 3.0 | 4.2 | 0.00 | 0.00 |
| 1 A 3 b diesel oil: Road Transportation | $CO_2$ | 3.0 | 3.0 | 4.2 | 0.85 | 1.05 |
| 1 A 3 b gasoline: Road Transportation | $CO_2$ | 3.0 | 3.0 | 4.2 | 0.30 | 0.35 |
| 1 A 4 biomass: Other Sectors | $CH_4$ | 10.0 | 50.0 | 51.0 | 0.15 | 0.08 |
| 1 A 4 mobile-diesel: Other Sectors | $CO_2$ | 3.0 | 0.5 | 3.0 | 0.03 | 0.04 |
| 1 A 4 other: Other Sectors | $CO_2$ | 10.0 | 20.0 | 22.4 | 0.04 | 0.07 |
| 1 A 4 solid: Other Sectors | $CO_2$ | 1.0 | 0.5 | 1.1 | 0.01 | 0.02 |
| 1 A 4 stat-liquid: Other Sectors | $CO_2$ | 3.0 | 0.5 | 3.0 | 0.17 | 0.27 |
| 1 A gaseous: Fuel Combustion (stationary) | $CO_2$ | 2.0 | 0.5 | 2.1 | 0.38 | 0.58 |
| 1 B 2 b: Natural gas | $CH_4$ | 4.2 | 14.1 | 14.7 | 0.10 | 0.07 |
| 2 A 1: Cement Production | $CO_2$ | 5.0 | 2.0 | 5.4 | 0.13 | 0.20 |
| 2 A 2: Lime Production | $CO_2$ | 20.0 | 5.0 | 20.6 | 0.14 | 0.22 |
| 2 A 3: Limestone and Dolomite Use | $CO_2$ | 19.6 | 2.0 | 19.7 | 0.07 | 0.11 |
| 2 A 7 b: Sinter Production | $CO_2$ | 2.0 | 5.0 | 5.4 | 0.02 | 0.02 |
| 2 B 1: Ammonia Production | $CO_2$ | 2.0 | 4.6 | 5.0 | 0.03 | 0.02 |
| 2 B 2: Nitric Acid Production | $N_2O$ | 0.0 | 5.0 | 5.0 | 0.02 | 0.05 |
| 2 C 1: Iron and Steel Production | $CO_2$ | 0.5 | 0.5 | 0.7 | 0.05 | 0.05 |
| 2 C 3: Aluminium production | $CO_2$ | 2.0 | 0.5 | 2.1 | 0.00 | 0.01 |
| 2 C 3: Aluminium production | PFC | 0.0 | 50.0 | 50.0 | 0.00 | 0.12 |
| 2 C 4: SF6 Used in Al and Mg Foundries | $SF_6$ | 0.0 | 5.0 | 5.0 | 0.00 | 0.02 |
| 2 F 1/2/3/4/5: ODS Substitutes | HFC | 20.0 | 50.0 | 53.9 | 0.18 | 0.14 |
| 2 F 7: Semiconductor Manufacture | FCs | 5.0 | 10.0 | 11.2 | 0.04 | 0.03 |
| 2 F 9: Other Sources of SF6 | $SF_6$ | 25.0 | 50.0 | 55.9 | 0.56 | 0.67 |
| 3: SOLVENT AND OTHER PRODUCT USE | $CO_2$ | 5.0 | 10.0 | 11.2 | 0.03 | 0.02 |
| 4 A 1: Cattle | $CH_4$ | 10.0 | 20.0 | 22.4 | 0.79 | 0.61 |
| 4 B 1: Cattle | $N_2O$ | 10.0 | 100.0 | 100.5 | 0.93 | 0.33 |
| 4 B 1: Cattle | $CH_4$ | 10.0 | 70.0 | 70.7 | 0.37 | 0.20 |
| 4 B 8: Swine | $CH_4$ | 10.0 | 70.0 | 70.7 | 0.34 | 0.11 |
| 4 D 1: Direct Soil Emissions | $N_2O$ | 5.0 | 150.0 | 150.1 | 2.87 | 0.75 |
| 4 D 2: Pasture, Range and Paddock Manure | $N_2O$ | 5.0 | 150.0 | 150.1 | 0.39 | 0.04 |

| IPCC Source category | Gas | AD | EF | Combined | Combined as % of total national emissions in 2007 | Introduced into the trend in total national emissions |
|---|---|---|---|---|---|---|
| | | Uncertainty [%] | | | | |
| 4 D 3: Indirect Emissions | $N_2O$ | 5.0 | 150.0 | 150.1 | 1.94 | 0.70 |
| 6 A: Solid Waste Disposal on Land | $CH_4$ | 12.0 | 25.0 | 27.7 | 0.57 | 0.76 |
| 6 B: Wastewater Handling | $N_2O$ | 20.0 | 50.0 | 53.9 | 0.18 | 0.15 |
| **Total** | | | | | **3.97** | **2.13** |

*Table 9: Tier 2 Uncertainty reporting according IPCC (2000) Table 6.2 – key sources.*

| IPCC Source category | Gas | Uncertainty in 2007 emissions as % of emissions in the category | | Uncertainty introduced on national total in 2007 | Uncertainty introduced into the trend in total national emissions |
|---|---|---|---|---|---|
| | | % below (2.5) | % above (97.5) | % | |
| 1 A 1 a liquid: Public Electricity and Heat Production | $CO_2$ | 0.7 | 0.7 | 0.01 | 0.01 |
| 1 A 1 a other: Public Electricity and Heat Production | $CO_2$ | 21.7 | 22.9 | 0.17 | 0.2 |
| 1 A 1 a solid: Public Electricity and Heat Production | $CO_2$ | 0.7 | 0.7 | 0.04 | 0.1 |
| 1 A 1 b liquid: Petroleum refining | $CO_2$ | 0.6 | 0.6 | 0.02 | 0.02 |
| 1 A 2 mobile-liquid: Manufacturing Industries and Construction | $CO_2$ | 3.0 | 3.0 | 0.02 | 0.03 |
| 1 A 2 other: Manufacturing Industries and Construction | $CO_2$ | 21.6 | 23.2 | 0.24 | 0.22 |
| 1 A 2 solid: Manufacturing Industries and Construction | $CO_2$ | 1.1 | 1.1 | 0.07 | 0.11 |
| 1 A 2 stat-liquid: Manufacturing Industries and Construction | $CO_2$ | 2.7 | 2.7 | 0.07 | 0.12 |
| 1 A 3 a jet kerosene: Civil Aviation | $CO_2$ | 4.2 | 4.3 | 0.00 | 0.00 |
| 1 A 3 b diesel oil: Road Transportation | $CO_2$ | 4.2 | 4.3 | 0.83 | 0.82 |
| 1 A 3 b gasoline: Road Transportation | $CO_2$ | 4.2 | 4.3 | 0.29 | 0.38 |
| 1 A 4 biomass: Other Sectors | $CH_4$ | 49.3 | 49.8 | 0.15 | 0.06 |
| 1 A 4 mobile-diesel: Other Sectors | $CO_2$ | 3.0 | 3.0 | 0.03 | 0.04 |
| 1 A 4 other: Other Sectors | $CO_2$ | 21.6 | 23.2 | 0.04 | 0.07 |
| 1 A 4 solid: Other Sectors | $CO_2$ | 1.1 | 1.1 | 0.01 | 0.04 |
| 1 A 4 stat-liquid: Other Sectors | $CO_2$ | 2.8 | 2.8 | 0.16 | 0.32 |
| 1 A gaseous: Fuel Combustion (stationary) | $CO_2$ | 3.4 | 3.4 | 0.62 | 0.82 |
| 1 B 2 b: Natural gas | $CH_4$ | 14.5 | 14.7 | 0.10 | 0.06 |
| 2 A 1: Cement Production | $CO_2$ | 5.2 | 5.3 | 0.13 | 0.19 |
| 2 A 2: Lime Production | $CO_2$ | 20.2 | 20.7 | 0.14 | 0.18 |

| IPCC Source category | Gas | Uncertainty in 2007 emissions as % of emissions in the category | | Uncertainty introduced on national total in 2007 | Uncertainty introduced into the trend in total national emissions |
|---|---|---|---|---|---|
| | | % below (2.5) | % above (97.5) | % | |
| 2 A 3: Limestone and Dolomite Use | $CO_2$ | 19.6 | 19.1 | 0.07 | 0.09 |
| 2 A 7 b: Sinter Production | $CO_2$ | 5.3 | 5.3 | 0.02 | 0.02 |
| 2 B 1: Ammonia Production | $CO_2$ | 4.9 | 5.0 | 0.03 | 0.02 |
| 2 B 2: Nitric Acid Production | $N_2O$ | 19.6 | 20.3 | 0.06 | 0.17 |
| 2 C 1: Iron and Steel Production | $CO_2$ | 0.7 | 0.7 | 0.04 | 0.04 |
| 2 C 3: Aluminium production | $CO_2$ | 0.0 | 0.0 | 0.00 | 0.00 |
| 2 C 3: Aluminium production | PFC | 0.0 | 0.0 | 0.00 | 0.66 |
| 2 C 4: SF6 Used in Al and Mg Foundries | $SF_6$ | 0.0 | 0.0 | 0.00 | 0.02 |
| 2 F 1/2/3/4/5: ODS Substitutes | HFC | 52.3 | 53.5 | 0.53 | 0.59 |
| 2 F 7: Semiconductor Manufacture | FCs | 10.9 | 10.8 | 0.04 | 0.04 |
| 2 F 9: Other Sources of SF6 | $SF_6$ | 54.5 | 54.4 | 0.17 | 0.21 |
| 3: SOLVENT AND OTHER PRODUCT USE | $CO_2$ | 4.9 | 4.9 | 0.01 | 0.02 |
| 4 A 1: Cattle | $CH_4$ | 20.5 | 21.4 | 0.72 | 0.44 |
| 4 B 1: Cattle | $CH_4$ | 71.4 | 68.2 | 0.37 | 0.14 |
| 4 B 1: Cattle | $N_2O$ | 50.5 | 99.5 | 0.70 | 0.16 |
| 4 B 8: Swine | $CH_4$ | 71.2 | 67.9 | 0.33 | 0.07 |
| 4 D 1: Direct Soil Emissions | $N_2O$ | 70.2 | 196.2 | 2.89 | 0.41 |
| 4 D 2: Pasture, Range and Paddock Manure | $N_2O$ | 70.2 | 196.2 | 0.39 | 0.03 |
| 4 D 3: Indirect Emissions | $N_2O$ | 70.2 | 196.2 | 1.95 | 0.44 |
| 6 A: Solid Waste Disposal on Land | $CH_4$ | 26.3 | 28.3 | 0.55 | 0.77 |
| 6 B: Wastewater Handling | $N_2O$ | 41.4 | 45.9 | 0.14 | 0.09 |
| Non-Key Sources | $CO_2$ | 1.6 | 1.6 | 0.02 | 0.02 |
| Non-Key Sources | $CH_4$ | 18.0 | 18.2 | 0.11 | 0.06 |
| Non-Key Sources | $N_2O$ | 13.9 | 15.7 | 0.18 | 0.11 |
| Non-Key Sources | PFC | 52.3 | 53.5 | 0.00 | 0.00 |
| Non-Key Sources | HFC | - | - | 0.00 | 0.00 |
| Non-Key Sources | $SF_6$ | 54.5 | 54.4 | 0.03 | 0.03 |
| **National Total without LULUCF** | | | | **5.65** | **2.28** |

*Uncertainty expressed as percentiles (2.5%, 97.5%) is able to cover asymmetric distributions. Expressing percentages only (or percentage points, in the case of the trend) comes closer to the Tier 1 result, but fails to reflect the full potential of the approach.*

The complete uncertainty information (IPCC GPG tables 6.1 and 6.2) can be found in Annex 6.

### 1.7.7 Conclusions

The comparison of Tier 1 and Tier 2 results shows that, basically, both approaches yield very similar results in terms of contribution to level or trend uncertainty for an individual source category. Differences become visible where distributions are not symmetric (in the case of Austria, lognormal distributions have been applied to $N_2O$ emissions only, most visible for $N_2O$ from soils). This is also seen in the difference between the "lower range" vs. "upper range" uncertainties, and those determined by standard deviations (2s).

The most striking difference is that of the total uncertainty, the tier 1 approach is clearly lower. This difference may be explained by the fact that the tier 1 approach necessarily considers input data for two source categories to be independent. As we have described above, we do believe that such dependence is quite typical. Statistically dependent variables, as can easily be defined in a Monte Carlo analysis, will not allow overall relative uncertainty to be reduced as strongly as error propagation. Consequently, uncertainty results will be considerably higher than presented in a tier 1 approach.

We need to mention specifically that this difference in the results is not a necessity of the tier 2 approach, but depends just on the input assumptions taken. Many studies (MONNI & SYRI 2003, RAMIREZ-RAMIREZ et al. 2006, US-EPA 2007) apply different assumptions, or at least do not clearly refer to this problem. We have outlined above, however, why we believe that many of the parameters in the inventory are not independent and thus have to be assumed to contribute to a correlation.

Figure 6 shows the resulting probability density distribution for Austria, 2006. The distribution is most strongly influenced by the lognormal distribution of the uncertainty in soil $N_2O$ emissions. If the previous (WINIWARTER & RYPDAL 2001) assumption on "random" $N_2O$ emission factor uncertainty is taken (triangular distribution between 50% and 200% of the given emission factor), the total level uncertainty of the Austrian inventory decreases considerably. This is again proof of the importance on assumptions taken on $N_2O$ emissions on the overall uncertainty of a national GHG inventory.

Compared to the previous Monte-Carlo uncertainty analysis of the Austrian GHG inventory (WINIWARTER & ORTHOFER 2000, WINIWARTER & RYPDAL 2001), results (without LULUCF, and without considering systematic uncertainties) are somewhat higher. As has been discussed above, virtually all of that increase is due to different and new assumptions on the uncertainty of the emission factor of $N_2O$.

As is also shown in Figure 7, studying the sensitivity of the output to the input parameters yields a result virtually fully determined by soil $N_2O$ emission factor. While, compared to previously, other components have improved, it is now virtually $N_2O$ alone that determines the uncertainty. It should be noted that even at quite low uncertainty, transport has taken over a considerable role due to its large overall contribution to emissions, albeit not at all challenging the leading role of $N_2O$.

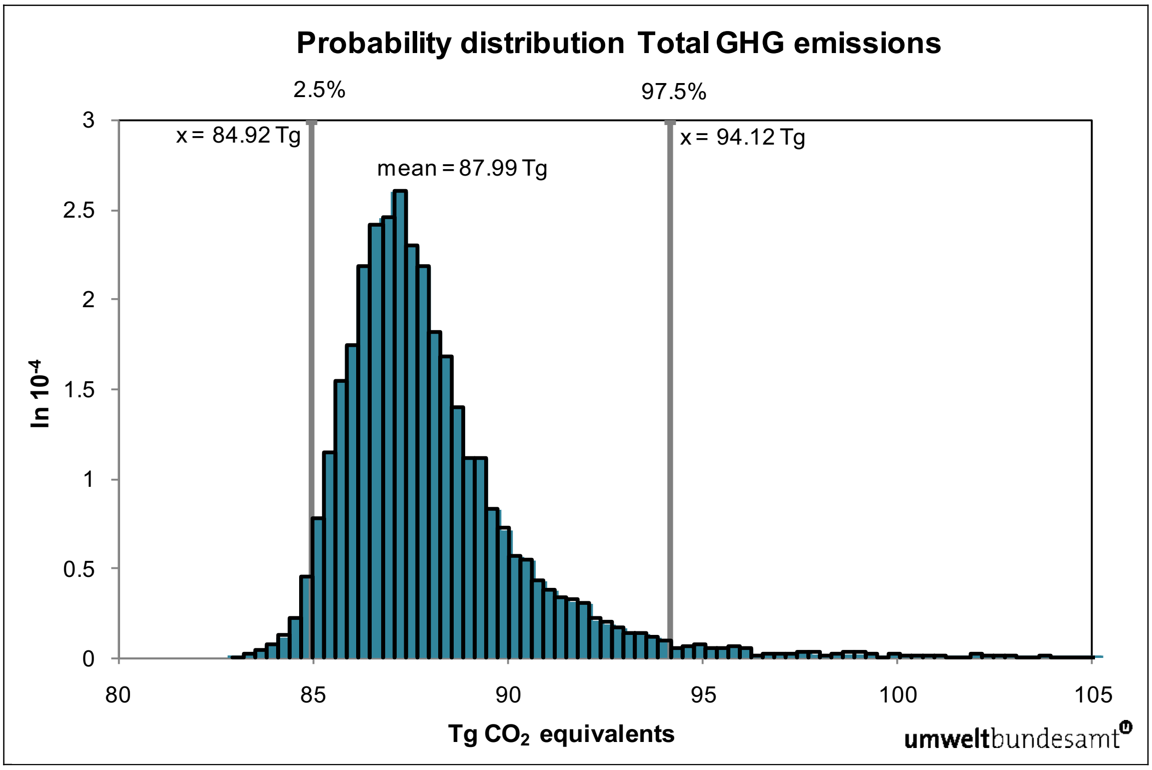


*Figure 6: Austria's greenhouse gas emissions in 2007 without LULUCF – probability bins according to uncertainty analysis.*

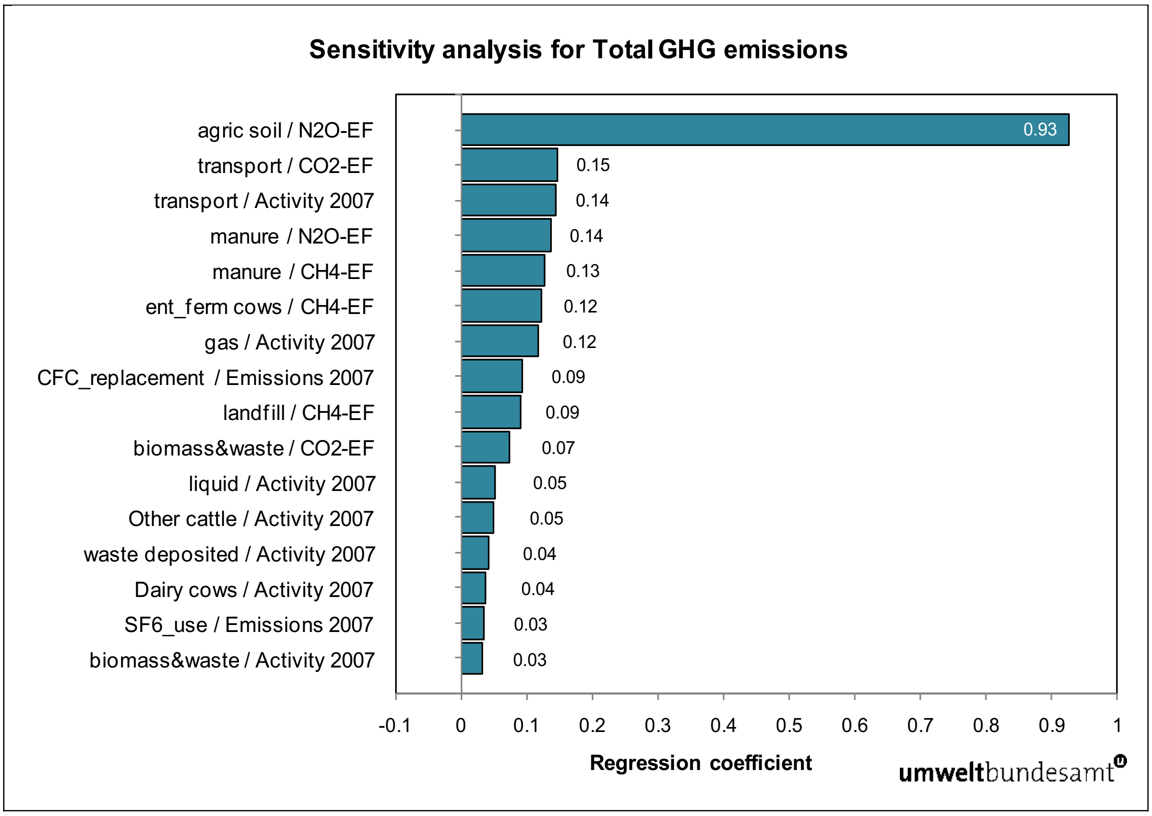


*Figure 7: Sensitivity analysis: regression coefficients between total GHG emissions 2007 (without LULUCF) and input parameters.*

Table 10 and Table 11 present a comparison to the previous study on uncertainties of the Austrian GHG inventory (WINIWARTER & RYPDAL 2001). As is evident from the 1990 emission figures (mean value), methodical problems of the underlying inventory as of the late 1990s only allow for a limited evaluation (differences to the state-of-the-art compilation methods, then not implemented in the national inventory, were regarded as systematic error and are not included in this analysis). The low uncertainty for $CO_2$, the dominating greenhouse gas, could be sustained. Improved analysis lead to better understanding of $CH_4$ emissions, thus reducing uncertainty. For $N_2O$, as discussed above, some of the uncertainty considered systematic and method-relevant had to be included into the random uncertainty after adaptation of the method. This is also the main reason for the change in total uncertainty, which is mostly determined by the $N_2O$ uncertainty and hardly influenced by uncertainties from the additionally evaluated F-gases.

Differences also become obvious when comparing between years (1990 vs. 2007). This is not due to the method, but only due to shifts in activities. Abolishing Al-production in Austria stops the highly uncertain emissions and decreases PFC uncertainty. The increase in uncertainty on $CO_2$ is due to a shift of the activity into transport, which is considered more uncertain than most other parts of fossil fuel consumption. The increase in uncertainty for individual gas emissions still allows for a decrease of the overall inventory, as the weight of $CO_2$ emissions becomes larger, and $N_2O$ emissions actually have been reduced in that period.

*Table 10: Key results of the first comprehensive study on the Austrian GHG inventory uncertainty (WINIWARTER & RYPDAL 2001).*

| Random uncertainty | | $CO_2$ | $CH_4$ | $N_2O$ | PFC | HFC | $SF_6$ | Total GHG emissions |
|---|---|---|---|---|---|---|---|---|
| 1990 | Mean value [Tg] | 63.54 | 11.41 | 1.99 | – | – | – | 76.94 |
| | Standard deviation | 0.30 | 1.64 | 0.26 | – | – | – | 1.73 |
| | **2σ** | **1.0%** | **28.7%** | **25.6%** | **–** | **–** | **–** | **4.5%** |
| 1997 | Mean value [Tg] | 68.05 | 10.02 | 2.27 | – | – | – | 80.34 |
| | Standard deviation | 0.34 | 1.43 | 0.27 | – | – | – | 1.53 |
| | **2σ** | **1.0%** | **28.5%** | **23.9%** | **–** | **–** | **–** | **3.8%** |

*Table 11: Key results of the Austrian GHG inventory uncertainty analysis 2009.*

| | Random uncertainty | $CO_2$ | $CH_4$ | $N_2O$ | PFC* | HFC | $SF_6$* | Total GHG emissions |
|---|---|---|---|---|---|---|---|---|
| 1990 | Mean value [Tg] | 62.09 | 9.16 | 6.22 | 1.05 | 0.02 | 0.53 | 79.07 |
| | Standard deviation | 0.41 | 0.72 | 2.64 | 0.26 | 0.01 | 0.04 | 2.78 |
| | **2σ** | **1.3%** | **15.8%** | **84.9%** | **49.8%** | **53.8%** | **16.1%** | **7.0%** |
| 2007 | Mean value [Tg] | 74.18 | 6.94 | 5.42 | 0.00 | 0.85 | 0.60 | 88.00 |
| | Standard deviation | 0.63 | 0.53 | 2.34 | 0.00 | 0.23 | 0.09 | 2.48 |
| | **2σ** | **1.7%** | **15.2%** | **86.2%** | **54.3%** | **54.3%** | **29.4%** | **5.6%** |

**Due to the definition of key category FC emissions from 2.F.7, PFC emissions are partly considered in $SF_6$ emissions.*

The results presented here are comparable to internationally discussed national inventory uncertainties, as they also do not include systematic uncertainties. If such systematic uncertainties should also be included, this can not be done for individual source categories, but only for the total inventory. We may expect (according to WINIWARTER & RYPDAL 2001) that systematic uncertainty will add about 5% to the level uncertainty, and 2% to the trend uncertainty.

## 1.8 Completeness

CRF-Table 9 (Completeness) has been used to give information on the aspect of completeness. This chapter includes additional information. An assessment of completeness for each sector is given in the Sector Overview part of the corresponding subchapters.

### Sources and sinks

All sources and sinks included in the IPCC Guidelines are adressed. No additional sources and sinks specific to Austria have been identified.

### Gases

Both direct GHGs as well as precursor gases are covered by the Austrian inventory.

### Geographic coverage

The geographic coverage is complete. There is no part of the Austrian territory not covered by the inventory.

### Notation keys

The sources and sinks not considered in the inventory but included in the IPCC Guidelines are clearly indicated, the reasons for such exclusion are explained. In addition, the notation keys presented below are used to fill in the blanks in all the tables in the CRF. Notation keys used in the NIR are consistent with those reported in the CRF. Notation keys are used according to the UNFCCC guidelines on reporting and review (FCCC/CP/2002/8).

Allocations to categories may differ from Party to Party. The main reasons for different category allocations are different allocations in national statistics, insufficient information on the national statistics, national methods, and the impossibility to disaggregate emission declarations.

*IE (included elsewhere):*
"IE" is used for emissions by sources and removals by sinks of greenhouse gases that have been estimated but included elsewhere in the inventory instead of the expected source/sink category. Where "IE" is used in the inventory, the CRF completeness table (Table 9) indicates where (in the inventory) these emissions or removals have been included. Such deviation from the expected category is explained.

*NE (not estimated):*
"NE" is used for existing emissions by sources and removals by sinks of greenhouse gases which have not been estimated. Where "NE" is used in an inventory for emissions or removals, both the NIR and the CRF completeness table indicate why emissions or removals have not been estimated. For emissions by sources and removals by sinks of greenhouse gases marked by "NE" check-ups are in progress to establish if they actually are "NO" (not occurring). As part of the improvement programme of the inventory, it is planned that these source or sink categories are either estimated or allocated to "NO".

*NA (not applicable):*
"NA" is used for activities in a given source/sink category that do not produce emissions or lead to removals of a specific gas.

*C (confidential):*
"C" is used for emissions which could lead to the disclosure of confidential information if reported at the most disaggregated level. In this case a minimum of aggregation is required to protect business information. Activity data for $SF_6$ from Aluminium Foundries (cast aluminium – sector *2 C 3*) and semiconductor manufacture are reported as "confidential".

In the Austrian QMS a transparency and a completeness index is used trying to quantify the quality of the inventory. They are calculated as follows:

*Transparency [%] = [1 – (number of IE/number of estimates)]*100*

*Completeness [%] = [1 – (number of NE/number of estimates)]*100*

In the following table transparency and completeness of submission 2008 is compared to the values of 2009. Only minor changes for the transparency indicator due to the more detailed data format for LULUCF (increasing the total number of estimates) can be observed.

*Table 12: Transparency and completeness in UNFCCC submissions 2009 and 2008.*

| **Sector** | **Submission 2009** | | | | **Submission 2008** | | | |
|---|---|---|---|---|---|---|---|---|
| | **IE** | **NE** | **Transparency** | **Completeness** | **IE** | **NE** | **Transparency** | **Completeness** |
| 1 Energy | 28 | 0 | *92%* | *100%* | 28 | 0 | *92%* | *100%* |
| 2 Industrial Processes | 49 | 24 | *91%* | *96%* | 49 | 24 | *91%* | *96%* |
| 3 Solvents | 0 | 0 | *100%* | *100%* | 0 | 0 | *100%* | *100%* |
| 4 Agriculture | 2 | 0 | *96%* | *100%* | 2 | 0 | *96%* | *100%* |
| 5 LULUCF | 20 | 8 | *92%* | *97%* | 18 | 8 | *92%* | *97%* |
| 6 Waste | 4 | 0 | *89%* | *100%* | 4 | 0 | *89%* | *100%* |
| **Total** | **103** | **32** | ***92%*** | ***97%*** | **101** | **32** | ***92%*** | ***97%*** |
| **Total number of estimates*** | **1 244** | | | | **1 236** | | | |

* *(including IE and NE, also including NO and NA)*

*NOTE: a transcription error for the values of the submission 2008 presented in the NIR 2008 has been corrected*

# 2 TREND IN TOTAL EMISSIONS

Austira's Kyoto target for the five-year commitment period from 2008 to 2012 is minus 13% compared to greenhouse gas emissions in 1990.

Annex B of the Kyoto Protocol lists a target of minus 8% for Austria, it is the common target of the European Community, which is also a Party to the Kyoto Protocol, and its Member States. However, following Article 24 of the Kyoto Protocol the European Community decided to achieve this goal jointly. Therefore, in April 2002, the Council of the EC has adopted a decision, the so-called "burden sharing agreement"[18], which includes reduction targets for each EC Member State. Austria agreed to reduce its greenhouse gas emissions for 2008–2012 by 13% compared to base year emissions.

## 2.1 Emission Trends for Aggregated GHG Emissions

Austria's total greenhouse gas emissions without LULUCF show an increase of 11.3% from the base year to 2007 (CO2: +19.5%). The trend is dominated by the trend of the most important sector, the energy sector.

In 2007 Austria's total greenhouse gas emissions decreased by 3.9% compared to 2006, CO2 emissions decreased by 4.4%. The key driver for this trend was the mild weather in 2007: the number of heating days further decreased by 9% related to the year before. The resulting lower heating demand affected emissions from "other sectors" (mainly residential heating) and energy industries. Furthermore an increase of renewable energy input can be observed, resulting in 10% lower emissions from energy industries in 2007 related to 2006. Some decrease of emissions from (mainly residential) heating - minus 17% for 2006-2007 - is also due to a significant decrease of liquid fuel sales, presumably due to leftovers of heating oil due to the milder weather in 2006 compared to 2005.

*Table 13: Summary of Austria's anthropogenic greenhouse gas emissions from 1990–2007.*

| GHG | | Total | $CO_2$ | $CH_4$ | $N_2O$ | HFCs | PFCs | $SF_6$ |
|---|---|---|---|---|---|---|---|---|
| BY* | [Gg $CO_2$ equivalent] | 79 036.84 | 62 081.53 | 9 183.05 | 6 167.40 | 23.03 | 1 079.24 | 502.58 |
| 1991 | | 83 121.20 | 65 671.09 | 9 161.93 | 6 502.52 | 45.21 | 1 087.08 | 653.36 |
| 1992 | | 76 400.94 | 60 226.24 | 8 874.04 | 6 091.46 | 48.68 | 462.67 | 697.85 |
| 1993 | | 76 307.31 | 60 542.84 | 8 851.12 | 5 909.39 | 157.34 | 52.90 | 793.71 |
| 1994 | | 77 209.93 | 60 929.63 | 8 658.55 | 6 370.62 | 206.83 | 58.61 | 985.70 |
| 1995 | | 80 506.24 | 63 965.30 | 8 541.81 | 6 523.93 | 267.34 | 68.69 | 1 139.16 |
| 1996 | | 83 581.17 | 67 407.08 | 8 352.11 | 6 190.88 | 346.84 | 66.20 | 1 218.05 |
| 1997 | | 83 132.73 | 67 200.32 | 8 074.58 | 6 213.50 | 427.42 | 96.75 | 1 120.15 |
| 1998 | | 82 499.73 | 66 774.88 | 7 953.10 | 6 324.22 | 494.89 | 44.65 | 907.99 |
| 1999 | | 80 925.20 | 65 553.99 | 7 780.01 | 6 300.60 | 542.20 | 64.44 | 683.96 |
| 2000 | | 81 078.39 | 65 951.25 | 7 621.43 | 6 203.92 | 596.26 | 72.21 | 633.31 |
| 2001 | | 85 082.78 | 70 056.03 | 7 526.83 | 6 086.84 | 694.45 | 82.02 | 636.62 |

[18] Council Decision of 25 April 2002 (2002/358/CE) concerning the approval, on behalf of the EC, of the KP to the UNFCCC and the joint fulfilment of commitments thereunder

| GHG | Total | $CO_2$ | $CH_4$ | $N_2O$ | HFCs | PFCs | $SF_6$ |
|---|---|---|---|---|---|---|---|
| 2002 | 87 030.88 | 72 014.92 | 7 412.94 | 6 094.24 | 781.21 | 86.73 | 640.83 |
| 2003 | 93 111.98 | 78 055.04 | 7 460.41 | 6 037.66 | 862.96 | 102.39 | 593.52 |
| 2004 | 91 774.79 | 77 590.77 | 7 312.98 | 5 335.53 | 896.71 | 125.68 | 513.12 |
| 2005 | 92 832.10 | 79 008.75 | 7 177.58 | 5 326.14 | 907.91 | 125.22 | 286.50 |
| 2006 | 91 518.47 | 77 586.14 | 7 080.04 | 5 375.65 | 860.74 | 135.67 | 480.24 |
| 2007 | 87 958.35 | 74 176.54 | 6 955.61 | 5 373.29 | 860.63 | 182.71 | 409.58 |

*Emissions without LULUCF*

* *BY= Base Year: 1990 for all gases*

Note: *Global warming potentials (GWPs) used (100 years time horizon): carbon dioxide ($CO_2$) = 1; methane ($CH_4$) = 21; nitrous oxide ($N_2O$) = 310; sulphur hexafluoride ($SF_6$) = 23 900; hydrofluorocarbons (HFCs) and perfluorocarbons (PFCs) consist of different substances, therefore GWPs have to be calculated individually depending on the substances*

The following figure depicts the trend of Austria's GHG emissions and also shows Austria's Kyoto Target for 2008-2012. The figure excludes emission sources and sinks from the land use, land use change and forestry sector as reported under the UNFCCC.

It has to be noted that for judging the compliance under the Kyoto Protocol sources and sinks related to Article 3.3 and 3.4 of the Kyoto Protocol (as reported voluntarily in Annex 8 of this report) have to be considered, and also the use of flexible mechanisms under the Kyoto Protocol has to be accounted.

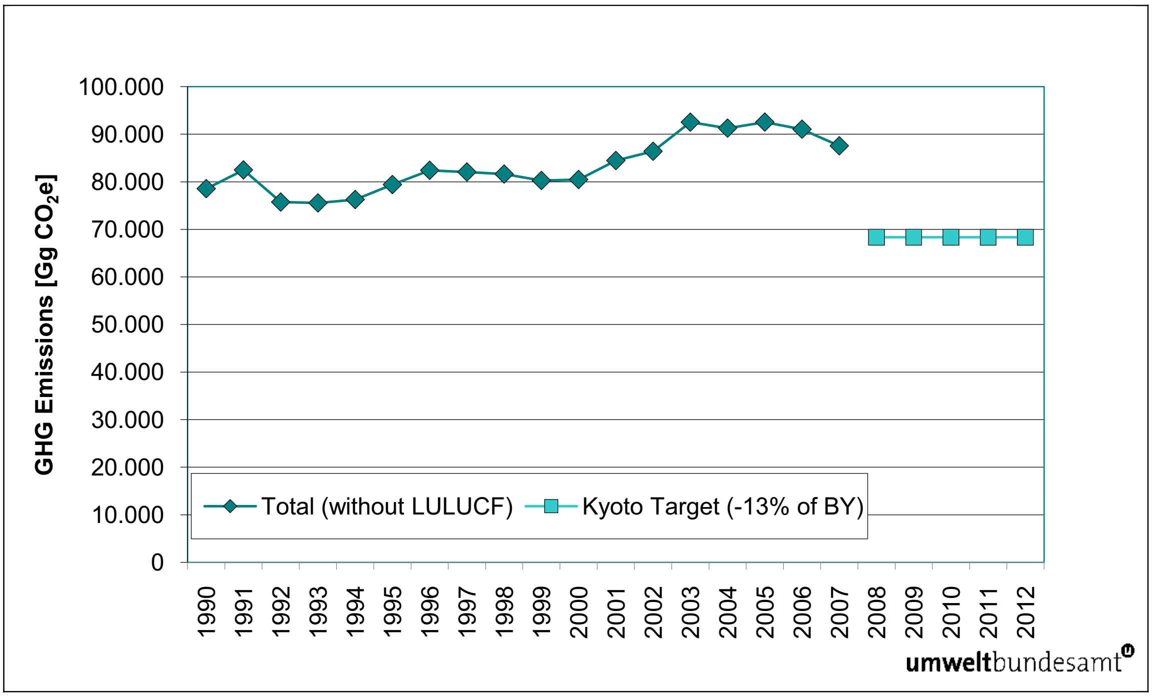


*Figure 8: Trend in total GHG emissions 1990–2007 without LULUCF.*

## 2.2 Emission Trends by Gas

The most important GHG in Austria is carbon dioxide ($CO_2$) with a share of 84% in 2007. The $CO_2$ emissions primarily result from combustion activities. Methane ($CH_4$), which mainly arises from stock farming and waste disposal, contributes 8% to national total GHG emissions, and nitrous oxide with agricultural soils as the main source adds another 6%. The remaining 2% is due to emissions of fluorinated compounds, which are mostly emitted from the use of these gases as substitutes for ozone depleting substances (ODS) in refrigeration equipment.

*Table 14: Austria's greenhouse gas emissions by gas in the base year and in 2007.*

| GHG | BY 1990 | 2007 | *BY 1990* | *2007* |
|---|---|---|---|---|
| | $CO_2$ equivalent [Gg] | | *Share [%]* | |
| Total | 79 037 | 87 958 | *100.0* | *100.0* |
| $CO_2$ | 62 082 | 74 177 | *78.5* | *84.3* |
| $CH_4$ | 9 183 | 6 956 | *11.6* | *7.9* |
| $N_2O$ | 6 167 | 5 373 | *7.8* | *6.1* |
| F-Gases | 1 605 | 1453 | *2.0* | *1.7* |

*Emissions without LULUCF*

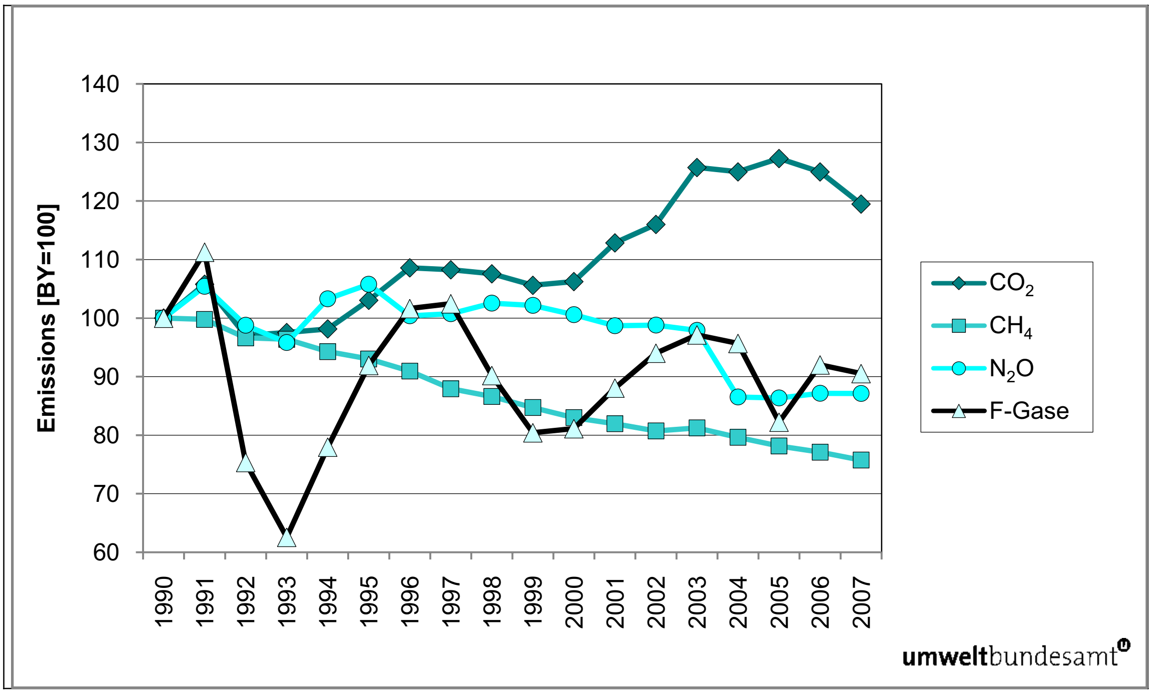


*Figure 9: Trend in greenhouse gas emissions 1990–2007 by gas in index form (base year = 100).*

### $CO_2$

$CO_2$ emissions increased by 19.5% from 1990 to 2007. In absolute figures, $CO_2$ emissions increased from 62 082 to 74 177 Gg during the period from 1990 to 2007 mainly due to higher emissions from transport, which increased by 73%.

The main source of $CO_2$ emissions in Austria is fossil fuel combustion; within the fuel combustion sector transport is the most important sub-source.

According to the Climate Convention, Austria's $CO_2$ emissions should have been reduced to the levels of 1990 by 2000, but the $CO_2$ stabilisation target for 2000 could not be met. However, the Member States of the European Community agreed to jointly achieve this goal and the EC was successful in doing so.

### $CH_4$

$CH_4$ emissions decreased steadily during the period from 1990 to 2007 from 9 183 to 6 956 Gg $CO_2$ equivalents. In 2007, $CH_4$ emissions were 24.3% below the level of the base year, mainly due to lower emissions from solid waste disposal sites.

The main sources of $CH_4$ emissions in Austria are solid waste disposal on land (landfills) and agriculture (enteric fermentation).

### $N_2O$

$N_2O$ emissions in Austria fluctuated between 1990 and 1998, increasing by 2% over this period. Since then emissions have shown a decreasing trend, resulting in 5 373 Gg $CO_2$ equivalents in 2007 compared to 6 167 in the base year (minus 12.9%). The general decrease is mainly due to lower $N_2O$ emissions from agricultural soils; the strong decrease 2003–2004 was due to emission reduction measures in the chemical industry.

The main source of $N_2O$ emissions are agricultural soils with a share of 55% in national total $N_2O$ emissions. Manure management has a share of 16% and fuel combustion, which is another important source with regard to national total $N_2O$ emissions, has a share of 14%.

### HFCs

HFC emissions increased remarkably during the period from 1990 to 2007 from 23 to 861 Gg $CO_2$ equivalents. HFCs are used as substitutes for HCFCs (Hydro Chloro Fluoro Carbons; these are ozone depleting substances), the use of which has been banned for most applications.

### PFCs

PFC emissions show an inverse trend of HFC emissions. PFC emissions decreased remarkably during the period from 1990 to 2007, from 1 079 to 183 Gg $CO_2$ equivalents. PFCs were in the base year mainly emitted as by-products of primary aluminium production, which closed down in Austria in 1992; in 2007 the main source of PFC emissions was semiconductor manufacture.

### $SF_6$

$SF_6$ emissions in 1990 amounted to 503 Gg $CO_2$ equivalents. They increased steadily until 1996 reaching a maximum of 1 218 Gg $CO_2$ equivalents. Since then they have been decreasing, in 2007 $SF_6$ emissions amounted to 410 Gg $CO_2$ equivalents, which was 10% below the level of the base year (1990).

The main sources of $SF_6$ emissions in 2007 were semiconductor manufacture and disposal of noise insulating windows.

## 2.3 Emission Trends by Source

Table 15 presents a summary of Austria's anthropogenic greenhouse gas emissions by sector for the period from 1990 to 2007:

*Table 15: Summary of Austria's anthropogenic greenhouse gas emissions by sector from 1990–2007.*

| | [Gg $CO_2$ equivalent] | Total | Energy | Industrial processes | Solvents | Agriculture | LULUCF | Waste |
|---|---|---|---|---|---|---|---|---|
| 1990 | | 79 036.84 | 55 594.99 | 10 110.82 | 511.80 | 9 170.66 | -13 177.85 | 3 648.57 |
| 1991 | | 83 121.20 | 59 509.54 | 10 152.82 | 465.98 | 9 353.59 | -19 083.10 | 3 639.26 |
| 1992 | | 76 400.94 | 54 579.42 | 8 999.19 | 417.65 | 8 868.31 | -14 041.66 | 3 536.38 |
| 1993 | | 76 307.31 | 55 009.32 | 8 750.64 | 418.48 | 8 636.40 | -17 922.81 | 3 492.47 |
| 1994 | | 77 209.93 | 55 058.97 | 9 274.83 | 403.26 | 9 136.46 | -16 570.55 | 3 336.42 |
| 1995 | | 80 506.24 | 57 929.50 | 9 729.22 | 422.45 | 9 242.05 | -16 011.06 | 3 183.01 |
| 1996 | | 83 581.17 | 61 763.26 | 9 601.24 | 405.66 | 8 771.75 | -10 925.41 | 3 039.25 |
| 1997 | | 83 132.73 | 60 859.25 | 10 192.53 | 424.37 | 8 745.25 | -19 856.37 | 2 911.33 |
| 1998 | | 82 499.73 | 60 846.33 | 9 674.37 | 406.32 | 8 748.54 | -17 982.19 | 2 824.18 |
| 1999 | | 80 925.20 | 59 823.96 | 9 391.10 | 392.26 | 8 585.15 | -22 370.12 | 2 732.74 |
| 2000 | | 81 078.39 | 59 581.92 | 10 034.18 | 425.06 | 8 386.35 | -16 974.21 | 2 650.88 |
| 2001 | | 85 082.78 | 63 829.89 | 9 907.41 | 424.79 | 8 331.73 | -19 662.47 | 2 588.95 |
| 2002 | | 87 030.88 | 65 253.03 | 10 591.37 | 428.96 | 8 211.12 | -15 924.88 | 2 546.39 |
| 2003 | | 93 111.98 | 71 412.24 | 10 662.20 | 423.34 | 8 020.07 | -17 304.72 | 2 594.13 |
| 2004 | | 91 774.79 | 71 056.08 | 9 984.86 | 379.04 | 7 872.85 | -17 349.95 | 2 481.96 |
| 2005 | | 92 832.10 | 71 905.71 | 10 306.44 | 393.53 | 7 848.10 | -17 153.07 | 2 378.32 |
| 2006 | | 91 518.47 | 70 050.88 | 10 880.85 | 412.16 | 7 880.47 | -17 166.53 | 2 294.10 |
| 2007 | | 87 958.35 | 66 146.99 | 11 277.19 | 408.80 | 7 949.49 | -17 122.97 | 2 175.87 |

*Total emissions without LULUCF*

The dominant sector regarding GHG emissions in Austria is the energy sector, which caused 75% of total greenhouse gas emissions in Austria in 2007 (70% in 1990), followed by the sector industrial processes, which caused 13% of greenhouse gas emissions. Both sectors show increasing emissions, whereas emissions from the other sectors have been decreasing.

*Table 16: Austria's greenhouse gas emissions by sector in the base year (1990) and in 2007 as well as their share and trend.*

| GHG | 1990 | 2007 | Trend 1990-2007 | 1990 | 2007 |
|---|---|---|---|---|---|
| | Emissions [Gg $CO_2$e] | | | Share [%] | |
| **Total** | **79 037** | **87 958** | **+11.3%** | **100.0%** | **100.0%** |
| Energy | 55 595 | 66 147 | +19.0% | 70.3% | 75.2% |
| Industrial processes | 10 111 | 11 277 | +11.5% | 12.8% | 12.8% |
| Solvents | 512 | 409 | -20.1% | 0.6% | 0.5% |
| Agriculture | 9 171 | 7 949 | -13.3% | 11.6% | 9.0% |
| LULUCF | -13 178 | -17 123 | +29.9% | -16.7% | -19.5% |
| Waste | 3 649 | 2 176 | -40.4% | 4.6% | 2.5% |

*Total emissions without emissions from LULUCF*

The energy sector (+19%) shows the most significant increase from 1990 to 2007, whereas the sector with the highest decline is *Waste* with a decrease of 40%. A description and interpretation of emissions trends per sector is given in the following sub-chapters.

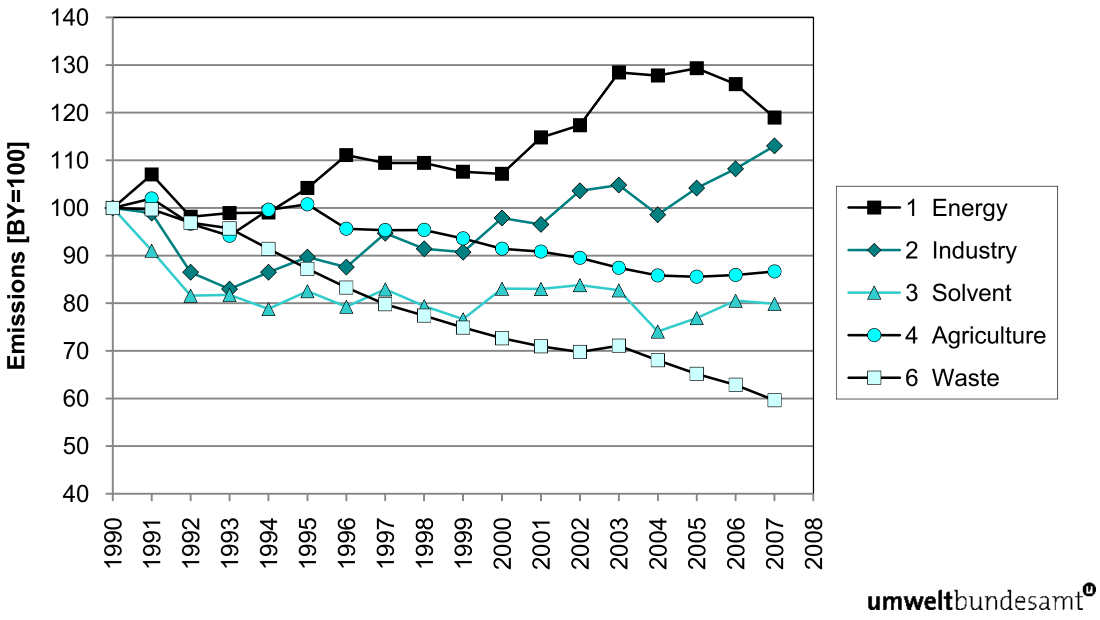


*Figure 10: Trend in emissions 1990–2007 by sector in index form (base year 1990 = 100).*

## 2.3.1 Energy

The overall trend in greenhouse gas emissions from the energy sector shows increasing emissions with a rise of 19% from 1990 to 2007. This is mainly due to a strong increase of emissions from road transport. The significant dips and jumps from year to year are mainly due to the weather circumstances in the corresponding years (in particular cold or mild winters, and/or dry or wet summers) which affect the heating demand, and the availability of climate change-friendly electricity from hydro plants.

From 2006 to 2007 emissions from the energy sector decreased by 6%, mainly due to lower emissions from "other sectors" (mainly residential heating) and *Energy Industries*.

In 2007, greenhouse gas emissions from the energy sector amounted to 66 147 Gg $CO_2$ equivalent which correspond to 75.2% of total national emissions. 98.6% of the emissions from this sector originate from fossil fuel combustion, fugitive emissions from fuels are of minor importance.

$CO_2$ contributed 97.3% of the total GHG emissions from the energy sector, $CH_4$ 1.5% and $N_2O$ 1.1%.

The most important energy sub-sectors in 2007 were t*ransport* with a share of 37%, followed by manufacturing industries and construction (24%), energy industries (21%), and "other sectors" (mainly residential heating -17%).

The increasing trend in energy is mainly due to a strong increase of emissions from sub-sector transport (+ 73% from 1990 to 2007), mainly due to an increase of road performance (kilometers driven). Additionally to the increase of road performance within Austria, the amount of fuel bought in Austria but driven elsewhere – e.g. by Austrian carriers that primary refuel at their own service stations in Austria – increased even more in relative terms. From 2006 to 2007 total emissions from transport increased by 1.1%.

Energy related emissions from manufacturing industries and construction increased by 24% from 1990 to 2007. The increase in fuel consumption was +42% in that period, where biomass accounted for half of this increase, which explains the significantly smaller increase in GHG emissions (as $CO_2$ emissions from biomass combustion are not accounted for under the UNFCCC reporting framework). From 2006 to 2007 emissions decreased slightly by 1.8%.

Emissions from sub-sector energy industries are now again on the level of the base year (+ 1.2% from the base year to 2007). The main drivers for emissions from this sector are total electricity production (which increased about 24% from 1990 to 2007) and an increase in heat production, which more than doubled over this period (+ 133%) due to an increase in the demand for district heating in the residential and commercial sector. Furthermore, the share of biomass used as a fuel in this sector (increasing from 1% to 16% for the total fuel consumption of sector 1.A.1) and the contribution of hydro plants to total electricity production (which is generally about 72% and varied from 65% to 78% in the period under observation - depending on the annual water situation), are important drivers. Also the climatic circumstances influence emissions from this sector: a cold winter leads to an increase of heat production. From 2006 to 2007 emissions decreased by 10%: while total fuel consumption decreased by 6%, biomass consumption increased by 25%, which further contributed to the decrease in anthropogenic GHG emissions (as $CO_2$ emissions from biomass combustion are not accounted for under the UNFCCC reporting framework).

The demand for heating and hot water generation, climatic circumstances and the change of fuel mix are the most important drivers for emissions from *Other Sectors* (mainly residential heating). Emissions in 2007 are 23% lower than in the base year, and 17% lower than in 2006: total fuel consumption of this sub sector decreased by 14% from 2006 to 2007, mainly driven by a strong decrease of liquid fuel sales by 25% (presumably due to the milder weather in 2006 compared to 2005, resulting in a leftover of heating oil). The decrease of fuel consumption for the other fuels is between 7 and 9%, which is consistent with the decrease of heating days by 9% in relation to the year before (2006).

### 2.3.2 Industrial processes

The overall trend in greenhouse gas emissions from industrial processes is increasing emissions with a plus of 12% from 1990 to 2007. Within this period emissions fluctuated showing a minimum in 1993. Important drivers for the development in emissions from this sector were (i) the termination of primary aluminium production in 1993, (ii) the introduction of $N_2O$ abatement techniques in chemical industry in 2004, (iii) increasing metal production resulting in 48% higher emissions in 2007, and (iv) a strong increase of HFC emissions in the period 1992 to 2003 from 49 to 863 Gg $CO_2$ equivalents.

From 2006 to 2007, emissions from this sector increased by 3.6%. The emission trend in this sector follows more or less the production figures.

In 2007 greenhouse gas emissions from industrial processes amounted to 11 277 Gg $CO_2$ equivalents, which corresponds to 12.8% of total national emissions.

The main sources of greenhouse gas emissions in the industrial *processes sector are metal production and mineral products, which caused 49% and 31% of the emissions* from this sector in 2007.

The most important GHG of this sector was carbon dioxide with 84. 6% of emissions from this category, followed by HFCs with 7.6%, $SF_6$ with 3.6%, $N_2O$ with 2.4%, PFCs with 1.6% and finally $CH_4$ with 0.2%.

### 2.3.3 Solvent and other product use

The overall trend in greenhouse gas emissions from solvent and other product use shows decreasing emissions, with a decrease of 20% from 1990 to 2007. This development is due to a decreasing use of solvents as a result of legal measures and decreasing $N_2O$ use.

From 2006 to 2007 emissions decreased slightly by 0.8%.

In 2007, 0.5% of total GHG emissions in Austria (409 Gg $CO_2$ equivalents) originated from solvent and other product use. 61% of these emissions were indirect $CO_2$ emissions, 39% originated from $N_2O$ emissions.

### 2.3.4 Agriculture

The trend in greenhouse gas emissions from agriculture shows decreasing emissions, with a decrease of 13% from 1990 to 2007. The decrease is mainly due to decreasing livestock numbers. Fluctuations which can be seen in particular in the first half of the 1990s result from the variability of mineral fertilizer sales data related to elasticity in prices; this data is used for calculating $N_2O$ emissions from an important sub-source: agricultural soils.

From 2006 to 2007 emissions increased slightly by 0.9%.

Emissions from agriculture amounted to 7 949 Gg $CO_2$ equivalent in 2007, which corresponds to 9.0% of total national emissions. In 2007 the most important sub-sector enteric fermentation contributed 40% of total greenhouse gas emissions from the agricultural sector; the second largest sub-sector agricultural soils has a share of 37%.

In the Austrian GHG inventory agriculture is the largest source for both $N_2O$ and $CH_4$ emissions: in 2007, 71% of total $N_2O$ emissions and 59% (196 Gg) of total $CH_4$ emissions in Austria originated from this sector. $N_2O$ emissions from agriculture amounted to 12.4 Gg in 2007 (3 839 Gg $CO_2$ equivalents), which corresponds to 48% of the GHG emissions from this sector. The share of methane was 52%.

### 2.3.5 LULUCF

Land use, land-use change and forestry is a net sink in Austria. The trend in net removals from LULUCF is plus 30% over the observed period. Fluctuations are due to weather conditions which affect the growth rates on the one hand and wind throws on the other, as well as timber demand and prices.

From 2006 to 2007 total removals from this sector remained quite stable (-0.3%).

Net removals from this category amounted to 13 178 Gg $CO_2$ equivalents in the base year, which corresponds to 17% of national total GHG emissions (without LULUCF) compared to 20% in the year 2007.[19]

The main sink is subcategory forest land with net removals of 19 539 Gg $CO_2$ in 2007. Small $CO_2$, $CH_4$ and $N_2O$ emissions arise from the other sub-sectors, where total net emissions amounted to 2 416 Gg $CO_2$ equivalents in 2007.

### 2.3.6 Waste

The trend in greenhouse gas emissions from waste has decreasing emissions, with a decrease of 40% from 1990 to 2007.

Greenhouse gas emissions decreased steadily during the period 1990–2002, mainly as a result of waste management policies: the amount of landfilled waste has decreased and methane recovery improved. The slight increase from 2002 to 2003 was followed by a decrease until 2007, the driving force behind this trend was the change in the amount of deposited waste.

From 2006 to 2007 emissions decreased by 5.2% due to a decreasing amount of deposited waste.

In 2007, greenhouse gas emissions from the waste sector amounted to 2 176 Gg $CO_2$ equivalents, which corresponds to 2.5% of total national emissions.

The main source of greenhouse gas emissions in the waste sector is solid waste disposal *on land*, which caused 80% of the emissions from this sector in 2007; the second largest source is waste water handling with 14%.

The most important GHG of the waste sector is $CH_4$ with 83.2% of emissions in 2007, followed by $N_2O$ with 16.2%, and $CO_2$ with 0.6%.

## 2.4 Emission Trends for Indirect Greenhouse Gases and $SO_2$

Emission estimates for $NO_x$, CO, NMVOC and $SO_2$ are also reported in the CRF. This chapter summarizes the trends for these gases.

A detailed description of the methodology used to estimate these emissions will be provided in *Austria's Informative Inventory Report (IIR) 2009, Submission under the UNECE/CLRTAP Convention*, which will be published by the end of 2009.

The "National Emission Ceilings" (NEC) as set out in the 1999 *Gothenburg Protocol to Abate Acidification, Eutrophication and Ground-level Ozone* are presented together with the trend from 1990 to 2007 in Table 17. These reduction targets should be met by 2010 by parties to the UNECE/CLRTAP convention who signed this protocol.

[19] However, the LULUCF sector as described here is not included under the Kyoto Protocol, instead of that Article 3.3 KP activities are included: afforestation, reforestation and deforestation (Austria decided not to include activities under Article 3.4 of the KP).

*Table 17: Emissions of indirect GHGs and $SO_2$ 1990–2007.*

| GHG | | $NO_x$ | CO | NMVOC | $SO_2$ |
|---|---|---|---|---|---|
| 1990 | [Gg] | 192.17 | 1 432.19 | 273.51 | 74.32 |
| 1991 | | 201.92 | 1 502.78 | 265.13 | 71.42 |
| 1992 | | 190.92 | 1 469.75 | 239.55 | 55.02 |
| 1993 | | 185.08 | 1 437.13 | 239.68 | 53.38 |
| 1994 | | 178.56 | 1 367.51 | 221.81 | 47.77 |
| 1995 | | 178.68 | 1 256.43 | 221.81 | 47.37 |
| 1996 | | 200.65 | 1 235.75 | 213.60 | 44.62 |
| 1997 | | 188.75 | 1 143.85 | 199.43 | 40.15 |
| 1998 | | 203.73 | 1 099.46 | 184.15 | 35.58 |
| 1999 | | 196.06 | 1 026.09 | 170.82 | 33.81 |
| 2000 | | 203.85 | 954.35 | 175.74 | 31.59 |
| 2001 | | 214.44 | 946.35 | 180.02 | 32.73 |
| 2002 | | 224.51 | 930.16 | 185.03 | 31.63 |
| 2003 | | 236.04 | 952.86 | 188.41 | 32.56 |
| 2004 | | 234.96 | 911.04 | 170.06 | 27.50 |
| 2005 | | 238.79 | 868.66 | 178.31 | 27.11 |
| 2006 | | 226.67 | 837.52 | 186.30 | 28.87 |
| 2007 | | 219.22 | 767.56 | 179.38 | 25.52 |
| **NEC** | | **107** | **--** | **159** | **39** |

*NEC: National Emission Ceiling, goal to be met by 2010*

Emissions of indirect greenhouse gases except $NO_x$ decreased in the period from 1990 to 2006: NMVOCs by 34%, CO by 46% and $SO_2$ emissions by 66%. However, $NO_x$ emissions increased by 14% over the considered period.

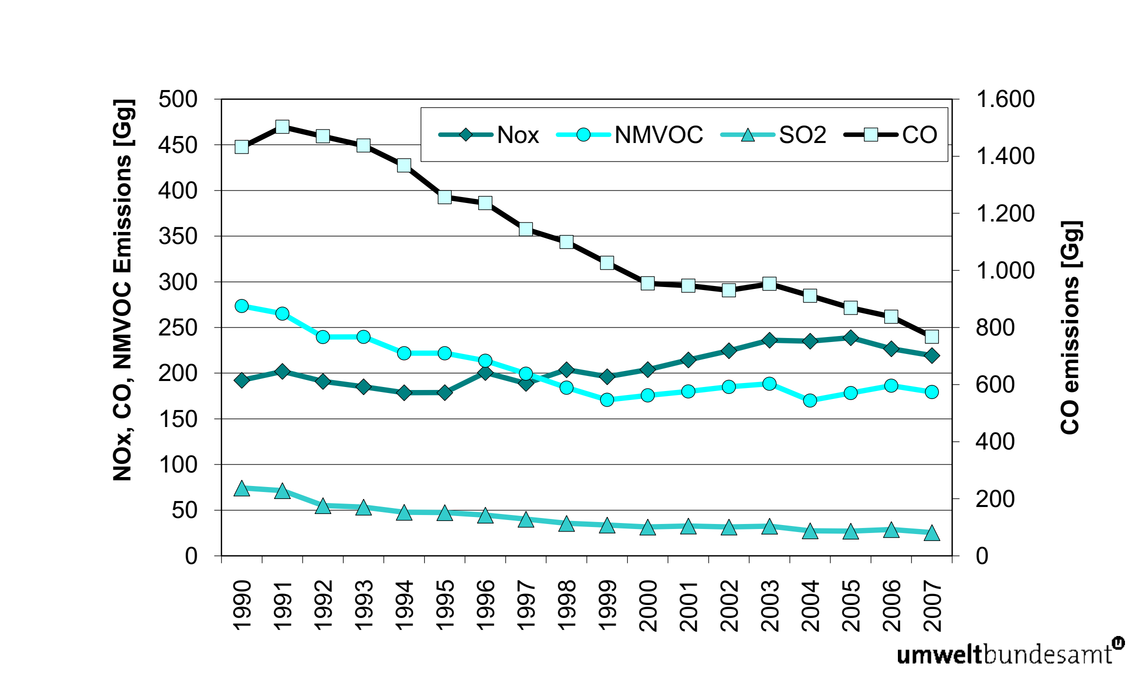


*Figure 11: Emissions of indirect GHGs and $SO_2$ 1990–2007.*

The most important emission source for $NO_x$, $SO_2$ and CO is fuel combustion. The most important emission source for NMVOC is Solvent and other Product Use.

### $NO_x$

$NO_x$ emissions increased from 192 to 219 Gg during the period from 1990 to 2007. In 2007 the $NO_x$ emissions were 14% above the level of 1990.

Nearly 97% of $NO_x$ emissions in Austria originate from fossil fuel combustion, with the major part originating from mobile combustion – road transport.

### CO

CO emissions decreased from 1 432 to 768 Gg during the period from 1990 to 2007. In 2007 CO emissions were 46% below the level of 1990.

In the year 2007, 96% of total CO emissions in Austria originated from fuel combustion activities. The most important sub-source regarding CO emissions is the residential sector followed by mobile combustion – road transport.

### NMVOC

NMVOC emissions decreased from 274 to 179 Gg during the period from 1990 to 2007. In 2007 NMVOC emissions were 34% below the level of 1990.

The most important emission sources for NMVOC emissions are solvent use and fossil fuel combustion, contributing 58% and 37% respectively of national total emissions in 2007.

**$SO_2$**

$SO_2$ emissions decreased from 74 to 26 Gg during the period from 1990 to 2007. In 2007 $SO_2$ emissions were 66% below the level of 1990.

The decrease is mainly due to lower emissions from residential heating, combustion in industries and energy industries, mainly caused by a switch from high sulfur fuels (like coal and heavy oil) to fuels with lower sulfur content, and the implementation of desulphurization units.

# 3 ENERGY (CRF SECTOR 1)

## 3.1 Sector Overview

In the energy sector emissions originating from fuel combustion activities in road traffic, in the energy and manufacturing industry and in the commercial, agricultural and residential sector (Category 1 A) as well as fugitive emissions from fuels (Category 1 B) are considered. However, fugitive emissions only make up about 1% of total emissions from this sector.

Emissions from the energy sector are the main source of GHGs in Austria: in the year 2007 about 75.2% of national total GHGs emissions and 86.8% of national total anthropogenic $CO_2$ emissions from Austria arose from the energy sector.

### 3.1.1 Emission Trends

Emissions from the energy sector increased by 19% from 55.59 Tg $CO_2$ equivalents in 1990 to 66.15 Tg $CO_2$ equivalents in 2007, which is mainly caused by increasing emissions from transport.

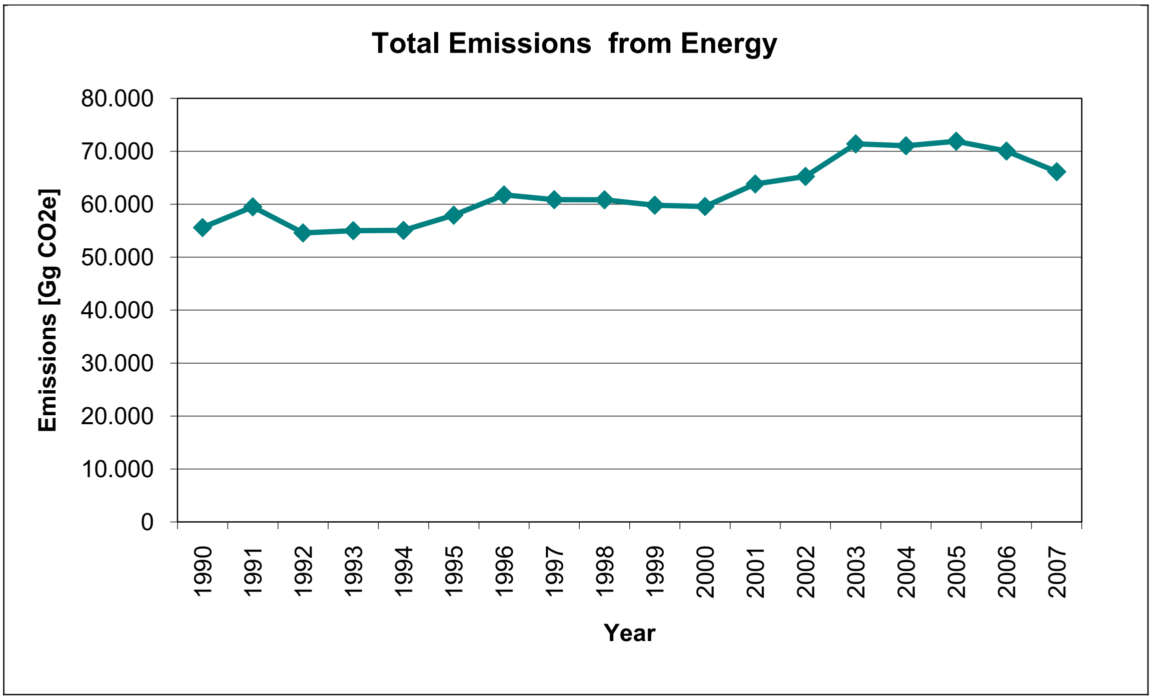


*Figure 12: Trend of GHG emissions from 1990–2007 for energy.*

Total emissions from energy mainly consist of $CO_2$; $N_2O$ and $CH_4$ only make up about 1.0% and 1.5%, respectively. The increase of $CO_2$ and $N_2O$ emissions is mainly caused by the increasing activity of transport. The strong increase of $CO_2$ emissions from 2002 to 2003 was additionally caused by public electricity plants. The increase of $CH_4$ emissions from 1999 onwards has been due to increasing fugitive emissions from natural gas distribution networks. The decrease from 2005 to 2007 is mainly due to a warm climate during the heating periods which reduced emissions both from the residential sector and from district heating plants.

*Table 18: Emissions of greenhouse gases and their trend from 1990–2007 from IPCC Category 1 Energy.*

| | $CO_2$ [Gg] | $CH_4$ [Gg] | $N_2O$ [Gg] |
|---|---|---|---|
| 1990 | 54 196 | 40.31 | 1.78 |
| 1991 | 57 989 | 42.83 | 2.00 |
| 1992 | 53 092 | 41.86 | 1.96 |
| 1993 | 53 493 | 42.42 | 2.02 |
| 1994 | 53 565 | 41.25 | 2.03 |
| 1995 | 56 382 | 42.79 | 2.09 |
| 1996 | 60 141 | 44.81 | 2.20 |
| 1997 | 59 326 | 41.14 | 2.16 |
| 1998 | 59 274 | 41.05 | 2.29 |
| 1999 | 58 220 | 42.15 | 2.32 |
| 2000 | 57 980 | 41.96 | 2.32 |
| 2001 | 62 146 | 43.92 | 2.46 |
| 2002 | 63 522 | 44.94 | 2.54 |
| 2003 | 69 611 | 46.67 | 2.65 |
| 2004 | 69 231 | 48.07 | 2.63 |
| 2005 | 70 080 | 48.83 | 2.58 |
| 2006 | 68 221 | 49.71 | 2.53 |
| 2007 | 64 381 | 48.35 | 2.42 |
| *Trend 1990–2007* | 18.8% | 20.0% | 36.0% |

**Emission trends by sub categories**

The most important sub category regarding total emissions in the base year was 'other sectors', which is mainly residential heating. However, emissions from this category slightly decreased in the period from 1990 to 2007 because of a change in the fuel mix and mild winters of the last two years, whereas emissions from the other categories increased. A significant increase took place for transport, and since the mid 1990s this sub category is the most important one.

The increase of emissions from fugitive emissions from fuels is mainly caused by the increase of $CH_4$ emissions from natural gas distribution reflecting the increase of natural gas consumed.

*Table 19: Total GHG emissions in [Gg $CO_2$ equivalent] from 1990–2007 by sub categories of energy.*

| | 1 | 1.A | 1.A.1 | 1.A.2 | 1.A.3 | 1.A.4 | 1.A.5 | 1.B | 1.B.1 | 1.B.2 |
|---|---|---|---|---|---|---|---|---|---|---|
| 1990 | 55 595 | 55 108 | 13 844 | 12 773 | 14 023 | 14 432 | 36 | 487 | 11 | 476 |
| 1991 | 59 510 | 59 000 | 14 681 | 13 170 | 15 532 | 15 579 | 38 | 510 | 9 | 500 |
| 1992 | 54 579 | 54 043 | 11 528 | 11 876 | 15 512 | 15 092 | 35 | 537 | 8 | 529 |
| 1993 | 55 009 | 54 462 | 11 515 | 12 347 | 15 654 | 14 906 | 40 | 547 | 8 | 540 |
| 1994 | 55 059 | 54 482 | 11 811 | 13 339 | 15 711 | 13 579 | 43 | 577 | 6 | 571 |
| 1995 | 57 930 | 57 330 | 12 973 | 13 595 | 15 993 | 14 737 | 33 | 599 | 6 | 593 |
| 1996 | 61 763 | 61 194 | 13 858 | 13 819 | 17 543 | 15 934 | 40 | 570 | 5 | 565 |
| 1997 | 60 859 | 60 222 | 13 937 | 15 351 | 16 556 | 14 340 | 38 | 638 | 5 | 633 |
| 1998 | 60 846 | 60 176 | 13 051 | 14 112 | 18 690 | 14 280 | 43 | 670 | 5 | 665 |
| 1999 | 59 824 | 59 104 | 12 898 | 13 201 | 18 137 | 14 825 | 43 | 720 | 5 | 715 |
| 2000 | 59 582 | 58 852 | 12 409 | 13 886 | 19 124 | 13 391 | 42 | 730 | 6 | 724 |
| 2001 | 63 830 | 63 073 | 14 193 | 13 680 | 20 363 | 14 795 | 42 | 756 | 5 | 751 |

| | 1 | 1.A | 1.A.1 | 1.A.2 | 1.A.3 | 1.A.4 | 1.A.5 | 1.B | 1.B.1 | 1.B.2 |
|---|---|---|---|---|---|---|---|---|---|---|
| 2002 | 65 253 | 64 489 | 13 737 | 14 222 | 22 295 | 14 193 | 43 | 764 | 6 | 757 |
| 2003 | 71 412 | 70 571 | 16 192 | 14 571 | 24 114 | 15 650 | 44 | 842 | 5 | 836 |
| 2004 | 71 056 | 70 193 | 16 436 | 14 570 | 24 715 | 14 427 | 44 | 863 | 1 | 862 |
| 2005 | 71 906 | 71 030 | 16 167 | 15 832 | 25 340 | 13 646 | 45 | 876 | 0 | 876 |
| 2006 | 70 051 | 69 120 | 15 627 | 16 122 | 23 970 | 13 356 | 45 | 931 | 0 | 931 |
| 2007 | 66 147 | 65 205 | 14 014 | 15 825 | 24 224 | 11 096 | 46 | 942 | 0 | 942 |
| *Trend 1990-2007* | *19.0%* | *18.3%* | *1.2%* | *23.9%* | *72.7%* | *-23.1%* | *27.1%* | *93.6%* | *-100%* | *98.1%* |

## 3.2 Fuel Combustion Activities (CRF Category 1.A)

This chapter gives an overview of emissions and key sources of fuel combustion activities, includes information on completeness, QA/QC, planned improvements as well as on emissions, emission trends and methodologies applied (including emission factors).

Additionally to information provided in this Chapter, Annex 2 includes further information on the underlying activity data used for emissions estimation. The Annex 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). Activity data and emission factors used for emissions calculation and information on the last revision of the national energy balance are also presented in Annex 2.

For results, methodology and detailed data used for the $CO_2$ reference approach see Annex 3.

National energy balance data are presented in Annex 4.

### 3.2.1 Source Category Description

In 2007 the most important source of GHGs was transport, with a share of 26.5% in national total GHG emissions. 14.1% of national GHG emissions were released by passenger cars, 2% by light duty vehicles, 9.3% by heavy-duty vehicles and 0.1% by mopeds and motorcycles. Austria's railway system is mainly driven by electricity, only 0.2% of overall GHGs originate from this sector. Fuels used by ships on inland waterways have a share of 0.1% in total GHG emissions. Because Austria is a landlocked country, there is no occurrence of maritime activities. About 0.1% of national GHG arise from domestic air transport.

Combustion in manufacturing industries and construction was the second largest sub-category with a share of 17.3% in 2007 total GHG emissions. This cateogry also includes mobile machinery mainly used in the construction sector. Emissions from non energy fuel use are reported under industrial processes (CRF Category 2).

The third largest GHG source of the energy sector in 2007 with a share of 15.3% total GHG emissions of was energy industries, were fossil fuels are used for electrical power and district heating production. In the year 2007 overall gross public electricity production was 54 661 GWh[20] of which 37 362 GWh (68.4%) were generated by hydro plants, 15 264 GWh (27.9%) by thermal power plants and 2 035 GWh (3.7%) by solar, geothermal and wind power plants. Industrial

[20] Source: IEA Questionnaire Dec/2008 by STATISTIK AUSTRIA.

auto producers generated 8 769 GWh of electricity in the year 2007. There are no operating nuclear plants in Austria. Due to the importance of hydropower the seasonal water situation in Austria has a high influence on the need for electric power generation by fossil fuels. In energy industries biomass is mainly used by smaller district heating plants. The refinery industry which consists of only one plant in Austria is also included in this category (sub-category *1.A.1.b Petroleum refining*).

Fossil fuels, mainly used for space and water heating in the commercial, agricultural and household sector (sub-category *1.A.4 Other Sectors* or "small combustion" sector) formed the fourth largest sub-category with a share of 12.1% in 2007 total GHG emissions. Emissions of this category are very dependent on the climatic circumstances and on the economic trend. E.g. a "cold winter" in combination with an economic uptrend may increase emissions from space heatings significantly. In Austria the main share of solid biomass consumption is used for space and water heating. Category *1.A.4* also includes emissions from mobile machinery mainly used in agriculture and forestry.

Category *1.A.5 Other* includes emissions from military air and road transport as well as from other mobile machinery. It contributes 0.05% to total GHG emissions in 2007.

#### 3.2.1.1 Key Sources

The methodology and results of the key category analysis is presented in Chapter 1.5. Table 20 presents the key source categories of *1 A Fuel Combustion Activities*.

*Table 20: Key sources of 1 A Fuel combustion activities.*

| IPCC Category | Category Name | GHG | Keysource Assessment |
|---|---|---|---|
| 1.A gaseous | Fuel Combustion (stationary) | $CO_2$ | LA; TA |
| 1.A.1.a liquid | Public Electricity and Heat Production | $CO_2$ | LA; TA |
| 1.A.1.a other | Public Electricity and Heat Production | $CO_2$ | LA 2007; TA |
| 1.A.1.a solid | Public Electricity and Heat Production | $CO_2$ | LA; TA |
| 1.A.1.b liquid | Petroleum refining | $CO_2$ | LA ;TA |
| 1.A.2 mob-liquid | Manufacturing Industries and Constr. | $CO_2$ | LA; TA |
| 1.A.2 other | Manufacturing Industries and Constr. | $CO_2$ | LA; TA |
| 1.A.2 solid | Manufacturing Industries and Constr. | $CO_2$ | LA ;TA |
| 1.A.2 stat-liquid | Manufacturing Industries and Constr. | $CO_2$ | LA; TA |
| 1.A.3.b diesel.oil | Road Transportation | $CO_2$ | LA; TA |
| 1.A.3.b gasoline | Road Transportation | $CO_2$ | LA; TA |
| 1.A.4 biomass | Other Sectors | $CH_4$ | LA 1990 |
| 1.A.4 mob-diesel | Other Sectors | $CO_2$ | LA |
| 1.A.4 solid | Other Sectors | $CO_2$ | LA; TA |
| 1.A.4 stat-liquid | Other Sectors | $CO_2$ | LA; TA |
| 1.A.4 other | Other Sectors | $CO_2$ | LA 1990; TA |

*LA = Level Assessment (if not further specified for the years 1990 and 2007)*

*TA = Trend Assessment 2007*

### 3.2.1.2 Completeness

Table 21 gives an overview of the IPCC 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 subcategories. A "✓" indicates that emissions from this sub-category have been estimated. "NO" indicates that the Austrian energy balance does not quote an energy consumption for the relevant sector and fuel category.

Emissions of all sources of category *1.A Fuel Combustion* have been estimated; the status of emission estimates of this category is complete.

*Table 21: Overview of subcategories of Category 1.A Fuel Combustion: transformation into SNAP Codes and status of estimation.*

| IPCC Category | SNAP | Status | | |
|---|---|---|---|---|
| | | $CO_2$ | $CH_4$ | $N_2O$ |
| **1.A.1.a Public Electricity and Heat Production** | **0101 Public power<br>0102 District heating plants** | | | |
| 1.A.1.a Liquid Fuels | | ✓ | ✓ | ✓ |
| 1.A.1.a Solid Fuels | | ✓ | ✓ | ✓ |
| 1.A.1.a Gaseous Fuels | | ✓ | ✓ | ✓ |
| 1.A.1.a Biomass | | ✓ | ✓ | ✓ |
| 1.A.1.a Other Fuels | | ✓ | ✓ | ✓ |
| **1.A.1.b Petroleum refining** | **0103 Petroleum refining plants** | | | |
| 1.A.1.b Liquid Fuels | | ✓ | IE(1) | ✓ |
| 1.A.1.b Solid Fuels | | NO | NO | NO |
| 1.A.1.b Gaseous Fuels | | ✓ | IE(1) | ✓ |
| 1.A.1.b Biomass | | NO | NO | NO |
| 1.A.1.b Other Fuels | | NO | NO | NO |
| **1.A.1.c Manufacture of Solid fuels and Other Energy Industries** | **010503 Oil/Gas Extraction plants** | | | |
| 1.A.1.c Liquid Fuels | | ✓ | ✓ | ✓ |
| 1.A.1.c Solid Fuels | | NO | NO | NO |
| 1.A.1.c Gaseous Fuels | | ✓ | ✓ | ✓ |
| 1.A.1.c Biomass | | NO | NO | NO |
| 1.A.1.c Other Fuels | | NO | NO | NO |
| **1.A.2.a Iron and Steel** | **0301 Comb. In boilers, gas turbines and stationary engines (Iron and Steel Industry)<br>030326 Processes with Contact-Other(Iron and Steel Industry)** | | | |
| 1.A.2.a Liquid Fuels | | ✓ | ✓ | ✓ |
| 1.A.2.a Solid Fuels | | ✓ | ✓ | ✓ |
| 1.A.2.a Gaseous Fuels | | ✓ | ✓ | ✓ |
| 1.A.2.a Biomass | | ✓ | ✓ | ✓ |
| 1.A.2.a Other Fuels | | NO | NO | NO |

| IPCC Category | SNAP | Status | | |
|---|---|---|---|---|
| | | $CO_2$ | $CH_4$ | $N_2O$ |
| **1.A.2.b Non-ferrous Metals** | **0301 Comb. In boilers, gas turbines and stationary engines(Non-ferrous Metals Industry)** | | | |
| 1.A.2.b Liquid Fuels | | ✓ | ✓ | ✓ |
| 1.A.2.b Solid Fuels | | ✓ | ✓ | ✓ |
| 1.A.2.b Gaseous Fuels | | ✓ | ✓ | ✓ |
| 1.A.2.b Biomass | | NO | NO | NO |
| 1.A.2.b Other Fuels | | NO | NO | NO |
| **1.A.2.c Chemicals** | **0301 Comb. in boilers, gas turbines and stationary engines (Chemical Industry)** | | | |
| 1.A.2.c Liquid Fuels | | ✓ | ✓ | ✓ |
| 1.A.2.c Solid Fuels | | ✓ | ✓ | ✓ |
| 1.A.2.c Gaseous Fuels | | ✓ | ✓ | ✓ |
| 1.A.2.c Biomass | | ✓ | ✓ | ✓ |
| 1.A.2.c Other Fuels | | ✓ | ✓ | ✓ |
| **1.A.2.d Pulp, Paper and Print** | **0301 Comb. in boilers, gas turbines and stationary engines (Pulp, Paper and Print Industry)** | | | |
| 1.A.2.d Liquid Fuels | | ✓ | ✓ | ✓ |
| 1.A.2.d Solid Fuels | | ✓ | ✓ | ✓ |
| 1.A.2.d Gaseous Fuels | | ✓ | ✓ | ✓ |
| 1.A.2.d Biomass | | ✓ | ✓ | ✓ |
| 1.A.2.d Other Fuels | | ✓ | ✓ | ✓ |
| **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.e Liquid Fuels | | ✓ | ✓ | ✓ |
| 1.A.2.e Solid Fuels | | ✓ | ✓ | ✓ |
| 1.A.2.e Gaseous Fuels | | ✓ | ✓ | ✓ |
| 1.A.2.e Biomass | | ✓ | ✓ | ✓ |
| 1.A.2.e Other Fuels | | ✓ | ✓ | ✓ |
| **1.A.2.f Other** | **0301 Comb. in boilers, gas turbines and stationary engines (Other Industry+ Electricity and Heat Production in Industry)**<br>**030311 Cement**<br>**030317 Glass**<br>**030312 Lime**<br>**030319 Bricks and Tiles**<br>**030323 Magnesia production (dolomite treatment)**<br>**0808 Other Mobile Sources and Machinery-Industry** | | | |
| 1.A.2.f Liquid Fuels | | ✓ | ✓ | ✓ |
| 1.A.2.f Solid Fuels | | ✓ | ✓ | ✓ |
| 1.A.2.f Gaseous Fuels | | ✓ | ✓ | ✓ |
| 1.A.2.f Biomass | | ✓ | ✓ | ✓ |
| 1.A.2.f Other Fuels | | ✓ | ✓ | ✓ |

| IPCC Category | SNAP | Status | | |
|---|---|---|---|---|
| | | $CO_2$ | $CH_4$ | $N_2O$ |
| **1.A.3.a Civil Aviation** | **080501 Domestic airport traffic (LTO cycles – < 1 000 m)<br>080503 Domestic cruise traffic (> 1 000 m)** | | | |
| 1.A.3.a Aviation Gasoline | | ✓ | ✓ | ✓ |
| 1.A.3.a Jet Kerosene | | ✓ | ✓ | ✓ |
| **1.A.3.b Road Transportation** | **0701 Passenger cars<br>0702 Light duty vehicles < 3.5 t<br>0703 Heavy duty vehicles > 3.5 t and buses<br>0704 Mopeds and Motorcycles < 50 cm³<br>0705 Motorcycles > 50 cm³<br>0706 Gasoline evaporation from vehicles** | | | |
| 1.A.3.b Gasoline | | ✓ | ✓ | ✓ |
| 1.A.3.b Diesel Oil | | ✓ | ✓ | ✓ |
| 1.A.3.b Natural Gas | | NO | NO | NO |
| 1.A.3.b Biomass | | NO | NO | NO |
| 1.A.3.b Other Fuels | | NO | NO | NO |
| **1.A.3.c Railways** | **0802 Other Mobile Sources and Machinery-Railways** | | | |
| 1.A.3.c Solid Fuels | | ✓ | ✓ | ✓ |
| 1.A.3.c Liquid Fuels | | ✓ | ✓ | ✓ |
| 1.A.3.c Other Fuels | | NO | NO | NO |
| **1.A.3.d Navigation** | **0803 Other Mobile Sources and Machinery-Inland waterways** | | | |
| 1.A.3.d Coal | | NO | NO | NO |
| 1.A.3.d Residual Oil | | NO | NO | NO |
| 1.A.3.d Gas/Diesel oil | | ✓ | ✓ | ✓ |
| 1.A.3.d Other Fuels: Gasoline | | ✓ | ✓ | ✓ |
| **1.A.3.e Other** | **010506 Pipeline Compressors** | | | |
| 1.A.3.e Liquid Fuels | | NO | NO | NO |
| 1.A.3.e Solid Fuels | | NO | NO | NO |
| 1.A.3.e Gaseous Fuels | | ✓ | ✓ | ✓ |
| **1.A.4.a Commercial/Institutional** | **0201 Commercial and institutional plants** | | | |
| 1.A.4.a Liquid Fuels | | ✓ | ✓ | ✓ |
| 1.A.4.a Solid Fuels | | ✓ | ✓ | ✓ |
| 1.A.4.a Gaseous Fuels | | ✓ | ✓ | ✓ |
| 1.A.4.a Biomass | | ✓ | ✓ | ✓ |
| 1.A.4.a Other Fuels | | ✓ | ✓ | ✓ |
| **1.A.4.b Residential** | **0202 Residential plants<br>0809 Other Mobile Sources and Machinery-Household and gardening** | | | |
| 1.A.4.b Liquid Fuels | | ✓ | ✓ | ✓ |
| 1.A.4.b Solid Fuels | | ✓ | ✓ | ✓ |
| 1.A.4.b Gaseous Fuels | | ✓ | ✓ | ✓ |
| 1.A.4.b Biomass | | ✓ | ✓ | ✓ |
| 1.A.4.b Other Fuels | | NO | NO | NO |

| IPCC Category | SNAP | Status | | |
|---|---|---|---|---|
| | | $CO_2$ | $CH_4$ | $N_2O$ |
| **1.A.4.c Agriculture/Forestry/Fisheries** | **0203 Plants in agriculture, forestry and aquaculture<br>0806 Other Mobile Sources and Machinery-Agriculture<br>0807 Other Mobile Sources and Machinery-Forestry** | | | |
| 1.A.4.c Liquid Fuels | | ✓ | ✓ | ✓ |
| 1.A.4.c Solid Fuels | | ✓ | ✓ | ✓ |
| 1.A.4.c Gaseous Fuels | | ✓ | ✓ | ✓ |
| 1.A.4.c Biomass | | ✓ | ✓ | ✓ |
| 1.A.4.c Other Fuels | | NO | NO | NO |
| **1.A.5 Other** | **0801 Other Mobile Sources and Machinery-Military** | | | |
| 1.A.5 Liquid Fuels | | ✓ | ✓ | ✓ |
| 1.A.5 Solid Fuels | | NO | NO | NO |
| 1.A.5 Gaseous Fuels | | NO | NO | NO |
| 1.A.5 Biomass | | NO | NO | NO |
| 1.A.5 Other Fuels | | NO | NO | NO |
| **Marine Bunkers** | | | | |
| Gasoline | | NO | NO | NO |
| Gas/Diesel oil | | NO | NO | NO |
| Residual Fuel Oil | | NO | NO | NO |
| Lubricants | | NO | NO | NO |
| Coal | | NO | NO | NO |
| Other Fuels | | NO | NO | NO |
| **Aviation Bunkers** | **080502 International airport traffic (LTO cycles – < 1 000 m)<br>080504 International cruise traffic (> 1 000 m)** | | | |
| Jet Kerosene | | ✓ | ✓ | ✓ |
| Gasoline | | NO | NO | NO |
| **Multilateral Operations** | | NO | NO | NO |

*(1) $CH_4$ emissions from petroleum refining are included in* 1 B 2 Fugitive Emissions from Fuels.

### 3.2.2 Methodological Issues

**Choice of Method**

In general the CORINAIR methodologies are applied: in the inventory area sources as well as point sources are considered.

However, the applied methodologies are equivalent to the IPCC Tier 2 and Tier 3 methodologies, respectively.

Tier 2 methodology

For the following categories and pollutants the IPCC Tier 2 methodology is used:

- *1 A 1 a Public Electricity and Heat Production, plants >= 50 $MW_{th}$:* $CO_2$, $CH_4$, $N_2O$, NMVOC
- *1 A 1 a Public Electricity and Heat Production, plants < 50 $MW_{th}$:* All Pollutants

- *1 A 1 b Petroleum Refining:* $CO_2$, $CH_4$, $N_2O$
- *1 A 1 c Manufacture of Solid Fuels and Other Energy Industries:* All Pollutants
- *1 A 2 Manufacturing Industries and Construction – Stationary sources:* All Pollutants
- *1 A 3 c Railways:* All Pollutants
- *1 A 3 d Navigation:* All Pollutants
- *1 A 3 e Other Transportation – Pipeline compressors:* All Pollutants
- *1 A 4 Other Sectors – Stationary sources:* All Pollutants

Methodology of emission calculation: Each activity (fuel input) of each sub-category is multiplied by an emission factor.

Activity data are taken from official energy statistics.

Calorific values used for conversion of fuel activity data from [tonnes] and [cubicmetres] into [Terajoule] are country specific.

Emissions factors are country specific, fuel and technology dependent.

Regarding the above listed criteria this methodology is equivalent to the IPCC bottom up Tier 2 methodology. See (IPCC 1996 rev. Guidelines) Chapter *2.1.1.1 Choice of Method.*

Tier 3 methodology

For the following categories the IPCC Tier 3 methodology is used.

- *1 A 3 a Civil Aviation (Tier 3a)*
- *1 A 3 b Road Transport*
- *1 A 2 f Industry – Mobile machinery*
- *1 A 4 b Residential – Mobile machinery*
- *1 A 4 c Agriculture and Forestry – mobile machinery*
- *1 A 5 Other Mobile – Military*
- *Memo item - International Bunkers – Aviation*

Methodology of emission calculation: Each activity (fuel input) of each sub-category is multiplied by an emission factor.

Emissions factors are fuel and technology dependent.

Calorific values used for conversion of fuel activity data from [tonnes] into [Terajoule] are country specific.

Technology dependent activity data are calculated by means of a bottom up model and adjusted to top down activity data. Bottom up activity data are calculated by means of vehicle-kilometres, vehicle stock statistics and operating condition dependant fuel consumption per vehicle kilometer. Bottom up fuel consumption of civil aviation is calculated by aircraft specific LTO-cycle and cruise-kilometer consumption. Top down activity data are based on fuel sales taken from the national energy balance.

Consideration of point source emissions

For the following categories and pollutants plant or boiler specific emission declarations are considered.

- *1 A 1 a Public Electricity and Heat Production (55 boilers):* CO, $SO_2$, $NO_x$

- *1 A 1 b Petroleum Refining (1 plant):* $SO_2$, $NO_x$, CO, VOC ("IE": reported under 1 B)
- *1 A 2 a Iron and Steel (2 integrated iron & steel plants):* $CO_2$, CO, VOC, $SO_2$, $NO_x$
- *1 A 2 f Other – Cement production (10 plants):* $CO_2$, $SO_2$, $NO_x$, CO, VOC

To avoid double counting of point source emissions with area sources (data from the national energy balance) consistency of reported activity by plant operators with activity data from energy statistics is checked: reported data must not be greater than data from energy statistics for the respective category (the correspondence of a plant to the specific energy balance sector is determined by identical NACE or ISIC-Codes). Only consistent and complete point source data are used for inventory preparation, if data are not consistent then data from the national energy balance are used. Activity data and emissions of point source emissions declarations are checked by comparing implied emission factors against IPCC default values or by comparing emissions to those of a simple Tier 1 approach.

**Consideration of $CO_2$ emission trading system (ETS) "bottom up" data**

Currently the following industrial branches are fully covered by the national ETS:

- Refineries
- Iron and steel manufacturing industries
- Non metallic mineral industries (cement, glass, lime, bricks and tiles, other ceramic materials)
- Pulp an paper manufacturing industries

Combustion plants of other industrial branches (including power plants) are considered if their thermal plant capacity exceeds 20 $MW_{th}$ (excluding boilers < 3 MW, biomass-boilers and hazardous and muncipal waste incineration plants)

Description of received ETS data

ETS data is submitted by means of a standard calculation sheet which includes numerical data about multiple fuels, processes and material flows. Additionally a written QA/QC report has to be submitted.

For fuel combustion and industrial processes the following numerical data is reported:

- Activity data: mass or volume of fuel consumption/process input material.
- Net calorific value of fuel
- Oxidation factor of fuel/conversion factor of process material
- $CO_2$ emission factor of fuel or process material
- Share of non fossil $CO_2$ in case of "non-traded fuels"

For sites with complex material flows (e.g. refineries, iron and steel plants) carbon mass balance data is reported alternatively:

- Activity data: mass or volume of material flow
- Net calorific value of material
- Carbon content of material

Direct $CO_2$ measurements have not been submitted.

The ETS reports include data about "traded-fuels" (e.g. different types of coal and fuel oils, natural gas) as well as "non-traded fuels" (e.g. industrial wastes, biomass). For each of the "traded fuels" a national default NCV and a national default $CO_2$ emisson factor may be selected for emission calculation. For "non-traded fuels" plant operators have to make their own estimate of carbon content and NCV.

Methodology of ETS data consideration

ETS "bottom up" data 2005–2007 are used for calculation of emission data in categories *1 A 1*, *1 A 2* and *1 A 4 a*. About 200 plants reported 800 fuel and material flows which have been considered in the inventory.

- In accordance with STATISTIK AUSTRIA each plant is allocated to a NACE category of the energy balance.
- In accordance with STATISTIK AUSTRIA each reported fuel is allocated to a fuel type according to the energy statistics system. For "non-traded fuels" systematic errors of allocation have to be avoided as far as possible.
- ETS fuel masses/volumes and NCVs are used for activity data calculation. The remaining activity data is calculated by means of remaining fuel masses/volumes and averaged NCVs from the energy balance:
  $Activity_{category,\ fuel} = (Energy\_Balance\_Activity_{category,\ fuel} - \Sigma i(ETS\_Activity_{plant\ i,\ fuel})) \times Energy\_Balance\_NCV_{fuel} + \Sigma i(ETS\_Activity_{plant\ i,\ fuel} \times ETS\_NCV_{plant\ i,\ fuel})$
- ETS $CO_2$ emissions are considered by fuel. The remaining $CO_2$ emissions are calculated by remaining activity data and "national default" emission factors:
  $CO2_{category,\ fuel} = (Energy\_Balance\_Activity_{category,\ fuel} - \Sigma i(ETS\_Activity_{plant\ i,\ fuel})) \times Energy\_Balance\_NCV_{fuel} \times Default\_EF_{fuel} + \Sigma i(ETS\_CO2_{plant\ i,\ fuel})$

### Choice of emission factors for stationary sources

Emission factors for combustion plants are expressed as kg/GJ for $CO_2$ and as g/GJ for $CH_4$ and $N_2O$. Please note that emission factors sometimes are different for different sectors because of the different share of fuel types combusted (e.g. the $CO_2$ emission factor for "hard coal" used in the energy industries is different from the factor used for manufacturing industry because different hard coal types with different origin are used; "hard coal" is actually a group of different hard coal types).

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, carbon content of coal, $CH_4$ content of natural gas.
- The mix of fuels in the 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.
- The technical equipment of a combustion plant, which burns a specific fuel, changes over time.

References for $CO_2$ and $CH_4$ emission factors are national studies (BMWA-EB 1990, 1996, 2003, UMWELTBUNDESAMT 2002). $N_2O$ emission factors are also taken from national studies (STANZEL et al. 1995) and (BMUJF 1994). Detailed figures are included in the relevant chapters.

#### *$CO_2$ emission factors for stationary sources per fuel type*

Natural Gas (fossil)

For all stationary sources of natural gas combustion a $CO_2$ emission factor of 55.4 t $CO_2$/TJ (UMWELTBUNDESAMT 2002) has been applied.

Liquid fuels (fossil)

*Fuel oil*: Depending on the sulphur content three fuel oil categories are considered in the inventory. $CO_2$ emisson factors are taken from (BMWA-EB 1996).

*Gasoil, Diesel Oil* : $CO_2$ emisson factors are taken from (BMWA-EB 1996).

*Liquid Petroleum Gas, LPG*: $CO_2$ emisson factors are taken from (BMWA-EB 1996).

*Refinery Gas*: The $CO_2$ emission factor is based on plant specific measurements. See Chapter 3.2.2.2 1.A.1.b Petroleum Refining.

Solid fuels (fossil)

*Coal*: (BMWA-EB 1996): $CO_2$ emission factors are based on elemental analysis with the assumption that 100% of carbon is released as $CO_2$ (values originate from the study (HACKL & MAUSCHITZ 1996), where the EF are based on the elemental analysis for different coal types).

*Peat*: A default carbon content of 29.9 t C/TJ for peat is taken from (IPCC Guidelines 1997).

Municipal Solid Waste, MSW (partly fossil)

The fossil carbon content for MSW is taken from (ABFALLWIRTSCHAFT 2003). A fraction analysis of the typical wet MSW for Vienna[21] was performed by the local waste authority of Vienna (MA 48) in 1997/1998.

The fossil and non fossil carbon content of each fraction is taken from (ÖKOINSTITUT 2002). This leads to a fossil share of 45% of the overall carbon content of 261 kg C/t $MSW_{wet\ matter}$. The $CO_2$ emission factor is converted into t $CO_2$/TJ by means of a heating value of 9.8 GJ/t. The heating value is a personal information of STATISTIK AUSTRIA to the Umweltbundesamt and consistent with the energy balance (IEA JQ 2007). STATISTIK AUSTRIA quotes that the heating value was obtained from the plant operator.

Industrial Waste (partly fossil)

The main share of industrial waste is used in cement and chemical industry for the purpose of energy recovery. For cement industry emission factors are based on the studies (HACKL & MAUSCHITZ 1995, 1997, 2001, 2003, 2007) and (MAUSCHITZ 2004) which include information about fractions and carbon contents. Details about emissions from cement industry are given in Chapter 3.2.2.9 (1.A.2.f Manufacturing Industries and Construction – Other).

The fractions and the specific carbon contents of waste incinerated in chemical industry, pulp and paper industry and wood products manufacturing industry are not reported by the ETS report and are unknown. It is assumed that the heating value is mainly determined by combustion of carbon which is mainly of fossil origin. Therefore the default emission factor from GPG, Table 5.6 for hazardous waste is used:

[21] Until 1998 incineration of MSW in Vienna took place only at the one plant where the analysis was performed; in 2003 73% of total MSW in Austria was combusted in this plant, the value was applied to total MSW combustion in Austria.

A carbon content of 500 kg C/ t waste is selected with a fossil share of 90% and 99.5% combustion efficiency. This leads to an emissions factor of 1 641.8 kg $CO_2$/t waste. By selecting a net calorific value of 15.76 GJ/t (which is the value used by STATISTIK AUSTRIA for preparing the energy balance) this leads to an emission factor of 104.17 t $CO_2$/TJ waste.

Sewage Sludge (non fossil)

Sewage sludge is incinerated in one waste incineration plant and a couple of public power plants. A default carbon content of 29.9 t C/TJ for solid biomass is taken from (IPCC Guidelines, 1997).

Black Liquor (non fossil)

Black liquor is incinerated in pulp and paper industry and in wood products manufacturing industry. A default carbon content of 29.9 t C/TJ for solid biomass is taken from (IPCC Guidelines, 1997).

Biogas, Sewage Sludge Gas, Landfill Gas (non fossil)

Biogas reported by (IEA JQ 2004) is used for energy recovery in all subcategories of Category *1 A.* A default carbon content of 30.6 t C/TJ for biogas is taken from (IPCC Guidelines 1997).

***$CO_2$ emissions reported by the ETS***

The following Table 22 shows certificated $CO_2$ emissions from the ETS (UMWELTBUNDESAMT, C 2006/2007/2008) and their allocation to IPCC categories. The allocation does not always follow the category reported by plant operators but is harmonized by means of reported NACE-codes and therefore harmonized with energy statistics. To improve time series consistency industrial so called "co-generation" plants are allocated to the industrial sectors where the energy is used. Minor emissions could not be allocated to a specific category but are assumed to be included elsewhere in the inventory (e.g. carburisation material) or negligible (e.g. pyrolisis material).

*Table 22: 2005–2007 $CO_2$ emissions [Gg] as reported by the ETS.*

| | Category | 2005 | 2006 | 2007 |
|---|---|---|---|---|
| Total ETS[1)] | | 33 373 | 32 381 | 31 745 |
| 1.A | FUEL COMBUSTION ACTIVITIES | 25 299 | 23 998 | 22 836 |
| 1.A.1.a | Public Electricity and Heat Production | 11 482 | 10 374 | 9 037 |
| 1.A.1.b | Petroleum refining | 2 827 | 2 830 | 2 868 |
| 1.A.1.c | Manufacture of Solid fuels and Other Energy Industries | 43 | 50 | 52 |
| 1.A.2.a | Iron and Steel | 5 688 | 5 527 | 5 596 |
| 1.A.2.b | Non-ferrous Metals | 0 | 0 | 0 |
| 1.A.2.c | Chemicals | 665 | 623 | 592 |
| 1.A.2.d | Pulp, Paper and Print | 2 245 | 2 153 | 2 150 |
| 1.A.2.e | Food Processing, Beverages and Tobacco | 316 | 278 | 283 |
| 1.A.2.f | Other | 2 010 | 2 139 | 2 239 |
| 1.A.4.a | Commercial/Institutional | 22 | 23 | 19 |
| 2. | INDUSTRIAL PROCESSES | 8 091 | 8 447 | 8 974 |
| 2.A.1 | Cement Production | 1 797 | 1 954 | 2 131 |
| 2.A.2 | Lime Production | 579 | 570 | 596 |
| 2.A.3 | Limestone and Dolomite Use | 267 | 272 | 289 |
| 2.A.4 | Soda Ash Production and use | 15 | 16 | 17 |
| 2.A.7.a | Bricks and Tiles (decarbonizing) | 128 | 130 | 130 |
| 2.A.7.b | Sinter Production | 310 | 312 | 329 |
| 2.C.1.a | Steel | 763 | 778 | 826 |
| 2.C.1.b | Pig Iron | 4 186 | 4 366 | 4 598 |
| 2.C.1.e.1 | Electric furnace steel plant | 45 | 49 | 58 |
| | *Included elsewhere[2)]* | *17* | *63* | *65* |

[1)] *Source: UMWELTBUNDESAMT, ECRA (2006/2007/2008).*

[2)] *Emissions which could not be allocated to a specific IPCC category.*

### $CO_2$ emission factors reported within the ETS

Table 23 and Table 24 show the implied $CO_2$ emisson factors reported within the ETS by fuel and SNAP category for the recent reported year. In some cases rather small fuel consumption was reported for specific categories. This may lead to significant errors in implied emission factor calculation (e.g. diesel, gasoil) because within the ETS $CO_2$ emissions are rounded to the nearest ton wheras reported fuel consumption is not rounded.

*Table 23: 2007 $CO_2$ implied emission factors calculated from ETS data. Coal, Petrol Coke, Waste and Natural Gas.*

| SNAP | 102A Hard Coal | 105A Brown Coal | 107A Coke Oven Coke | 110A Petrol Coke | 115A Ind. Waste | 301A Natural Gas |
|---|---|---|---|---|---|---|
| **Weighted average** | **93.12** | **97.04** | **105.62** | **109.21** | **60.44** | **54.68** |
| 010101 Public Power plants >= 300 $MW_{th}$ | 92.97 | 0.00 | - | - | - | 55.00 |
| 010102 Public Power plants >= 50 $MW_{th}$ < 300 $MW_{th}$ | 93.61 | 0.00 | - | - | 96.15 | 55.00 |
| 010103 Public Power plants <= 50 $MW_{th}$ | - | - | - | - | - | - |
| 010201 Public District Heating plants >= 300 $MW_{th}$ | - | - | - | - | - | 55.00 |
| 010202 Public District Heating plants >= 50 $MW_{th}$ < 300 $MW_{th}$ | - | - | - | - | - | 55.00 |
| 010203 Public District Heating plants < 50 $MW_{th}$ | - | - | - | - | - | 55.00 |
| 010301 Refinery | - | - | - | 117.03 | - | 53.03 |
| 010504 Other Energy Industries – Gas Turbines | - | - | - | - | - | 55.00 |
| 020103 Commercial plants < 50 $MW_{th}$ | - | - | - | - | - | 55.00 |
| 0301 Industry – Steel | 114.98 | - | 104.10 | - | - | 55.00 |
| 0301 Industry – Non ferrous metals | - | - | - | - | - | - |
| 0301 Industry – Chemicals | 94.29 | - | - | - | 75.01 | 55.00 |
| 0301 Industry – Pulp and Paper | 89.82 | - | - | - | 65.52 | 55.00 |
| 0301 Industry – Food and Beverages | 98.30 | - | 104.00 | - | - | 55.00 |
| 03010 Industry – Other | 128.56 | - | - | - | 18.82 | 55.00 |
| 030311 Cement kilns | 93.84 | 96.63 | - | 91.88 | 64.41 | 55.01 |
| 030312 Lime kilns | - | - | 104.00 | - | - | 55.00 |
| 030317 Glass | - | - | - | - | - | 55.00 |
| 030319 Bricks and Tiles | 0.00 | 113.41 | 104.00 | 102.51 | 0.28 | 55.00 |
| 030323 Dolomite Treatment | - | - | - | 95.75 | - | 55.00 |
| 030326 Integrated Iron & Steel works | 94.11 | - | 105.63 | - | 82.59 | 55.08 |

*Table 24: 2007 $CO_2$ implied emission factors calculated from ETS data. Oil products.*

| SNAP | 203B light fel oil | 203C Medium fuel oil | 203D Heavy fuel oil | 204A Gasoil | 2050 Diesel | 224A other liquid | 303A LPG |
|---|---|---|---|---|---|---|---|
| **Weighted average** | **77.61** | **78.00** | **79.80** | **74.98** | **73.67** | **79.38** | **64.01** |
| 010101 Public Power plants >= 300 $MW_{th}$ | 76.72 | - | 79.94 | 75.30 | 78.58 | - | - |
| 010102 Public Power plants >= 50 $MW_{th}$ < 300 $MW_{th}$ | 79.94 | - | 80.07 | 72.59 | - | - | - |
| 010103 Public Power plants <= 50 $MW_{th}$ | - | - | - | - | - | - | - |
| 010201 Public District Heating plants >= 300 $MW_{th}$ | 77.00 | - | 80.01 | 74.99 | 67.97 | - | - |
| 010202 Public District Heating plants >= 50 $MW_{th}$ < 300 $MW_{th}$ | 76.99 | 78.00 | 80.00 | 75.03 | 64.36 | - | - |
| 010203 Public District Heating plants < 50 $MW_{th}$ | 77.46 | - | 79.52 | 75.04 | 73.58 | - | 63.99 |
| 010301 Refinery | - | - | - | - | - | 79.38 | - |
| 010504 Other Energy Industries – Gas Turbines | - | - | - | - | - | - | - |
| 020103 Commercial plants < 50 $MW_{th}$ | - | - | - | 73.11 | - | - | - |
| 0301 Industry – Steel | - | - | - | - | - | - | - |
| 0301 Industry – Non ferrous metals | - | - | - | - | - | - | - |
| 0301 Industry – Chemicals | - | - | 82.01 | 75.20 | 62.31 | - | - |
| 0301 Industry – Pulp and Paper | 78.00 | - | 78.46 | 74.85 | 74.16 | - | - |
| 0301 Industry – Food and Beverages | 83.85 | - | 78.03 | 75.17 | 70.41 | - | - |
| 03010 Industry – Other | 78.00 | - | 78.00 | 74.90 | 76.38 | - | - |
| 030311 Cement kilns | 78.03 | - | 77.98 | 74.96 | - | - | - |
| 030312 Lime kilns | - | - | 77.76 | 75.84 | - | - | - |
| 030317 Glass | 78.00 | - | - | 73.36 | 71.52 | - | - |
| 030319 Bricks and Tiles | 77.96 | - | 78.00 | 75.01 | 106.20 | 82.36 | 64.01 |
| 030323 Dolomite Treatment | 74.35 | - | - | - | 81.98 | - | 64.28 |
| 030326 Integrated Iron & Steel works | - | - | 80.08 | - | - | - | - |

***Choice of activity data for stationary sources***

For information on the underlying activity data used for estimating emissions see Annex 2. It describes the national energy balance (including fuel and fuel categories, net calorific values) and the methodology applied to extract activity data from the energy balance for the calculation of emissions for *Sector 1 A Fuel Combustion* (such as correspondence of categories of the energy balance to IPCC categories). Activity data used for estimating emissions in the sectoral approach is taken from the energy balance as well as information on the last revision of the national energy balance (see Annex 2).

The national energy balance is provided by Statistik Austria (IEA JQ 2008) and presented in Annex 4. The net calorific values (NCV) used for converting mass or volume units of the fuel quantities into energy units [TJ] are provided by Statistik Austria and presented in Annex 4.

In the sectoral approach of Category *1 A* only the fuel quantities that are combusted are relevant and thus considered for emission calculation. Quantities not considered are: non energy and feedstock use, international bunker fuels, transformation and distribution losses, transformations of fuels to other fuels like hard coal to coke oven coke and internal refinery processes which have been added to the transformation sector of the energy balance.

Potential emissions from non energy and feedstock fuel use are considered in the correspondent IPCC categories as described in Chapter 3.4 Feedstocks.

#### 3.2.2.1 1.A.1.a Public Electricity and Heat Production

*Key Sources: $CO_2$ from gaseous, liquid, solid and other fuels*

Category *1 A 1 a Public Electricity and Heat Production* covers emissions from fuel combustion in public power and heat plants. The share in total GHG emissions from sector *1 A* is 19.8% for the year 1990 and 16.1% for the year 2007. The increased $CH_4$ emissions are due to increased natural gas combustion in plants smaller 50 $MW_{th}$ (see tables in Annex 2). In 2007 $CO_2$ emissions decreased by 13% (1 613 Gg) due to less electricity and heat production.

**Methodology**

For the years 1990 to 2004 IPCC Tier 2 methodology is applied by using activity data from energy balance and national default emission factors.

For the years 2005–2007 $CO_2$ emissions from plants >= 20 $MW_{th}$ are taken from ETS reports and $CO_2$ emissions from plants < 20 $MW_{th}$ are calculated by means of national default emission factors and remaining fuel consumption of the energy balance. Coal consumption is fully covered by the ETS. The general methodology is described in chapter 3.2.2.

**Emission factors**

National emission factors for $CO_2$ and $CH_4$ are taken from (BMWA-EB, 1990, 1996, (UMWELTBUNDESAMT 2001a) and (GEMIS, 2002). $N_2O$-emission factors are taken from a national study (STANZEL et al. 1995). The selected emissions factors for 2007 are listed in the following table. The $CO_2$ emission factor for municipal solid waste is taken from (ABFALLWIRTSCHAFT 2003). The following table shows the national default emission factors.

*Table 25: Emission factors of Category 1.A.1 a for the year 2007.*

| Fuel | Default $CO_2$ [t/TJ] | $CH_4$ [kg/TJ] | $N_2O$ [kg/TJ] |
|---|---|---|---|
| Light Fuel Oil in plants >= 50 $MW_{th}$ | 77.00 | 1.00 | 1.00 |
| Light Fuel Oil in plants <= 50 $MW_{th}$ | 78.00 | 0.80 | 0.60 |
| Medium Fuel Oil | 78.00 | 1.00 | 1.00 |
| Heavy Fuel Oil in plants >= 50 $MW_{th}$ | 80.00 | 0.60–1.00 | 1.80 |
| Heavy Fuel Oil in plants <= 50 $MW_{th}$ | 78.00 | 2.00 | 1.00 |
| Gasoil | 75.00 | 1.20 | 1.00 |

| Fuel | Default $CO_2$ [t/TJ] | $CH_4$ [kg/TJ] | $N_2O$ [kg/TJ] |
|---|---|---|---|
| Diesel oil | 75.00 | 0.20 | 0.60 |
| Liquified Petroleum Gas | 64.00 | 1.50 | 1.00 |
| Hard coal in power and CHP plants | 95.00 | 0.10 | 0.50 |
| Hard coal in district heating plants. | 93.00 | 0.30 | 5.00 |
| Lignite and brown coal in power and CHP plants >= 50 $MW_{th}$ | 110.00 | 0.10 | 0.50 |
| Lignite and brown coal in district heating plants >= 50 $MW_{th}$ | 108.00 | 0.20 | 2.00 |
| Lignite, brown coal and brown coal briquettes in plants < 50 $MW_{th}$ | 97.00 | 7.00 | 1.40 |
| Natural Gas in power and CHP plants >= 50 $MW_{th}$ | 55.40 | 0.18 | 0.50 |
| Natural Gas in district heating plants >= 50 $MW_{th}$ | 55.40 | 1.50 | 1.00 |
| Natural Gas in plants <= 50 $MW_{th}$ | 55.40 | 1.50 | 0.10 |
| Fuel Wood | 100.00[1)] | 21.00 | 3.00 |
| Wood Waste | 110.00[1)] | 2.00 | 4.00 |
| Sewage Sludge | 110.00[1)] | 12.00 | 1.40 |
| Biogas, Sewage Sludge Gas, Landfill Gas | 112.00[1)] | 1.50 | 1.00 |
| Municipal Solid $Waste_{wet}$ | 48.88[2)] | 12.00 | 1.40 |
| Industrial Waste | 104.17[2)] | 12.00 | 1.40 |

1) *Reported as $CO_2$ emissions from biomass.*

2) *According to IPCC guidelines non fossil $CO_2$ emissions of "other fuels" are not reported.*

### Activity data

Total fuel consumption of Category *1.A.1 a* is taken from (IEA JQ 2008) prepared by Statistik Austria (see Annex 4).

Fuel consumption in the public electricity sector varies strongly over time. The most important reason for this variation is the fact that in Austria up to 78% of yearly electricity production comes from hydropower. If production of electricity from hydropower is low, production from thermal power plants is high and vice versa.

The following Table 26 shows the gross electricity and heat production of public power and district heating plants. Increasing district heat production is mainly generated by new biomass (local) heat plants and by waste incineration. The share of combined heat and power plants (CHP generation) is increasing and leads to higher efficiency of energy generation.

*Table 26: Public gross electricity and heat production.*

| | Public gross electricity production [GWh] | | | | | | Public Heat Production [TJ] by Combustible Fuels |
|---|---|---|---|---|---|---|---|
| | Total | Hydro[1)] | Combustible Fuels | Geothermal | Solar | Wind | |
| 1990 | **43 403** | 30 111 | 13 292 | 0 | 0 | 0 | 24 426 |
| 1991 | **43 497** | 30 268 | 13 229 | 0 | 0 | 0 | 29 038 |
| 1992 | **42 838** | 33 530 | 9 308 | 0 | 0 | 0 | 27 599 |
| 1993 | **45 064** | 35 334 | 9 729 | 0 | 1 | 0 | 30 427 |
| 1994 | **44 982** | 34 243 | 10 738 | 0 | 1 | 0 | 30 727 |
| 1995 | **47 944** | 35 794 | 12 148 | 0 | 1 | 1 | 34 425 |
| 1996 | **46 011** | 32 950 | 13 055 | 0 | 1 | 5 | 44 482 |

| | Public gross electricity production [GWh] | | | | | | Public Heat Production [TJ] by Combustible Fuels |
|---|---|---|---|---|---|---|---|
| | **Total** | **Hydro[1)]** | **Combustible Fuels** | **Geothermal** | **Solar** | **Wind** | |
| 1997 | **47 695** | 34 701 | 12 972 | 0 | 2 | 20 | 40 630 |
| 1998 | **48 251** | 36 058 | 12 146 | 0 | 2 | 45 | 43 454 |
| 1999 | **52 191** | 39 593 | 12 545 | 0 | 2 | 51 | 43 084 |
| 2000 | **53 089** | 41 410 | 11 609 | 0 | 3 | 67 | 42 654 |
| 2001 | **54 082** | 39 681 | 14 225 | 0 | 4 | 172 | 48 412 |
| 2002 | **54 466** | 40 581 | 13 672 | 3 | 7 | 203 | 45 981 |
| 2003 | **52 500** | 34 230 | 17 890 | 3 | 11 | 366 | 49 515 |
| 2004 | **56 028** | 37 700 | 17 388 | 2 | 14 | 924 | 52 976 |
| 2005 | **57 468** | 37 379 | 18 745 | 2 | 14 | 1 328 | 55 980 |
| 2006 | **55 007** | 36 458 | 16 779 | 3 | 15 | 1 752 | 60 691 |
| 2007 | **54 661** | 37 362 | 15 264 | 3 | 17 | 2 015 | 56 465 |

[1)] *including use for pumped storage; Source: STATISTIK AUSTRIA*

Although electricity consumption increases continously the domestic production is decreasing since 2004 but net imports have more than doubled since 2004 as shown in the following Table 27.

*Table 27: Electricity supply, gross production imports, exports and net imports [GWh].*

| | Electricity [GWh] | | | | |
|---|---|---|---|---|---|
| | **Supply[1)]** | **Gross production[2)]** | **Imports** | **Exports** | **Net Imports** |
| 1990 | 46 540 | 50 294 | 6 838 | 7 298 | -460 |
| 1991 | 48 794 | 51 483 | 8 503 | 7 738 | 765 |
| 1992 | 48 187 | 51 180 | 9 175 | 8 620 | 555 |
| 1993 | 49 062 | 52 676 | 8 072 | 8 806 | -734 |
| 1994 | 49 609 | 53 310 | 8 219 | 9 042 | -823 |
| 1995 | 50 979 | 56 589 | 7 287 | 9 757 | -2 470 |
| 1996 | 52 515 | 54 938 | 9 428 | 8 476 | 952 |
| 1997 | 53 068 | 56 873 | 9 007 | 9 775 | -768 |
| 1998 | 54 040 | 57 463 | 10 304 | 10 467 | -163 |
| 1999 | 55 964 | 60 943 | 11 608 | 13 507 | -1 899 |
| 2000 | 55 783 | 61 517 | 13 824 | 15 192 | -1 368 |
| 2001 | 57 974 | 62 377 | 14 467 | 14 252 | 215 |
| 2002 | 57 109 | 62 420 | 15 375 | 14 676 | 699 |
| 2003 | 58 636 | 60 098 | 19 002 | 13 389 | 5 613 |
| 2004 | 59 940 | 64 127 | 16 629 | 13 548 | 3 081 |
| 2005 | 61 016 | 65 698 | 20 397 | 17 732 | 2 665 |
| 2006 | 62 328 | 63 537 | 21 257 | 14 407 | 6 850 |
| 2007 | 62 252 | 63 430 | 22 130 | 15 511 | 6 619 |

*Source: Statistik Austria*

[1)] *Excluding own use and heat pumps, boilers and pumped storage use. Including losses*

[2)] *Public and autoproducer gross production*

**Recalculations**

Changes of activity data are based on energy balance recalculation as described in Annex 2.

**Sector specific QA/QC procedures**

Large point source data are used for validation of energy consumption. The Umweltbundesamt operates a database to store boiler specific data, which is called "*Dampfkesseldatenbank"* (DKDB, UMWELTBUNDESAMT 2007b) which includes fuel consumption, CO, $NO_x$, $SO_x$ and dust emissions from boilers with a thermal capacity greater than 3 MW for the years 1990 onwards. These data are used to generate a sectoral split of the categories *Public Power* and *District Heating* each into the two categories ≥ *300 MW* and ≥ *50 MW to 300 MW* of thermal capacity. Currently 56 boilers between 35 and 1 760 $MW_{th}$ are considered in this approach.

The remaining fuel consumption (= total consumption minus consumption of large point sources) is the activity data for boilers smaller than 50 MW.

### 3.2.2.2 1.A.1.b Petroleum Refining

*Key Sources: $CO_2$ from gaseous and liquid fuels*

Category *1 A 1 b Petroleum Refining* enfolds $CO_2$ and $N_2O$ emissions from fuel combustion, flaring and thermal cracking of the only petroleum refining plant in Austria. $CH_4$ emissions are included in category *1 B 2 a Fugitive Emissions from Fuels – Oil*. Since 2003 the plant has been upgraded which increases $CO_2$ emissions from bitumen blowing and hydrogen production.

The share in total GHG emissions from sector *1 A* is 4.4% for the year 1990 and 4.4% for the year 2007. Crude oil input which was 8 Mio t in 1990 and 8.5 Mio t in 2007.

**Methodology**

The IPCC Tier 2 bottom up methodology is used. Activity data is multiplied by emission factors. For calculation of $CO_2$ emissions plant specific emission factors are used. For calculation of $N_2O$ emissions country specific default emission factors are used.

The carbon contents for the fuel groups *gaseous*, *liquid* and *solid* are reported by the plant operator. The fuel groups do not correspond with IPCC definitions, e.g. gaseous fuels include refinery gas which is, according to IPCC definition, a liquid fuel.

*Table 28: Carbon content per fuel group for petroleum refining.*

| Fuel-Group | Carbon Content [t $CO_2$/t fuel] | Associated IEA-Fuels |
|---|---|---|
| Gaseous | 2.683 | Natural Gas, Refinery Gas |
| Liquid | 3.047 | Residual Fuel Oil, Gas Oil, Diesel, Petroleum, Jet Gasoline, Other Oil Products, LPG |
| Solid | 3.430 | Petrol coke (FCC-coke) |

For 1990 to 2001 $CO_2$ emissions are calculated by multiplying activity data from the energy balance by the emission factors in Table 28. $CO_2$ emissions 2002 to 2005 are reported by the Austrian Association of Mineral Oil Industries which are consistent with ETS 2005 data. For the year 2006 on reported ETS data is used.

To be consistent with IPCC fuel group definition, total $CO_2$ emissions are disaggregated to the IEA fuel types (see column "Associated IEA-fuels") by using default emission factors for industrial boilers (they are presented in Table 30, for references see Chapter 3.2.2 Methodological Issues), subtracting the calculated $CO_2$ emissions from total $CO_2$ emissions, and associating remaining $CO_2$ emissions to refinery gas. The resulting IEF for refinery gas is presented in Table 29.

*Table 29: Implied emission factors for refinery gas.*

| | t $CO_2$/TJ |
|---|---|
| 1990 | 51.6 |
| 1991 | 50.7 |
| 1992 | 50.9 |
| 1993 | 48.9 |
| 1994 | 50.2 |
| 1995 | 52.1 |
| 1996 | 51.6 |
| 1997 | 50.8 |
| 1998 | 51.0 |
| 1999 | 55.1 |
| 2000 | 50.7 |
| 2001 | 51.2 |
| 2002 | 50.7 |
| 2003 | 68.6 |
| 2004 | 67.8 |
| 2005 | 58.4 |
| 2006 | 74.8 |
| 2007 | 70.4 |

$N_2O$ emissions are calculated by multiplying fuel consumption by the emission factors presented in Table 30 (they are selected according to chapter 3.2.2 Methodological Issues).

No combustion specific $CH_4$ emissions are reported for this category, process-specific $CH_4$ emissions are reported in Category *1.B.2.a Fugitive Emissions from Fuels – Oil*.

For corresponding crude oil input data which may be used as an indicator over time series refer to description of category *1.B.2.a Oil*.

*Table 30: Emission factors of Category 1.A.1.b.*

| Fuel | $CO_2$ [t/TJ] | $N_2O$ [kg/TJ] |
|---|---|---|
| Residual Fuel Oil | 80.00 | 0.60 |
| Gas oil | 75.00 | 0.60 |
| Diesel | 78.00 | 0.60 |
| Petroleum | 78.00 | 0.60 |
| Jet Gasoline | 78.00 | 0.60 |
| Other Oil Products | 78.00 | 0.60 |
| LPG | 64.00 | 1.00 |
| Petrol Coke | 100.88 | – |
| Natural Gas | 55.40 | 0.10 |

### Activity data

Fuel consumption is taken from (IEA JQ 2008) as presented in Annex 4 except for the years 1999 to 2005, where *petrol coke* is additionally counted in *other oil products* (1999: +63 kt, 2004: +59 kt) to obtain consistency with plant specific activity data reported in (DKDB, UMWELTBUNDESAMT 2007b).

### Sector specific QA/QC procedures

A simple mass balanced input/output validation of energy balance data has been performed which shows a plausible and time series consistent correlation of the input and output material flows as shown in the following Table 31. The last line shows the difference between input and output. Natural gas consumption is not considered in this approach.

*Table 31: Refinery input/output mass balance.*

| Material flow [kt] | 1990 | 1995 | 2000 | 2005 | 2006 | 2007 |
|---|---|---|---|---|---|---|
| **Total Input** | **9 062** | **9 244** | **8 887** | **9 291** | **9 099** | **9 197** |
| Crude oil | 7 952 | 8 619 | 8 240 | 8 743 | 8 472 | 8 546 |
| NGL | 41 | 43 | 107 | 43 | 47 | 141 |
| Feedstocks | 1 069 | 582 | 541 | 471 | 468 | 348 |
| Biofuel (blending) | | | | 34 | 112 | 163 |
| **Total Output** | **8 824** | **8 959** | **8 610** | **9 098** | **8 866** | **8 889** |
| Fuel oil | 1 913 | 1 502 | 979 | 1 045 | 915 | 879 |
| Gas oil | 1 239 | 1 454 | 1 062 | 997 | 1 004 | 612 |
| Diesel | 1 531 | 1 920 | 2 662 | 2 931 | 2 780 | 2 976 |
| Other Kerosene | 31 | 8 | 1 | 1 | 8 | 1 |
| Aviation kerosene | 291 | 420 | 544 | 592 | 526 | 604 |
| Aviation gasoline | 0 | 0 | 0 | 0 | 0 | 0 |
| Motör gasoline | 2 631 | 2 271 | 1 815 | 1 798 | 1 615 | 1 702 |
| White spirit | 0 | 5 | 0 | 0 | 0 | 0 |
| Bitumen | 269 | 254 | 343 | 466 | 392 | 411 |
| Other petroluem products | 499 | 761 | 859 | 851 | 1 186 | 1 217 |
| LPG | 47 | 60 | 34 | 107 | 50 | 70 |
| Refinery gas | 373 | 305 | 312 | 309 | 390 | 417 |
| **Input-Output** | **237** | **285** | **277** | **193** | **233** | **309** |

### Planned improvements

A large fluctuation of Refinery gas $CO_2$-IEF (see Table 29) has been identified. Activity data should be reconsidered. From 2005 to 2007 refinery gas activity data (IEA JQ 2008) increased by 33% while $CO_2$ emissions increased by only 1.4%.

#### 3.2.2.3 1.A.1.c Manufacture of Solid Fuels and Other Energy Industries

*Key Source: $CO_2$ from gaseous fuels*

Category *1.A.1.c Manufacture of Solid Fuels and Other Energy Industries* enfolds emissions from fuel combustion in the oil and gas extraction sector (reported by companies as 'own use'), compressors used for natural gas storage tanks and fuel use of gas processing facilities ("gas refineries"). For 1990 to 1995 transformation losses/own use in gas works are included too. The share in sector *1 A* overall GHG emissions is 0.9% for the year 1990 and 1% for the year 2007.

**Methodology**

CORINAIR simple methodology is applied.

For 2005 to 2007 $CO_2$ emissions and activity data of natural gas storage compressors are taken from ETS data.

**Emission factors**

$CO_2$ and $CH_4$ emission factors are taken from studies (BMWA-EB 1990, 1996).

The $N_2O$ emission factor is taken from a national study (BMUJF, 1994).

*Table 32: Emission factors of Category 1.A.1.c.*

| Fuel | $CO_2$ [t/TJ] | $CH_4$ [kg/TJ] | $N_2O$ [kg/TJ] |
|---|---|---|---|
| Natural Gas | 55.40 | 1.50 | 0.10 |
| Heavy Fuel Oil | 78.00 | 2.00 | 1.00 |

**Activity data**

Fuel consumption is taken from (IEA JQ 2008) as presented in Annex 4.

Transformation losses in gas works are calculated by subtracting final energy use from transformation input. Since the energy balance (IEA JQ 2008) does not report gas works gas activity data is taken from the "Austrian Energy Balance" provided by STATISTIK AUSTRIA which is structured differently but is consistent with (IEA JQ 2008).

**Recalculations**

Changes of activity data are based on energy balance recalculation as described in Annex 2.

**Planned improvements**

Investigate 'own usage' of natural gas suppliers. Check if a share of pipeline compressor gas turbine fuel consumption which should be reported under Category 1.A.3.e is included here.

Avoid possible double counting with category 1.B.2.b. Clarify where gas hydraulic starting system of turbines and gas hydraulic actuators for pipeline valves are included. Check what natural gas "losses" reported by the energy statistics includes.

### 3.2.2.4 1.A.2.a Iron and Steel

*Key Source: $CO_2$ from 1.A.2 gaseous, solid and liquid-stationary fuels*

Category *1.A.2.a Iron and Steel* enfolds emissions from fuel combustion in iron and steel industry. $CO_2$ emissions from ore reduction in blast furnaces are included in category *2.C.1.b Pig Iron*. The share in total GHG emissions from Sector 1 A is 9% for the year 1990 and 9.6% for the year 2007.

**Methodology**

Two iron and steel production sites (the only operating blast furnaces in Austria) are considered as point sources. For 1990 to 2002 $CO_2$ emissions and fuel consumption from these two plants were reported by the plant operator. The reported fuel consumption of the two plants is subtracted from total fuel consumption for iron and steel production in Austria, the resulting fuel consumption is considered as area source. For the area sources CORINAIR simple methodology was applied for all GHGs.

The methodology of separating process $CO_2$ emissions from total integrated steel plants' $CO_2$ emissions is explained in the methodology chapter of category *2.C.1*.

$CO_2$, NMVOC, CO, $NO_X$ and $SO_2$ emissions are reported by the two Austrian iron and steel plants together with their coal, fuel oil and natural gas fuel consumption. For liquid fuels, natural gas and coke oven coke $CO_2$ emission factors taken from (BMWA-EB 1996) are applied. The remaining $CO_2$ emissions are allocated to the reported coke oven gas consumption. The methodology to divide the reported fuel consumption into energy related and process related consumption is performed with the information provided in (IEA JQ 2007). The complex carbon fluxes in iron and steel plants can not be well modelled within the energy balance which leads to a fluctuation of implied $CO_2$ emission factors for *1 A 2 a* solid fuels over time. $CO_2$ emissions 2005 to 2007 are reported from plant operators. The emissions declaration includes emissions from natural gas consumption not included in the ETS.

$N_2O$ emissions of the two iron and steel plants are calculated with the CORINAIR simple methodology.

$CH_4$ emissions are calculated under the assumption that the ratio of $CH_4$ emissions to the reported NMVOC emissions is equal to the ratio of $CH_4$ and NMVOC emissions if calculated with the CORINAIR simple method. For the year 2007 this ratio is 378/302; the plant reported 302 t NMVOC and by applying the ratio obtained from the CORINAIR simple methodology, total $CH_4$ emissions were estimated to be 90 t. In a last step $CH_4$ emissions were allocated to the different fuel types.

<u>Point source $CO_2$ emissions 2003 and 2004</u>

Since for the years 2003 and 2004 no point source $CO_2$ emissions have been reported by plant operators, the *Umweltbundesamt* performed calculations on the basis of 2000 to 2002 data by means of a simple approach: Activity data reported by plant operators are multiplied by national default emission factors. The resulting emissions are those from blast furnaces and autoproducer power plants. $CO_2$ emissions from coke ovens (2004: 285 Gg) are estimated by means of coke oven output and an emission factor of 0.2 t $CO_2$/t coke which is equal to 5% transformation losses.

## Emissions

The following table lists the results of the two approaches. Please note that process related $CO_2$ emissions from blast furnaces are reported under category 2.C.1.

*Table 33: Greenhouse gas emissions from Category 1.A.2.a by sub sources.*

| | area sources | | | point sources | | |
|---|---|---|---|---|---|---|
| | $CO_2$ [Gg] | $CH_4$ [Gg] | $N_2O$ [Gg] | $CO_2$ [Gg] | $CH_4$ [Gg] | $N_2O$ [Gg] |
| 1990 | 191 | 0.005 | 0.001 | 4 753 | 0.020 | 0.041 |
| 1991 | 250 | 0.007 | 0.001 | 4 365 | 0.016 | 0.041 |
| 1992 | 202 | 0.005 | 0.001 | 3 730 | 0.014 | 0.035 |
| 1993 | 222 | 0.006 | 0.002 | 3 969 | 0.016 | 0.036 |
| 1994 | 234 | 0.006 | 0.002 | 4 207 | 0.020 | 0.039 |
| 1995 | 291 | 0.007 | 0.002 | 4 483 | 0.019 | 0.045 |
| 1996 | 445 | 0.012 | 0.003 | 4 221 | 0.019 | 0.040 |
| 1997 | 465 | 0.012 | 0.002 | 4 822 | 0.022 | 0.046 |
| 1998 | 424 | 0.011 | 0.002 | 4 291 | 0.022 | 0.046 |
| 1999 | 316 | 0.008 | 0.001 | 4 521 | 0.022 | 0.048 |
| 2000 | 413 | 0.011 | 0.002 | 4 804 | 0.027 | 0.054 |
| 2001 | 302 | 0.008 | 0.001 | 4 889 | 0.027 | 0.052 |
| 2002 | 390 | 0.010 | 0.001 | 5 118 | 0.027 | 0.052 |
| 2003 | 361 | 0.010 | 0.001 | 5 263 | 0.068 | 0.053 |
| 2004 | 161 | 0.004 | 0.001 | 5 557 | 0.081 | 0.054 |
| 2005 | 447 | 0.012 | 0.002 | 6 003 | 0.089 | 0.057 |
| 2006 | 499 | 0.013 | 0.002 | 5 851 | 0.095 | 0.060 |
| 2007 | 386 | 0.011 | 0.001 | 5 839 | 0.090 | 0.062 |

## Emission factors

$CO_2$ and $CH_4$ emission factors are taken from studies (BMWA-EB 1990, 1996) and (UMWELTBUNDESAMT 2002), $N_2O$ emission factors are taken from the national study (BMUJF 1994).

The selected and calculated emission factors for 2007 are presented in Table 34 and Table 35.

*Table 34: Emission factors of Category 1.A.2.a for 2007, area sources.*

| Fuel | $CO_2$ [t/TJ] | $CH_4$ [kg/TJ] | $N_2O$ [kg/TJ] |
|---|---|---|---|
| Light Fuel Oil | 78.00 | 0.20 | 0.60 |
| Heavy Fuel Oil | 78.00 | 2.00 | 1.00 |
| Gas oil | 75.00 | 1.20 | 1.00 |
| Petroleum | 78.00 | 0.20 | 0.60 |
| LPG | 64.00 | 1.50 | 1.00 |
| Hard Coal | 94.00 | 5.00 | 1.40 |
| Lignite and brown coal | 97.00 | 7.00 | 1.40 |
| Coke | 104.00 | 2.00 | 1.40 |
| Natural Gas | 55.40 | 1.50 | 0.10 |
| Wood Waste | 110.00[1)] | 2.00 | 4.00 |

[1)] *Reported as $CO_2$ emissions from biomass.*

*Table 35: Emission factors of Category 1.A.2.a for 2007, point sources.*

| Fuel | $CO_2$ [t/TJ] | $CH_4$ [kg/TJ] | $N_2O$ [kg/TJ] |
|---|---|---|---|
| Heavy Fuel Oil | 78.00 | 1.60 | 1.00 |
| Coke | 104.00 | 1.60 | 1.40 |
| Coke Oven Gas | 94.60 | – | – |
| Natural Gas | 55.40 | 1.20 | 0.10 |

**Activity data**

Total fuel consumption is taken from (IEA JQ 2008) as presented in Annex 4.

Point source activity data are reported by plant operators which are widely consistent with (IEA JQ 2008).

**Recalculations**

Update of activity data according to the revised energy balance as described in Annex 2 implies only minor revisions for the years 2002 to 2006 for gaseous fuels (max +9 Gg $CO_2$).

For the year 2006 103,4 Gg $CO_2$ emissions have been shifted from *1 A 2 a solid fuels* to category *2 C 1 b Pig Iron* because the share of 'non energy use' on total coke oven coke consumption has been revised within the energy balance.

### 3.2.2.5 1.A.2.b Non-Ferrous Metals

*Key Source: $CO_2$ from 1.A.2 gaseous, solid and liquid-stationary fuels*

Category *1.A.2.b Non-Ferrous Metals* enfolds emissions from fuel combustion in non ferrous metal industry. The share in total GHG emissions from sector *1.A* is 0.2% for the year 1990 and 0.4% for the year 2007.

**Methodology**

CORINAIR simple methodology is applied. Fuel consumption is taken from (IEA JQ 2008) as described in Annex 4.

$CO_2$ and $CH_4$ emission factors are taken from studies (BMWA-EB 1990, 1996) and (UMWELTBUNDESAMT 2002).

$N_2O$ emission factors are taken from a national study (BMUJF 1994).

The emission factors for 2007 are presented in Table 36.

*Table 36: Emission factors of Category 1.A.2.b for 2006.*

| Fuel | $CO_2$ [t/TJ] | $CH_4$ [kg/TJ] | $N_2O$ [kg/TJ] |
|---|---|---|---|
| Light Fuel Oil | 78.00 | 0.20 | 0.60 |
| Medium Fuel Oil | 78.00 | 2.00 | 1.00 |
| Heavy Fuel Oil | 78.00 | 2.00 | 1.00 |
| Gas oil | 75.00 | 1.20 | 1.00 |
| Petroleum | 78.00 | 0.20 | 0.60 |
| LPG | 64.00 | 1.50 | 1.00 |
| Hard Coal | 94.00 | 5.00 | 1.40 |
| Coke | 104.00 | 2.00 | 1.40 |
| Natural Gas | 55.40 | 1.50 | 0.10 |

**Activity data**

Fuel consumption is taken from [IEA JQ 2008] as presented in Annex 4.

**Recalculations**

Changes of activity data are based on a recalculation of the energy balance as described in Annex 2 implies only minor revisions for the years 2005 and 2006 (-4 Gg $CO_2$).

### 3.2.2.6 1.A.2.c Chemicals

*Key Source: $CO_2$ from 1.A.2 gaseous, solid and liquid-stationary fuels*

Category *1.A.2.c Chemicals* enfolds emissions from fuel combustion in chemical industry. The share in total GHG emissions from sector *1 A* is 1.6% for the year 1990 and 2.4% for the year 2007. Larger fluctuations in emission trends occur because economic main activity of combined pulp and viscose manufacturing plants is changing over time and therefore allocated either to sector *1 A 2 c* or *1 A 2 d* of the energy balance.

**Methodology**

CORINAIR simple methodology is applied. For the years 2005 to 2007 $CO_2$ ETS data are considered.

$CO_2$ emissions from industrial waste: In the energy balance activity data of industrial waste has been revised significantly for the year 2006 (+ 3.1 PJ). Activity data in general shows a strong increase of more than 90% since the year 2000 which can not be explained for the time being. By applying the default $CO_2$ emission factor this would result in unreasonable high $CO_2$ emissions. One larger plant reported $CO_2$ emissions under the EPER-directive, these emissions were fully considered in the inventory. It is also known that chemical industry uses waste gas and recovers reaction heat from production processes. Therefore the unknown part of industrial waste (calculated by substracting the amount of waste corresponding to the reported $CO_2$ emissions using the default $CO_2$ EF) is considered as 50% waste gas (with a high share of hydrogen) and 50% chemical reaction heat (which is not relevant for GHG emissions). For waste gas 50% of the IPCC default factor is applied to consider the high share of hydrogen.

### Emission factors

$CO_2$ and $CH_4$ emission factors are taken from studies (BMWA-EB 1990, 1996) and (UMWELTBUNDESAMT 2002). $N_2O$ emission factors are taken from a national study (BMUJF 1994).

Emission factors for 2007 are presented in Table 37.

*Table 37: Emission factors of Category 1 A 2 c for 2007.*

| Fuel | $CO_2$ [t/TJ] | $CH_4$ [kg/TJ] | $N_2O$ [kg/TJ] |
|---|---|---|---|
| Light Fuel Oil | 78.00 | 0.20 | 0.60 |
| Medium Fuel Oil | 78.00 | 2.00 | 1.00 |
| Heavy Fuel Oil | 78.00 | 2.00 | 1.00 |
| Gas oil | 75.00 | 1.20 | 1.00 |
| LPG | 64.00 | 1.50 | 1.00 |
| Hard Coal | 94.00 | 5.00 | 1.40 |
| Lignite and brown coal | 97.00 | 7.00 | 1.40 |
| Brown Coal Briquettes | 97.00 | 7.00 | 1.40 |
| Coke | 104.00 | 2.00 | 1.40 |
| Natural Gas | 55.40 | 1.50 | 0.10 |
| Fuel Wood | 100.00[1)] | 2.00 | 4.00 |
| Wood Waste | 110.00[1)] | 2.00 | 4.00 |
| Black Liquor | 110.00[1)] | 2.00 | 1.40 |
| Biogas | 112.00[1)] | 1.50 | 1.00 |
| Industrial Waste | (104.17) 56.27[2)3)] | 12.00 | 1.40 |

1) *Reported as $CO_2$ emissions from biomass*

2) *According to IPCC guidelines non fossil $CO_2$ emissions of "other fuels" are not reported.*

3) *For the years 1990 to 1999: 104.17 t/TJ.*

### Activity data

Fuel consumption is taken from (IEA JQ 2007) as presented in Annex 4.

### Recalculations

Changes of activity data are based on a recalculation of the energy balance as described in Annex 2.

Recalculations mainly affect $CO_2$ emissions natural gas in the years 2005 (+92 Gg $CO_2$) and 2006 (+132 Gg $CO_2$).

Change in methodology for industrial waste (see methodological chapter).

### Planned Improvements

The composition of industrial wastes have to be investigated in more detail.

### 3.2.2.7 1.A.2.d Pulp, Paper and Print

*Key Source: $CO_2$ from 1.A.2 gaseous, solid and liquid-stationary fuels*

Category *1.A.2.d Pulp, Paper and Print* enfolds emissions from fuel combustion in pulp, paper and print industry. The share in total GHG emissions from sector *1.A* is 4.1% for the year 1990 and 3.4% for the year 2007.

#### Methodology

The CORINAIR simple methodology is applied. For the years 2005 to 2007 $CO_2$ ETS data are considered.

#### Emission factors

$CO_2$ and $CH_4$ emission factors are taken from studies (BMWA-EB 1990, 1996) and (UMWELTBUNDESAMT 2002). $N_2O$ emission factors are taken from a national study (BMUJF 1994).

Emission factors for 2007 are presented in Table 38.

*Table 38: Emission factors of Category 1.A.2.d for 2007.*

| Fuel | $CO_2$ [t/TJ] | $CH_4$ [kg/TJ] | $N_2O$ [kg/TJ] |
|---|---|---|---|
| Hard Coal | 94.00 | 5.00 | 1.40 |
| Lignite and brown coal | 97.00 | 7.00 | 1.40 |
| Brown Coal Briquettes | 97.00 | 7.00 | 1.40 |
| Coke | 104.00 | 2.00 | 1.40 |
| Light Fuel Oil | 78.00 | 0.20 | 0.60 |
| Heavy Fuel Oil | 78.00 | 2.00 | 1.00 |
| Gas oil | 75.00 | 1.20 | 1.00 |
| Petroleum | 78.00 | 0.20 | 0.60 |
| Diesel | 75.00 | 0.20 | 0.60 |
| LPG | 64.00 | 1.50 | 1.00 |
| Natural Gas | 55.40 | 1.50 | 0.10 |
| Fuel Wood | 100.00[1)] | 2.00 | 4.00 |
| Wood Waste[2)] | 110.00[1)] | 2.00 | 4.00 |
| Black Liquor | 110.00[1)] | 2.00 | 1.40 |
| Biogas | 112.00[1)] | 1.50 | 1.00 |
| Landfill Gas | 112.00[1)] | 1.50 | 1.00 |
| Industrial Waste | 104.17[3)] | 12.00 | 1.40 |

1) *Reported as $CO_2$ emissions from biomass*

2) *Including sewage sludge from paper mills*

3) *According to IPCC guidelines non fossil $CO_2$ emissions of "other fuels" are not reported.*

#### Activity data

Fuel consumption is taken from (IEA JQ 2008) as presented in Annex 4.

### Recalculations

Changes of activity data are based on a recalculation of the energy balance as described in Annex 2.

Recalculations mainly affect $CO_2$ emissions from natural gas 1999 (-130 Gg $CO_2$) and 2001 (-91 Gg $CO_2$).

### 3.2.2.8 1.A.2.e Food Processing, Beverages and Tobacco

*Key Source: $CO_2$ from 1.A.2 gaseous, solid and liquid-stationary fuels*

Category *1.A.2.e Food Processing, Beverages and Tobacco* enfolds emissions from fuel combustion in food processing, beverages and tobacco industry. The share in total GHG emissions from sector *1.A* is 1.6% for the year 1990 and 1.4% for the year 2007.

### Methodology

CORINAIR simple methodology is applied. For the years 2005 to 2007 $CO_2$ ETS data are considered.

### Emission factors

$CO_2$ and $CH_4$ emission factors are taken from studies (BMWA-EB 1990, 1996) and (UMWELTBUNDESAMT 2002). $N_2O$ emission factors are taken from a national study (BMUJF 1994).

Emission factors for 2007 are presented in Table 39.

*Table 39: Emission factors of Category 1.A.2.e for 2007.*

| Fuel | $CO_2$ [t/TJ] | $CH_4$ [kg/TJ] | $N_2O$ [kg/TJ] |
|---|---|---|---|
| Light Fuel Oil | 78.00 | 0.20 | 0.60 |
| Medium Fuel Oil | 78.00 | 2.00 | 1.00 |
| Heavy Fuel Oil | 78.00 | 2.00 | 1.00 |
| Gas oil | 75.00 | 1.20 | 1.00 |
| Petroleum | 78.00 | 0.20 | 0.60 |
| Diesel | 75.00 | 0.20 | 0.60 |
| LPG | 64.00 | 1.50 | 1.00 |
| Hard Coal | 94.00 | 5.00 | 1.40 |
| Lignite and brown coal | 97.00 | 7.00 | 1.40 |
| Brown Coal Briquettes | 97.00 | 7.00 | 1.40 |
| Coke | 104.00 | 2.00 | 1.40 |
| Natural Gas | 55.40 | 1.50 | 0.10 |
| Fuel Wood | 100.00 [1)] | 2.00 | 4.00 |
| Wood Waste | 110.00 [1)] | 2.00 | 4.00 |
| Biogas | 112.00 [1)] | 1.50 | 1.00 |
| Industrial Waste | 104.17 [2)] | 12.00 | 1.40 |

1) *Reported as $CO_2$ emissions from biomass*

2) *According to IPCC guidelines non fossil $CO_2$ emissions of "other fuels" are not reported.*

**Activity data**

Fuel consumption is taken from (IEA JQ 2007) as presented in Annex 4.

**Recalculations**

Changes of activity data are based on a recalculation of the energy balance as described in Annex 2.

Recalculations mainly affect $CO_2$ emissions from natural gas 1995 (-20 Gg $CO_2$) and 1999 (+66 Gg $CO_2$) to 2005 (+54 Gg $CO_2$).

### 3.2.2.9 1.A.2.f Manufacturing Industries and Construction – Other

*Key Source: $CO_2$ from 1.A.2 gaseous, solid and liquid-stationary fuels*

Category *1.A.2.f Other* enfolds emissions from fuel combustion in industry which are not reported under categories *1.A.2.a, 1.A.2.b, 1.A.2.c, 1.A.2.d* and *1.A.2.e*. It also includes emissions from mobile sources (off road machinery) of total industry. For the stationary sources cement industry is considered separately.

The share in total GHG emissions from Sector *1.A* is 6.7% for the year 1990 and 7.2% for the year 2007. $N_2O$ emissions mainly arise from mobile machinery (1990: 68%; 2007: 59%).

***1.A.2.f Manufacturing Industries and Construction – Other – stationary sources***

In the following the methodology of estimating emissions from stationary sources of category *1.A.2.f Other* is described. The share in total GHG emissions from sector *1.A* is 6.2% for the year 1990 and 6% for the year 2007.

**1.A.2.f Manufacturing Industries and Construction – Cement Clinker Production (NACE 26.51)**

This category enfolds emissions from fuel combustion in cement clinker kilns. The yearly production capacity of the 9 Austrian plants is about 4.3 mio t cement clinker. Yearly clinker production is about 80% of total capacity. Further information about yearly clinker production is provided in the methodology chapter of category *2.A.1 cement production*.

**Methodology**

Information about $CO_2$ emissions due to fuel combustion for cement production is taken from four studies of the Austrian cement industry (HACKL & MAUSCHITZ, 1995, 1997, 2001, 2003, 2007) and (MAUSCHITZ 2004). The data presented in these studies include fuel consumption and emission data for emissions from combustion processes and from calcination processes (process specific emissions, see category *2 A 1*) separately. The studies cover the years 1988 to 2005.

For the studies mentioned above $CO_2$ emissions from all cement production plants in Austria were investigated. The determination of the emission data took place by inspection of every single plant, recording and evaluation of plant specific records and also plant specific measurements and analysis carried out by independent scientific institutes. Using this data (single measurement data or half-hourly mean values from continuous measurements) yearly mean values for concentration of $CO_2$ in the waste gas flow were calculated. With the average flow of dry waste gas the plant specific $CO_2$ emission mass stream and consequently the plant specific emission factors (normalized to ton clinker and/ or ton cement) were calculated.

$CO_2$ emissions 1990 to 2003

Emissions for the years 1990 to 2003 are taken from industry (HACKL & MAUSCHITZ, 1995, 1997, 2001, 2003, 2007) and (MAUSCHITZ 2004).

For solid, liquid and gaseous fuels $CO_2$ emissions are calculated by multiplying activity data by national default emission factors (for sources of emission factors see relating chapter). The remaining $CO_2$ emissions are allocated to industrial waste.

$CO_2$ emissions 2004 to 2007 are taken from the ETS allocation plan survey and ETS data.

$CH_4$ and $N_2O$ emissions

Are calculated with the simple CORINAIR methodology.

**Activity data**

Calculated thermal energy intake of cement kilns is between 3.46 GJ/t clinker in 1990 and 3.63 GJ/t clinker in 2007.

Hard Coal, Brown Coal, Petrol Coke and Industrial Waste

In (IEA JQ 2008) the category *Non-metallic Mineral Products* enfolds fuel consumption of NACE Division 26. As within this NACE division industrial branches other than cement industry do not use coal and industrial waste for fuel combustion, 100% of those fuels are allocated to the cement industry. The same is for for petrol coke until 2001 but from 2002 on a share is allocated to magnesia production from dolomite by using ETS data. It has to be noted that for industrial waste (IEA JQ 2008) calorific values between 22,06 GJ/t in 1990 and 20,21 GJ/t in 2007 are used which is different to (HACKL & MAUSCHITZ 1995, 1997, 2001, 2003, 2007) and (MAUSCHITZ 2004). By keeping activity data consistent with (IEA JQ 2008) this leads to slightly different implied emission factors than calculated from the above mentioned studies for *other fuels* – $CO_2$ between 1990 and 2004.

Natural Gas and Fuel Oil

For the period 1990 to 2004 natural gas and fuel oil consumption is taken from (HACKL & MAUSCHITZ 1995, 1997, 2001, 2003, 2007) and (MAUSCHITZ 2004) and converted into the unit TJ by applying the calorific values reported in (IEA JQ 2008).

Activity data 2005–2006

For the years 2005–2007 ETS data are taken.

### Emission factors

$CO_2$ and $CH_4$ emission factors are taken from studies (BMWA-EB 1990, 1996).

$N_2O$ emission factors are taken from a national study (BMUJF 1994).

### 1 A 2 f Manufacturing Industries and Construction – Other (NACE 17, 18, 19, 20, 25, 26.1, 26.2, 26.3 , 26.4, 26.6, 26.7, 26.8, 33, 34, 35, 36, 37, 45)

This category enfolds emissions due to fuel combustion of the industrial branches as specified in NACE 17, 18, 19, 20, 25, 26.1, 26.2, 26.3 , 26.4, 26.6, 26.7, 26.8, 33, 34, 35, 36, 37, 45.

### Methodology

The CORINAIR simple methodology is applied. For 2005 to 2007 ETS data is considered for glass, bricks & tiles and lime manufacturing plants.

### Activity data

Fuel consumption is taken from (IEA JQ 2008) as presented in Annex 4. Fuel consumption of cement industry is subtracted as it is considered separately (see above).

Since the energy balance (IEA JQ 2008) does not report gas works gas the activity data is taken from the "Austrian Energy Balance" provided by STATISTIK AUSTRIA which is in a different structure but consistent with (IEA JQ 2008).

### Emission factors

$CO_2$ and $CH_4$ emission factors are taken from studies (BMWA-EB 1990, 1996) and (UMWELTBUNDESAMT 2002). $N_2O$ emission factors are taken from a national study (BMUJF 1994).

The emission factors for 2007 are presented in Table 40.

*Table 40: Emission factors of Category 1.A.2.f stationary sources for 2007.*

| Fuel | $CO_2$ [t/TJ] | $CH_4$ [kg/TJ] | $N_2O$ [kg/TJ] |
|---|---|---|---|
| Hard Coal | 94.00 | 5.00 | 1.40 |
| Lignite and brown coal | 97.00 | 7.00 | 1.40 |
| Brown Coal Briquettes | 97.00 | 7.00 | 1.40 |
| Coke | 104.00 | 2.00 | 1.40 |
| Light Fuel Oil | 78.00 | 0.20 | 0.60 |
| Medium Fuel Oil | 78.00 | 2.00 | 1.00 |
| Heavy Fuel Oil | 78.00 | 2.00 | 1.00 |
| Gas oil | 75.00 | 1.20 | 1.00 |
| Diesel | 75.00 | 0.20 | 0.60 |
| Petroleum | 78.00 | 0.20 | 0.60 |
| LPG | 64.00 | 1.50 | 1.00 |
| Gas Works Gas | 64.00 | 0.20 | 1.00 |
| Petrol Coke | 100.88 | 0.00 | 0.00 |

| Fuel | $CO_2$ [t/TJ] | $CH_4$ [kg/TJ] | $N_2O$ [kg/TJ] |
|---|---|---|---|
| Natural Gas | 55.40 | 1.50 | 0.10 |
| Fuel Wood | 100.00[1)] | 2.00 | 4.00 |
| Wood Waste | 110.00[1)] | 2.00 | 4.00 |
| Black Liquor | 110.00[1)] | 2.00 | 1.40 |
| Biogas | 112.00[1)] | 1.50 | 1.00 |
| Sewage Sludge Gas | 112.00[1)] | 1.50 | 1.00 |
| Landfill Gas | 112.00[1)] | 1.50 | 1.00 |
| Industrial Waste –unspecified | 104.17[2)] | 12.00 | 1.40 |
| Industrial Waste – Cement industry | 64.41[3)] | 12.00 | 1.40 |

1) *Reported as $CO_2$ emissions from biomass*

2) *According to IPCC guidelines non fossil $CO_2$ emissions of "other fuels" are not reported.*

3) *Implied emission factor as cited in chapter methodology, see Page 100*

**Recalculations**

Changes of activity data are based on energy balance recalculation as described in Annex 2.

Recalculations mainly affect $CO_2$ emissions from natural gas 2000 (-131 Gg $CO_2$) to 2005 (+17 Gg $CO_2$) and $CO_2$ emissions from liquid fuels 2005 (+55 Gg $CO_2$) and 2006 (+100 Gg $CO_2$).

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

In the following the methodology of estimating emissions from mobile sources of category *1 A 2 f Other* is described. The share in total GHG emissions from sector *1 A* is 0.5% for the year 1990 and 1.2% for the year 2007. All GHGs emissions originate from liquid fossil fuel combustion.

*Table 41: Greenhouse gas emissions from Category 1 A 2 f mobile sources.*

| | $CO_2$ [Gg] | $CH_4$ [Gg] | $N_2O$ [Gg] | Gg $CO_2$ equivalent |
|---|---|---|---|---|
| 1990 | 257 | 0.01 | 0.09 | 286 |
| 1991 | 291 | 0.02 | 0.10 | 323 |
| 1992 | 308 | 0.02 | 0.11 | 342 |
| 1993 | 324 | 0.02 | 0.11 | 360 |
| 1994 | 338 | 0.02 | 0.12 | 376 |
| 1995 | 358 | 0.02 | 0.13 | 399 |
| 1996 | 445 | 0.02 | 0.17 | 499 |
| 1997 | 421 | 0.02 | 0.16 | 472 |
| 1998 | 490 | 0.02 | 0.19 | 550 |
| 1999 | 477 | 0.02 | 0.19 | 536 |
| 2000 | 566 | 0.02 | 0.23 | 638 |
| 2001 | 547 | 0.02 | 0.22 | 616 |
| 2002 | 550 | 0.02 | 0.22 | 617 |
| 2003 | 609 | 0.02 | 0.22 | 677 |
| 2004 | 654 | 0.02 | 0.21 | 719 |
| 2005 | 619 | 0.02 | 0.21 | 683 |
| 2006 | 693 | 0.02 | 0.18 | 750 |
| 2007 | 715 | 0.02 | 0.17 | 769 |
| *Trend 1990-2007* | 178.0% | 47.1% | 91.5% | 169.4% |

Combustion of liquid fossil fuels is the only mobile source of $CO_2$ emissions from category *1 A 2 f*.

**Methodology**

Energy consumption and emissions of off-road traffic in Austria are calculated with the model GEORG (Grazer Emissionsmodell für Off Road Geräte). This model has been developed within a study about off road emissions in Austria (PISCHINGER 2000). The study was prepared to improve the poor data quality in this sector. The following categories were taken into account:

- 1 A 2 f Industry
- 1 A 3 c Railways
- 1 A 3 d Navigation
- 1 A 4 b Household and Gardening
- 1 A 4 c Agriculture and Forestry
- 1 A 5 Military Activities

Input data to the model are:

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

From machinery stock data and drop out rates an age structure of the off road machinery was obtained by GEORG. Four categories of engine types were considered. Depending on the fuel consumption of the engine the ratio power of the engine was calculated.

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

With this method national total fuel consumption and total emissions are calculated with a bottom-up method. 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%. To be consistent with the national energy balance, activity data in the bottom-up approaches for both road transport and off-road transport is adjusted so that finally the calculated total fuel consumption equals the figure of fuel sold in the national energy balance.

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

### Emission factors

Emission factors were defined for four categories of engine type (average motor capacity) depending on the year of construction. Implied emission factors expressed in t/TJ or kg,/TJ respectively, are listed in Table 42 to Table 45. These implied emission factors represent emissions according to the engine power output and also fuel consumption.

*Table 42: Implied emission factors for diesel engines > 80 kW.*

| Year | $CO_2$ [t/TJ] | $CH_4$ [kg/TJ] | $N_2O$ |
|---|---|---|---|
| 1993 | 243.08 | 10.77 | 87.79 |
| 2001 | 230.55 | 8.08 | 97.24 |
| 2003 | 226.07 | 2.09 | 62.13 |
| 2006 | 235.21 | 3.43 | 33.35 |

*Table 43: Implied emission factors for diesel engines < 80 kW.*

| Year | $CO_2$ [t/TJ] | $CH_4$ [kg/TJ] | $N_2O$ |
|---|---|---|---|
| 1993 | 249.62 | 12.93 | 87.79 |
| 2001 | 235.11 | 9.87 | 97.24 |
| 2003 | 240.24 | 8.05 | 62.13 |
| 2006 | 240.24 | 4.46 | 33.35 |

*Table 44: Implied emission factors for 4-stroke-petrol engines.*

| Year | $CO_2$ [t/TJ] | $CH_4$ [kg/TJ] | $N_2O$ |
|---|---|---|---|
| 1993 | 491.43 | 222.93 | 10.42 |
| 2001 | 472.95 | 178.40 | 11.46 |
| 2003 | 411.12 | 170.40 | 11.46 |
| 2006 | 411.12 | 164.53 | 11.46 |

*Table 45: Implied emission factors for 2-stroke-petrol engines.*

| Year | $CO_2$ [t/TJ] | $CH_4$ [kg/TJ] | $N_2O$ [kg/TJ] |
|---|---|---|---|
| 1993 | 647.24 | 695.28 | 4.11 |
| 2001 | 588.25 | 489.03 | 4.11 |
| 2003 | 572.05 | 461.94 | 4.11 |
| 2006 | 437.92 | 141.67 | 3.89 |

**Activity data**

Activity data, vehicle stock and specific fuel consumption for vehicles and machinery (e.g. leader, digger, …) were taken from:

- Statistik Austria (fuel statistics)
- Questionnaire to vehicle and machinery user
- Information from vehicle and machinery manufacturer
- Interviews with experts
- Expert judgment

Activities used for estimating emissions of *1 A 2 f* as well as the implied emission factors (national total emissions divided by total fuel consumption in TJ) are presented in the following table.

*Table 46: Implied emission factors and activities for industrial off-road traffic 1990–2007.*

| | Activity | Implied Emission Factors | | |
|---|---|---|---|---|
| | TJ | $CO_2$ t/TJ | $CH_4$ kg/TJ | $N_2O$ kg/TJ |
| 1990 | 3 475 | 74.04 | 3.92 | 26.08 |
| 1991 | 3 927 | 74.04 | 3.90 | 26.11 |
| 1992 | 4 159 | 74.04 | 3.89 | 26.13 |
| 1993 | 4 375 | 74.02 | 3.89 | 26.13 |
| 1994 | 4 564 | 74.02 | 3.71 | 26.95 |
| 1995 | 4 846 | 73.85 | 3.62 | 27.42 |
| 1996 | 6 026 | 73.85 | 3.42 | 28.58 |
| 1997 | 5 707 | 73.85 | 3.45 | 28.43 |
| 1998 | 6 631 | 73.85 | 3.31 | 29.27 |
| 1999 | 6 475 | 73.68 | 3.29 | 29.32 |
| 2000 | 7 686 | 73.68 | 3.20 | 29.78 |
| 2001 | 7 426 | 73.68 | 3.20 | 29.81 |
| 2002 | 7 463 | 73.68 | 3.00 | 28.84 |
| 2003 | 8 261 | 73.68 | 2.58 | 26.45 |
| 2004 | 8 882 | 73.68 | 2.45 | 23.28 |
| 2005 | 8 524 | 72.61 | 2.45 | 24.22 |
| 2006 | 9 943 | 69.67 | 2.06 | 18.47 |
| 2007 | 10 332 | 69.23 | 1.94 | 16.79 |

**Recalculations**

Updated energy data for all off road sectors according to the energy statistic for the years 1990-2007.

### 3.2.2.10 1.A.3.a Civil Aviation

*Key Source: $CO_2$*

Greenhouse gas emissions from aviation are low in comparison to emissions from the transport sector but show a strong increase from 1990 to 2007. However, the trend for the different GHGs varies due to different methodologies of emission estimation.

The category *1 A 3 a Civil Aviation* contains flights according to Visual Flight Rules (VFR) and Instrument Flight Rules (IFR) for national LTO (landing/take off) and national cruise. International LTO and international cruise is considered in *I B Av International Bunkers Aviation*. Military Aviation is allocated in *1 A 5 Other.* For VFR only $CO_2$ emissions were considered.

*Table 47: $CO_2$ and $N_2O$ emissions from 1 A 3 a Civil Aviation by subcategories 1990–2007.*

| Year | $CO_2$ | | | $N_2O$ | | Activity | | |
|---|---|---|---|---|---|---|---|---|
| | dom. LTO | dom. LTO | dom. cruise | dom. LTO | dom. cruise | dom. LTO | dom. LTO | dom. cruise |
| | Kerosene [Gg] | Gasoline [Gg] | Kerosene [Gg] | Kerosene [Gg] | Kerosene [Gg] | Kerosene [TJ] | Gasoline [TJ] | Kerosene [TJ] |
| 1990 | 10.0 | 7.8 | 14.2 | 0.0006 | 0.0005 | 138 | 103 | 197 |
| 1991 | 10.8 | 8.1 | 18.7 | 0.0007 | 0.0006 | 149 | 107 | 259 |
| 1992 | 11.6 | 8.3 | 23.2 | 0.0007 | 0.0007 | 160 | 110 | 321 |
| 1993 | 12.4 | 8.6 | 27.6 | 0.0008 | 0.0009 | 171 | 116 | 382 |
| 1994 | 13.2 | 8.8 | 32.1 | 0.0008 | 0.0010 | 182 | 119 | 444 |
| 1995 | 14.0 | 7.1 | 36.6 | 0.0009 | 0.0012 | 192 | 95 | 503 |
| 1996 | 16.2 | 6.8 | 40.6 | 0.0010 | 0.0013 | 222 | 92 | 559 |
| 1997 | 18.4 | 7.6 | 44.5 | 0.0011 | 0.0014 | 253 | 103 | 614 |
| 1998 | 20.6 | 8.2 | 48.5 | 0.0012 | 0.0015 | 283 | 111 | 668 |
| 1999 | 21.1 | 8.7 | 51.3 | 0.0012 | 0.0016 | 290 | 118 | 705 |
| 2000 | 19.3 | 6.4 | 41.6 | 0.0023 | 0.0013 | 265 | 87 | 571 |
| 2001 | 15.8 | 5.9 | 38.4 | 0.0020 | 0.0012 | 217 | 79 | 527 |
| 2002 | 16.4 | 7.5 | 38.2 | 0.0021 | 0.0012 | 226 | 102 | 525 |
| 2003 | 16.1 | 8.2 | 38.3 | 0.0020 | 0.0012 | 221 | 110 | 526 |
| 2004 | 17.2 | 7.6 | 39.5 | 0.0020 | 0.0013 | 237 | 102 | 543 |
| 2005 | 16.4 | 8.8 | 41.6 | 0.0020 | 0.0013 | 225 | 118 | 571 |
| 2006 | 19.6 | 9.0 | 43.2 | 0.0021 | 0.0014 | 269 | 124 | 593 |
| 2007 | 20.0 | 9.0 | 44.7 | 0.0021 | 0.0014 | 274 | 123 | 614 |

### Methodological Issues

### IFR

For the years 1990–1999 a country-specific methodology was applied. The calculations are based on a study commissioned by the Umweltbundesamt finished in 2002 (KALIVODA et al. 2002). This methodology is consistent with the very detailed CORINAIR Tier 3b methodology (advanced version based on (MEET 1999)): air traffic movement data[22] (flight distance and destination per aircraft type) and aircraft/ engine performances data were used for the calculation.

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

### VFR

CORINAIR, simple methodology was applied

### Activity Data

IVR flights

For the years 1990 – 1999 fuel consumptions for the different transport modes IFR national LTO, IFR international LTO, IFR national cruise and IFR international cruise as obtained from the MEET model were summed up to a total fuel consumption figure. This value was compared with the total amount of kerosene sold in Austria of the national energy balance. As fuel sold is a robust value, the fuel consumption of IFR international cruise was adjusted so that the total fuel consumption of the calculations according to the MEET model is consistent with national fuel sales figures from the energy balance. The reason for choosing IFR international cruise for this adjustment is that this mode is assumed to have the highest uncertainty.

For the years 2000 – 2007 fuel consumption for the different transport modes IFR national LTO, IFR international LTO, IFR national cruise and IFR international cruise was calculated according to the CORINAIR Tier 3a method, with average consumption data per aircraft typs and flight distances. The fuel consumption of IFR international cruise was adjusted as explained above. The number of flight movements per aircraft type were obtained from Statistik Austria (statistics of civil aviation "Statistik der Zivilluftfahrt"). The total amount of jet kerosene was also obtained from Statistik Austria (energy balance).

VFR flights

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.

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

*Table 48: Number of national IFR LTO cycles and fuel consumptions as obtained from the MEET model 1990–2007.*

| | Activity | | | national |
|---|---|---|---|---|
| | **nat. LTO Kerosene [Mg]** | **VFR Gasoline [Mg]** | **nat. cruise Kerosene [Mg]** | **LTO IFR [no.]** |
| 1990 | 3 164 | 2 487 | 4 508 | 6 220 |
| 1991 | 3 417 | 2 563 | 5 929 | 6 644 |
| 1992 | 3 670 | 2 641 | 7 351 | 7 450 |
| 1993 | 3 924 | 2 722 | 8 773 | 7 947 |
| 1994 | 4 177 | 2 805 | 10 195 | 8 219 |
| 1995 | 4 430 | 2 241 | 11 616 | 8 923 |
| 1996 | 5 128 | 2 153 | 12 877 | 10 233 |
| 1997 | 5 827 | 2 417 | 14 137 | 11 013 |
| 1998 | 6 525 | 2 602 | 15 398 | 12 025 |
| 1999 | 6 697 | 2 771 | 16 279 | 12 210 |
| 2000 | 6 109 | 2 039 | 13 178 | 22 611 |
| 2001 | 5 010 | 1 868 | 12 167 | 20 325 |
| 2002 | 5 214 | 2 389 | 12 130 | 21 422 |
| 2003 | 5 096 | 2 596 | 12 155 | 20 243 |
| 2004 | 5 470 | 2 405 | 12 537 | 20 175 |
| 2005 | 5 205 | 2 787 | 13 192 | 20 179 |
| 2006 | 6 202 | 2 868 | 13 697 | 20 727 |
| 2007 | 6 334 | 2 856 | 14 189 | 20 740 |
| *Trend 1990-2007* | 100% | 15% | 215% | 233% |

### Emissionsfactors

#### $CO_2$

*IFR / VFR*

$CO_2$ emissions covered in this sub-category were calculated separately for VFR-flights and IFR-flights, for national LTO and national cruise.

For calculation of $CO_2$ emissions an emission factor of 3 150 kg $CO_2$/ Mg fuel has been used for IFR and VFR flights (CORINAIR, KALIVODA et al. 2002,).

#### $N_2O$

*IFR*

The applied emission factors for national/international cruise and national/international LTO were taken from the CORINAIR Guidebook, they are based on LTO cycles and fuel used for cruise (0.1 kg $N_2O$/LTO for LTO and 0.1 kg $N_2O$/Mg fuel for cruise).

*VFR*

For $N_2O$ emissions VFR flights are not considered as the applied emission factors only refers to an "average international fleet with large aircraft" which is not true for this sub-category.

**$CH_4$**

*National/international cruise*

Following the simple methodology of the CORINAIR Guidebook, $CH_4$ emissions for national and international cruise are assumed to be Zero. Furthermore, for calculating $CH_4$ emissions VFR aviation was not considered.

*National/international LTO*

Emission factor follows the CORINAIR Guidebook (10% of total VOC emissions, simple methodology).

**Recalculations**

Update of national/international fuel consumption data, resulting in a recalculation of $CO_2$, $CH_4$ and $N_2O$ emissions from 2000 to 2007 according to the bottom up CORINAIR Tier 3a method.

**Planned improvements**

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

Update of activity data from military flights, see chapter Military Aviation.

### 3.2.2.11 1.A.3.b Road Transport

*Key Source: Yes ($CO_2$: diesel/gasoline)*

Emissions from road transportation are covered in this category.

*Table 49: Greenhouse gas emissions from Category 1 A3 b Road Transport.*

| | $CO_2$ [Gg] | $CH_4$ [Gg] | $N_2O$ [Gg] | Gg $CO_2$ equivalent |
|---|---|---|---|---|
| 1990 | 13 286 | 3.07 | 0.57 | 13 528 |
| 1991 | 14 741 | 3.36 | 0.70 | 15 028 |
| 1992 | 14 716 | 3.36 | 0.72 | 15 010 |
| 1993 | 14 853 | 3.36 | 0.75 | 15 156 |
| 1994 | 14 892 | 3.20 | 0.78 | 15 202 |
| 1995 | 15 160 | 2.98 | 0.79 | 15 469 |
| 1996 | 16 711 | 2.70 | 0.82 | 17 021 |
| 1997 | 15 730 | 2.42 | 0.80 | 16 030 |
| 1998 | 17 705 | 2.33 | 0.91 | 18 035 |
| 1999 | 17 047 | 2.05 | 0.88 | 17 362 |
| 2000 | 17 938 | 1.86 | 0.89 | 18 254 |

| | $CO_2$ [Gg] | $CH_4$ [Gg] | $N_2O$ [Gg] | Gg $CO_2$ equivalent |
|---|---|---|---|---|
| 2001 | 19 259 | 1.73 | 0.92 | 19 582 |
| 2002 | 21 342 | 1.66 | 1.01 | 21 689 |
| 2003 | 23 080 | 1.55 | 1.04 | 23 435 |
| 2004 | 23 629 | 1.38 | 1.02 | 23 974 |
| 2005 | 24 145 | 1.24 | 0.98 | 24 476 |
| 2006 | 22 899 | 1.08 | 0.91 | 23 204 |
| 2007 | 23 167 | 0.96 | 0.86 | 23 455 |
| *Trend 1990-2007* | *74%* | *-69%* | *51%* | *73%* |

*Table 50: GHG emissions from Road Transport, differentiated by means of transportation.*

| | Passenger cars | | light duty vehicles | heavy duty vehicles | moped | motorcycle |
|---|---|---|---|---|---|---|
| | petrol | diesel | | | | |
| | [Gg $CO_2$e] | [Gg $CO_2$e] | [Gg $CO_2$e] | [Gg $CO_2$e] | [Gg $CO_2$e] | [Gg $CO_2$e] |
| 1990 | 7 447.5 | 1 457.47 | 1 309.28 | 3 248.52 | 30.79 | 34.34 |
| 1991 | 8 281.6 | 1 678.48 | 1 352.63 | 3 650.25 | 28.71 | 36.63 |
| 1992 | 7 936.4 | 1 795.19 | 1 394.88 | 3 816.09 | 27.25 | 40.75 |
| 1993 | 7 633.1 | 1 941.23 | 1 417.22 | 4 094.09 | 25.81 | 45.07 |
| 1994 | 7 372.1 | 2 200.60 | 1 472.07 | 4 081.79 | 24.71 | 50.41 |
| 1995 | 7 138.4 | 2 430.50 | 1 493.09 | 4 325.83 | 23.74 | 57.18 |
| 1996 | 6 594.1 | 2 702.13 | 1 510.60 | 6 128.01 | 22.94 | 63.47 |
| 1997 | 6 248.4 | 2 974.45 | 1 545.51 | 5 169.42 | 22.20 | 69.68 |
| 1998 | 6 589.5 | 3 442.09 | 1 589.40 | 6 314.67 | 21.69 | 77.87 |
| 1999 | 6 113.9 | 3 659.32 | 1 640.35 | 5 841.50 | 21.06 | 86.23 |
| 2000 | 5 914.1 | 4 019.36 | 1 688.43 | 6 520.32 | 20.28 | 91.11 |
| 2001 | 5 981.7 | 4 519.44 | 1 700.71 | 7 264.73 | 19.61 | 95.64 |
| 2002 | 6 490.1 | 5 348.65 | 1 696.98 | 8 034.18 | 18.90 | 100.42 |
| 2003 | 6 659.1 | 6 045.16 | 1 715.51 | 8 892.73 | 18.41 | 104.18 |
| 2004 | 6 478.4 | 6 532.23 | 1 740.83 | 9 097.55 | 17.83 | 107.06 |
| 2005 | 6 263.9 | 6 803.16 | 1 787.08 | 9 494.14 | 17.67 | 109.98 |
| 2006 | 6 008.2 | 6 778.27 | 1 808.09 | 8 482.84 | 16.82 | 111.20 |
| 2007 | 5 863.5 | 7 040.57 | 1 864.33 | 8 555.64 | 16.67 | 114.77 |
| *Trend 1990-2007* | *-21%* | *383%* | *42%* | *163%* | *-46%* | *234%* |

In 2007 more than a third of the greenhouse gas emissions of the road sector are caused by heavy duty vehicles. In comparison with the emissions of 1990 the emissions of diesel cars and heavy duty vehicles nearly quadrupled.

### Methodology

Mobile combustion is differentiated into the categories *Passenger Cars*, *Light Duty Vehicles*, *Heavy Duty Vehicles* and *Buses, Mopeds and Motorcycles*.

In order to apply the CORINAIR methodology a split of the fuel consumption of different vehicle categories is needed. Calculations of emissions from *Mobile Combustion* are based on the GLOBEMI model (HAUSBERGER 1998).

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

Model input is:

1) the vehicle stock of each category split into layers according to the propulsion system (SI,CI, ...), cylinder capacity classes or vehicle mass
2) the emission factors of the vehicles according to the year of first registration and the layers from 1)
3) The passengers per vehicle and tons payload per vehicle
4) Optional either
   - the total gasoline and diesel consumption of the area under consideration
   - the average km per vehicle and year

Following data is calculated:

a) km driven per vehicle and year or total fuel consumption
b) total vehicle mileages
c) total passenger-km and ton-km
d) specific emission values for the vehicle fleets [g/km], [g/t-km], [g/pass-km]
e) total emissions and energy consumption of the traffic (fc, CO, HC, $NO_x$, particulate matter, $CO_2$, $SO_2$ and several unregulated pollutants among them $CH_4$ and $N_2O$)

Figure 13 shows a schematic picture of GLOBEMI.

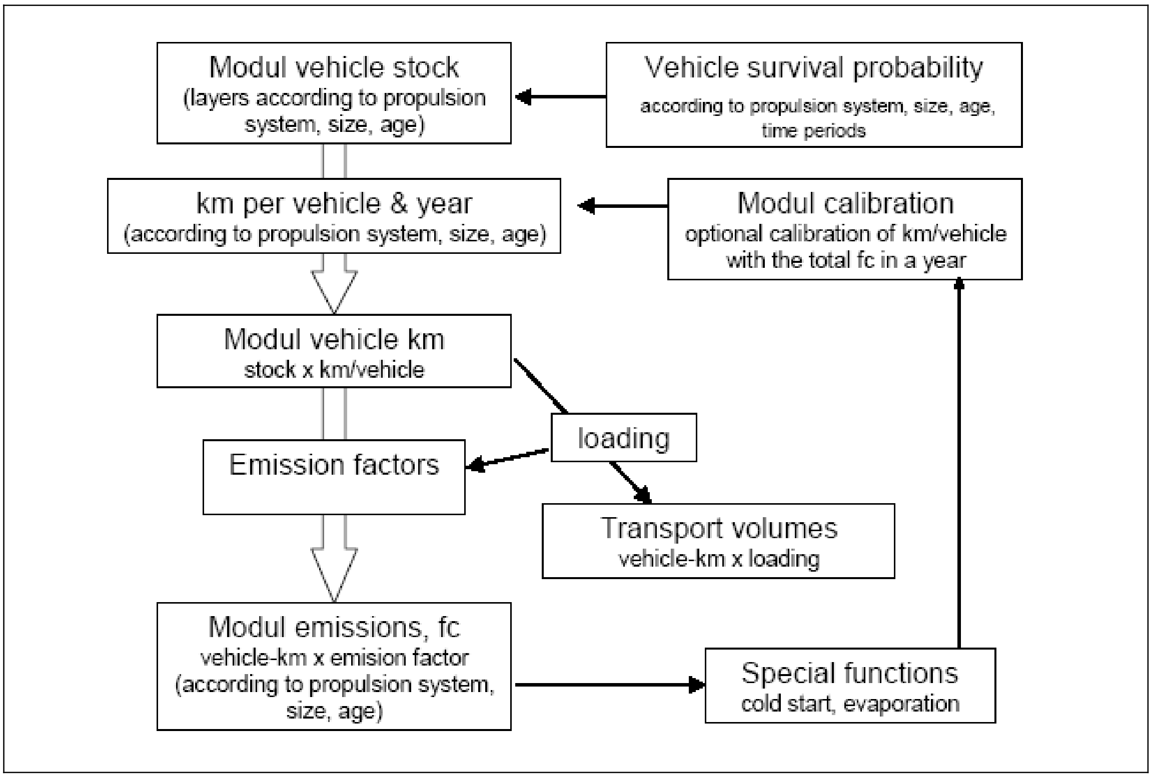


*Figure 13: Schematic picture of the model GLOBEMI.*

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

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

$$stock_{Jg_i,yeari} = stock_{Jg_i,yeari-1} \times \text{survival probability}_{Jg_i}$$

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

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

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

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

$$\text{Emission}_{E_i} = \text{total mileage}_{E_i} \times \text{emission factor}_{K_j,E_i}$$

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

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

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

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

7) Summation over all vehicle categories

*with $Jg_i$...... Index for a vehicle layer (defined size class, propulsion type, year of first registration)*

*$E_i$........ Index for vehicles within a emission category (defined size class, propulsion type and exhaust certification level)*

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

**Emission factors**

Implied emission factors for the different means of road transportation are listed in the following tables. The IEFs change over time due to new technologies.

*Table 51: Implied emission factors of passenger cars 1990–2007.*

| | Activity | Implied Emission Factors | | |
|---|---|---|---|---|
| | | $CO_2$ | $CH_4$ | $N_2O$ |
| | TJ | T/TJ | kg/TJ | kg/TJ |
| 1990 | 115 164 | 75.64 | 19.37 | 4.10 |
| 1991 | 128 576 | 75.63 | 19.92 | 4.58 |
| 1992 | 125 512 | 75.60 | 20.75 | 4.85 |
| 1993 | 125 526 | 74.28 | 21.04 | 5.01 |
| 1994 | 125 433 | 74.26 | 20.08 | 5.27 |
| 1995 | 125 462 | 74.22 | 18.66 | 5.35 |
| 1996 | 121 943 | 74.20 | 16.95 | 5.43 |
| 1997 | 121 108 | 74.13 | 15.30 | 5.49 |
| 1998 | 131 709 | 74.12 | 13.55 | 5.69 |
| 1999 | 128 515 | 74.03 | 11.99 | 5.68 |
| 2000 | 130 747 | 74.01 | 10.53 | 5.61 |
| 2001 | 138 413 | 73.98 | 9.13 | 5.47 |
| 2002 | 156 171 | 73.99 | 7.77 | 5.32 |
| 2003 | 167 813 | 73.98 | 6.64 | 5.12 |
| 2004 | 172 123 | 73.96 | 5.66 | 4.86 |
| 2005 | 174 543 | 73.35 | 4.80 | 4.55 |
| 2006 | 176 287 | 71.15 | 4.00 | 4.16 |
| 2007 | 179 671 | 70.54 | 3.40 | 3.89 |

The catalytic converter of former generation (EURO 1) had a higher $N_2O$-niveau than the catalysts of the newer generation (as of EURO 2). Therefore, since 1996 (implementation of EURO 2) the implied emission factor of $N_2O$ is decreasing steadily.

The decrease of the IEF for $CH_4$ is also due to the increasing share of vehicles with catalytic converters and improved combustion technologies.

*Table 52: Implied emission factors of light duty vehicles 1990–2007.*

| | Activity | Implied Emission Factors | | |
|---|---|---|---|---|
| | | $CO_2$ | $CH_4$ | $N_2O$ |
| | TJ | T/TJ | kg/TJ | kg/TJ |
| 1990 | 17 306 | 74.80 | 14.04 | 1.80 |
| 1991 | 17 897 | 74.73 | 13.01 | 1.84 |
| 1992 | 18 473 | 74.67 | 12.04 | 1.90 |
| 1993 | 18 908 | 74.12 | 11.19 | 1.94 |
| 1994 | 19 651 | 74.11 | 9.93 | 1.93 |
| 1995 | 19 975 | 73.97 | 8.75 | 1.91 |
| 1996 | 20 221 | 73.96 | 7.74 | 1.88 |
| 1997 | 20 705 | 73.93 | 6.72 | 1.84 |
| 1998 | 21 305 | 73.92 | 5.80 | 1.80 |
| 1999 | 22 042 | 73.77 | 4.95 | 1.76 |
| 2000 | 22 700 | 73.76 | 4.24 | 1.71 |
| 2001 | 22 877 | 73.75 | 3.66 | 1.68 |
| 2002 | 22 835 | 73.74 | 3.17 | 1.63 |
| 2003 | 23 093 | 73.73 | 2.69 | 1.60 |
| 2004 | 23 444 | 73.73 | 2.25 | 1.56 |
| 2005 | 24 395 | 72.74 | 2.02 | 1.54 |
| 2006 | 25 678 | 69.90 | 1.76 | 1.54 |
| 2007 | 26 679 | 69.41 | 1.38 | 1.42 |

*Table 53: Implied emission factors of heavy duty vehicles 1990–2007.*

| | | $CO_2$ | $CH_4$ | $N_2O$ |
|---|---|---|---|---|
| | TJ | T/TJ | kg/TJ | kg/TJ |
| 1990 | 43 544 | 74.07 | 2.20 | 1.59 |
| 1991 | 48 937 | 74.06 | 2.07 | 1.57 |
| 1992 | 51 169 | 74.06 | 1.97 | 1.55 |
| 1993 | 54 928 | 74.02 | 1.88 | 1.53 |
| 1994 | 54 774 | 74.02 | 1.83 | 1.49 |
| 1995 | 58 195 | 73.85 | 1.77 | 1.44 |
| 1996 | 82 454 | 73.85 | 1.58 | 1.42 |
| 1997 | 69 565 | 73.85 | 1.53 | 1.40 |
| 1998 | 84 988 | 73.84 | 1.38 | 1.38 |
| 1999 | 78 809 | 73.67 | 1.31 | 1.36 |
| 2000 | 87 975 | 73.67 | 1.23 | 1.35 |
| 2001 | 98 039 | 73.67 | 1.16 | 1.31 |
| 2002 | 108 448 | 73.67 | 1.10 | 1.26 |
| 2003 | 120 062 | 73.67 | 1.06 | 1.21 |
| 2004 | 122 847 | 73.67 | 1.04 | 1.18 |
| 2005 | 130 113 | 72.59 | 1.01 | 1.15 |
| 2006 | 121 186 | 69.63 | 1.01 | 1.11 |
| 2007 | 123 038 | 69.20 | 0.97 | 1.03 |

*Table 54: Implied emission factors of mopeds 1990–2007.*

| | | $CO_2$ | $CH_4$ | $N_2O$ |
|---|---|---|---|---|
| | TJ | T/TJ | kg/TJ | kg/TJ |
| 1990 | 271 | 75.98 | 1 791 | 0.37 |
| 1991 | 253 | 75.97 | 1 774 | 0.39 |
| 1992 | 243 | 75.97 | 1 717 | 0.41 |
| 1993 | 237 | 74.35 | 1 635 | 0.42 |
| 1994 | 230 | 74.34 | 1 571 | 0.43 |
| 1995 | 224 | 74.35 | 1 510 | 0.45 |
| 1996 | 219 | 74.35 | 1 444 | 0.46 |
| 1997 | 215 | 74.27 | 1 381 | 0.47 |
| 1998 | 213 | 74.27 | 1 308 | 0.47 |
| 1999 | 210 | 74.26 | 1 249 | - |
| 2000 | 204 | 74.26 | 1 207 | - |
| 2001 | 199 | 74.22 | 1 159 | - |
| 2002 | 193 | 74.27 | 1 120 | - |
| 2003 | 190 | 74.27 | 1 069 | - |
| 2004 | 186 | 74.27 | 1 025 | - |
| 2005 | 187 | 74.21 | 957 | - |
| 2006 | 182 | 72.97 | 917 | - |
| 2007 | 185 | 72.26 | 848 | - |

*Table 55: Implied emission factors of motorcycles 1990–2007.*

| | | $CO_2$ | $CH_4$ | $N_2O$ |
|---|---|---|---|---|
| | TJ | T/TJ | kg/TJ | kg/TJ |
| 1990 | 446 | 75.98 | 32.2 | 0.930 |
| 1991 | 476 | 75.97 | 32.1 | 0.865 |
| 1992 | 530 | 75.97 | 32.0 | 0.777 |
| 1993 | 599 | 74.35 | 31.0 | 0.860 |
| 1994 | 670 | 74.34 | 30.8 | 0.914 |
| 1995 | 760 | 74.35 | 30.5 | 0.805 |
| 1996 | 844 | 74.35 | 30.1 | 0.840 |
| 1997 | 927 | 74.27 | 29.8 | 0.876 |
| 1998 | 1 036 | 74.27 | 29.5 | 0.877 |
| 1999 | 1 148 | 74.26 | 29.2 | 0.882 |
| 2000 | 1 213 | 74.26 | 28.6 | 0.829 |
| 2001 | 1 274 | 74.22 | 28.1 | 0.871 |
| 2002 | 1 337 | 74.27 | 27.6 | 0.904 |
| 2003 | 1 387 | 74.27 | 27.0 | 0.869 |
| 2004 | 1 426 | 74.27 | 26.4 | 0.848 |
| 2005 | 1 466 | 74.21 | 25.8 | 0.893 |
| 2006 | 1 508 | 72.97 | 24.9 | 0.868 |
| 2007 | 1 571 | 72.26 | 24.7 | 0.827 |

**Activity data**

Energy consumption and emissions of the different vehicle categories are calculated by multiplying the yearly road performance per vehicle category (km/vehicle and year) by the specific energy use (g/km) and by the emission factors in g/km (Model: GLOBEMI).

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

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

VMOe is a network-based. multi-modal transport model covering passenger and freight transport. Transport volumes for road are based on official background statistics relevant for travel and freight transport demand. These statistics include traffic counting information as well as average vehicle road performance (supplied by the Austrian automobile clubs throughout the annual vehicle inspection system), population data, motorisation rates, vehicle fleet sizes, economic and income development statistics. VMOe covers traffic movements between "transport zones" (the Austrian communities) and estimates the traffic generated by movements within the zones. This covers the total traffic within Austria driven by Austrian and foreign vehicles. The resulting mileages per vehicle categorie are implemented in GLOBEMI to calculate the total fuel consumption.

GLOBEMI also models the road performance and emissions per vehicle size, age and motor type based on dynamic vehicle specific drop out- and road performance functions.

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.

Based on the results of investigations on biodiesel in the transport sector in Austria (UMWELTBUNDESAMT 2008a), for the year 2007 a consumption of 370 000 t biodiesel, 20 400 t bioethanol is used as input data for the calculation model.

**Uncertainties**

Uncertainty estimates are based on (WINIWARTER & RYPDAL 2001):

- The uncertainty of activity data (total fuel sold) for road transport is considered to be low (3%), and also the uncertainty of $CO_2$ emission factors is estimated to be 3%.
- $N_2O$ emission factors are determined in vehicle emission tests, mostly carried out on test benches. Therefore emission factors are prone to uncertainties for the following reasons:
  - test driving cycles cannot fully reflect real driving behaviour
  - uncertainties of test equipment and emission measurement equipment
  - emission factor varies over time because of chemical characteristics of the fuels
  - the influence of aging and maintenance of the vehicle stock

Due to these reasons the uncertainty for the $N_2O$ emission factor is relatively high; it is estimated to be -70 and +170% (lognorm) for gasoline and ±30% (norm) for diesel.

### Recalculation

Activity data for the years 1990-2007 was recalculated based on VMOe (Verkehrs-Mengenmodell-Oesterreich – Austrian National Transport Model. Ministry of Transport, BMVIT, unpublished).

#### 3.2.2.12 1.A.3.c Railways

*Key Source: No*

In this category emissions from diesel railcars and steam engines are considered.

*Table 56: Greenhouse gas emissions from Category 1 A 3 c Railways.*

| | $CO_2$ [Gg] | $CH_4$ [Gg] | $N_2O$ [Gg} |
|---|---|---|---|
| 1990 | 174 | 0.01 | 0.02 |
| 1991 | 180 | 0.01 | 0.02 |
| 1992 | 180 | 0.01 | 0.02 |
| 1993 | 175 | 0.01 | 0.02 |
| 1994 | 177 | 0.01 | 0.02 |
| 1995 | 165 | 0.01 | 0.02 |
| 1996 | 149 | 0.01 | 0.02 |
| 1997 | 148 | 0.01 | 0.02 |
| 1998 | 146 | 0.01 | 0.02 |
| 1999 | 180 | 0.01 | 0.02 |
| 2000 | 179 | 0.01 | 0.02 |
| 2001 | 177 | 0.01 | 0.02 |
| 2002 | 173 | 0.01 | 0.02 |
| 2003 | 169 | 0.01 | 0.02 |
| 2004 | 142 | 0.01 | 0.02 |
| 2005 | 162 | 0.00 | 0.02 |
| 2006 | 164 | 0.00 | 0.02 |
| 2007 | 163 | 0.00 | 0.01 |
| *Trend 1990-2007* | -6,1% | -43,8% | -31,2% |

The applied methodology is described in the subchapter on mobile sources of *1 A 2 f* (see Chapter 3.2.2.9 1.A.2.f Manufacturing Industries and Construction – Other). Activities used for estimating the emissions and the implied emission factors are presented in the following table.

*Table 57: Emission factors and activity data for railway 1990–2007.*

| | Activity | Implied Emission Factors | | |
|---|---|---|---|---|
| | | $CO_2$ | $CH_4$ | $N_2O$ |
| | TJ | T/TJ | kg/TJ | kg/TJ |
| 1990 | 2 330 | 74.64 | 3.14 | 9.30 |
| 1991 | 2 417 | 74.56 | 3.10 | 9.35 |
| 1992 | 2 411 | 74.59 | 3.03 | 9.20 |
| 1993 | 2 351 | 74.55 | 2.95 | 9.07 |

| | Activity | Implied Emission Factors | | |
|---|---|---|---|---|
| | | $CO_2$ | $CH_4$ | $N_2O$ |
| | TJ | T/TJ | kg/TJ | kg/TJ |
| 1994 | 2 372 | 74.53 | 2.88 | 8.94 |
| 1995 | 2 217 | 74.42 | 2.82 | 8.78 |
| 1996 | 2 004 | 74.48 | 2.77 | 8.64 |
| 1997 | 1 998 | 74.21 | 2.65 | 8.53 |
| 1998 | 1 968 | 74.17 | 2.58 | 8.40 |
| 1999 | 2 433 | 73.94 | 2.50 | 8.26 |
| 2000 | 2 428 | 73.90 | 2.44 | 8.14 |
| 2001 | 2 391 | 73.89 | 2.38 | 8.02 |
| 2002 | 2 342 | 73.90 | 2.32 | 7.90 |
| 2003 | 2 287 | 73.90 | 2.26 | 7.78 |
| 2004 | 1 916 | 73.91 | 2.73 | 9.45 |
| 2005 | 2 227 | 72.65 | 1.93 | 6.85 |
| 2006 | 2 349 | 69.69 | 1.79 | 6.42 |
| 2007 | 2 357 | 69.25 | 1.75 | 6.32 |

### 3.2.2.13 1.A.3.d Navigation

*Key Source: No*

In this category, emissions from diesel and gas fuelled ships are considered.

*Table 58: Greenhouse gas emissions from Category 1 A 3 d Navigation.*

| | $CO_2$ [Gg] | $CH_4$ [Gg] | $N_2O$ [Gg] |
|---|---|---|---|
| 1990 | 53 | 0.01 | 0.02 |
| 1991 | 48 | 0.01 | 0.01 |
| 1992 | 47 | 0.01 | 0.01 |
| 1993 | 47 | 0.01 | 0.01 |
| 1994 | 56 | 0.01 | 0.02 |
| 1995 | 62 | 0.01 | 0.02 |
| 1996 | 63 | 0.01 | 0.02 |
| 1997 | 62 | 0.01 | 0.02 |
| 1998 | 67 | 0.01 | 0.02 |
| 1999 | 66 | 0.01 | 0.02 |
| 2000 | 71 | 0.01 | 0.02 |
| 2001 | 73 | 0.01 | 0.02 |
| 2002 | 80 | 0.01 | 0.03 |
| 2003 | 66 | 0.01 | 0.02 |
| 2004 | 79 | 0.01 | 0.03 |
| 2005 | 76 | 0.01 | 0.02 |
| 2006 | 66 | 0.01 | 0.02 |
| 2007 | 69 | 0.01 | 0.02 |
| *Trend 1990-2007* | 31% | -18% | 46% |

The applied methodology is described in the subchapter on mobile sources of *1 A 2 f* (see Chapter 3.2.2.9 1.A.2.f Manufacturing Industries and Construction – Other). Activities used for estimating the emissions and the implied emission factors are presented in the following table.

*Table 59: Emission factors and activity data for the sector Navigation 1990–2007.*

| | Activity | Implied Emission Factors | | |
|---|---|---|---|---|
| | | $CO_2$ | $CH_4$ | $N_2O$ |
| | TJ | T/TJ | kg/TJ | kg/TJ |
| 1990 | 710 | 74.38 | 12.97 | 21.54 |
| 1991 | 645 | 74.42 | 13.86 | 21.14 |
| 1992 | 632 | 74.42 | 14.03 | 21.07 |
| 1993 | 639 | 74.08 | 13.85 | 21.04 |
| 1994 | 759 | 74.07 | 12.10 | 21.92 |
| 1995 | 834 | 73.92 | 11.16 | 22.36 |
| 1996 | 850 | 73.92 | 10.85 | 22.55 |
| 1997 | 844 | 73.91 | 10.74 | 22.64 |
| 1998 | 906 | 73.90 | 10.09 | 23.01 |
| 1999 | 890 | 73.75 | 10.03 | 23.03 |
| 2000 | 958 | 73.75 | 9.42 | 23.42 |
| 2001 | 994 | 73.74 | 9.06 | 23.68 |
| 2002 | 1 086 | 73.74 | 8.39 | 23.97 |
| 2003 | 896 | 73.75 | 9.27 | 23.29 |
| 2004 | 1 069 | 73.74 | 8.07 | 23.73 |
| 2005 | 1 051 | 72.78 | 7.87 | 23.37 |
| 2006 | 942 | 70.07 | 8.11 | 22.62 |
| 2007 | 998 | 69.57 | 7.55 | 22.41 |

### 3.2.2.14 1.A.3.e Other Transportation – Pipeline Compressors

*Key Source: Yes ($CO_2$: gaseous)*

Category *1.A.3.e Other Transportation* enfolds emissions from pipeline transport by gas turbine driven compressors. The share in total GHG emissions from sector *1 A* is 0.4% for the year 1990 and 0.7% for the year 2007. The increase of emissions is mainly caused by the increase of natural gas transfer through Austria.

#### Methodology

CORINAIR simple methodology is applied.

#### Activity data

Activity data (fuel consumption) is taken from (IEA JQ 2008) as presented in Annex 4.

**Emission factors**

$CO_2$ and $CH_4$ emission factors are taken from studies (BMWA-EB 1996) and (UMWELTBUNDESAMT 2002).

$N_2O$ emission factors are taken from a national study (BMUJF 1994).

Emission factors are presented in Table 60.

*Table 60: Emission factors of Category 1 A 2 e for all years.*

| Fuel | $CO_2$ [t/TJ] | $CH_4$ [kg/TJ] | $N_2O$ [kg/TJ] |
|---|---|---|---|
| Natural Gas | 55.40 | 1.50 | 0.10 |

### 3.2.2.15 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.

The share in total GHG emissions from sector *1 A* is 26.2% for the year 1990 and 17% for the year 2007.

***1.A.4 Other sectors – stationary sources***

*Key Source: $CO_2$ from gaseous, liquid and solid solid; $CH_4$ from biomass.*

Category *1.A.4 Other Sectors* includes emissions from stationary fuel combustion in the small combustion sector. Emissions from generation of public district heating plants are included in category *1.A.1.a Public Electricity and Heat Production* or the respective sub categories of *1.A.2 Manufacturing Industries and Construction* if district heat is sold by industry. Information about type of heatings is collected by micro census surveys and according to the energy statistics supplier. A clear distinction between "real" public district heating or micro heating networks which serve several buildings under the same ownership can not always be made by the interviewed person or interviewers.

The share in total GHG emissions from sector *1.A* is 24.4% for the year 1990 and 15.5% for the year 2007.

**Methodology**

The CORINAIR simple methodology is applied.

There are three technology dependent subcategories (heating types) for this category:

- Central Heatings (CH)
- Apartment Heatings (AH)
- Stoves (ST)

1 A 4 a Commercial/Institutional; 1 A 4 b Agriculture/Forestry/Fishing

There is no information about the structure of devices within this categories. Therefore it is assumed that the whole fuel consumption reported in (IEA JQ 2008) is combusted in devices similar to central heatings.

1 A 4 b Residential

Energy consumption by type of fuel and by type of heating is taken from a statistical evaluation of micro census data 1990, 1992, 1999 and 2004 by STATISTIK AUSTRIA. The calculated shares are used to subdivide total final energy consumption to the several technologies. For the years in between the shares are interpolated and the shares of 2004 are taken for the years from 2005 on.

### Emission factors

$CO_2$, $CH_4$ and VOC emission factors are taken from studies (BMWA-EB 1990, 1996) and (UMWELTBUNDESAMT 2002). $N_2O$ emission factors are taken from a national study (BMUJF 1994). $CO_2$ emission factors are identical for the three different heating types. The studies provide VOC and $C_{org}$ emission factors for different fuels and heating types.

The $C_{org}$ (Organic Carbon) emission factors provided in (BMWA-EB 1996) are converted into VOC emission factors with the formula VOC = 1.3 * $C_{org}$. The factor of 1.3 is an expert judgement by Umweltbundesamt as no factor was available from literature. It is based on analytical data of the composition of VOC emissions from the combustion of fuel wood for residential heating.

$CH_4$ emission factors are determined assuming that a certain percentage of VOC emissions is methane as listed in Table 61. The split follows closely (STANZEL et al. 1995).

From 2001 on new biomass boiler types are considered which have lower VOC emissions and thus lower $CH_4$ emissions than conventional boiler types.

*Table 61: Share of $CH_4$ and NMVOC on VOC for small combustion devices.*

| | $CH_4$ | NMVOC | VOC |
|---|---|---|---|
| Coal | 25% | 75% | 100% |
| Gas oil; Petroleum | 20% | 80% | 100% |
| Residual Fuel Oil | 25% | 75% | 100% |
| Natural Gas; LPG | 80% | 20% | 100% |
| Biomass | 25% | 75% | 100% |

The selected emission factors for 2007 are presented in Table 62.

*Table 62: Emission factors of Category 1.A.4 conventional boilers for the year 2007.*

| Fuel | $CO_2$ [t/TJ] | $CH_4$ [kg/TJ] | | $N_2O$ [kg/TJ] | |
|---|---|---|---|---|---|
| | | CH and AH | Stove | CH and AH | Stove |
| Hard Coal | 93.00 | 90.00 | 110.00 | 2.00 | 1.00 |
| Hard Coal Briquettes | 93.00 | 90.00 | 110.00 | 2.00 | 1.00 |
| Lignite and brown coal | 108.00 | 90.00 | 110.00 | 4.00 | 1.00 |
| Brown Coal Briquettes | 97.00 | 90.00 | 110.00 | 4.00 | 4.00 |
| Coke | 92.00 | 90.00 | 110.00 | 2.00 | 2.00 |
| Peat | 106.00 | – | 90.00 | – | 1.00 |
| Light Fuel Oil | 77.00 | 0.25 | – | 0.60 | – |
| Medium Fuel Oil | 78.00 | 2.00 | – | 1.00 | – |
| Heavy Fuel Oil | 78.00 | 2.00 | – | 1.00 | – |
| Gas oil | 75.00 | 0.20 | 0.50 | 1.00 | 1.00 |
| Petroleum | 78.00 | 0.20 | – | 0.60 | – |
| LPG | 64.00 | 1.50 | – | 1.00 | – |
| Gas Works Gas | 64.00 | 0.20 | – | 1.00 | – |
| Natural Gas | 55.40 | 0.80 | 0.80 | 1.00 | 1.00 |
| Fuel Wood | 100.00 1) | 143.04 | 201.69 | 3–5 | 7.00 |
| Wood Waste | 110.00 1) | 96.58 | 201.69 | 3–7 | 7.00 |
| Landfill Gas | 112.00 1) | 1.50 | – | 1.00 | – |
| Industrial Waste | 104.17 2) | 12.00 | – | 1.40 | – |

1) *reported as $CO_2$ emissions from biomass*

2) *According to IPCC guidelines non fossil $CO_2$ emissions of "other fuels" are not reported.*

Because no measurements are available $CH_4$ emission factors for new biomass heatings (Table 63) are derived from conventional boiler emission factors with the ratio of conventional boiler and new biomass heatings NMVOC emission factors:

$$EF(CH_4)_{new\ biomass} = EF(CH_4)_{conventional} * EF(NMVOC)_{new\ biomass}/EF(NMVOC)_{conventional}$$

*Table 63: Emission factors of Category 1 A 4 new biomass boilers for the year 2006.*

| Fuel | $CO_2$ [t/TJ] | $CH_4$ [kg/TJ] | | $N_2O$ [kg/TJ] | |
|---|---|---|---|---|---|
| | | CH/AH | Stove | CH and AH | Stove |
| Fuel Wood | 100.00 1) | 80.1/108.2 | 164.3 | 3.00 | 7.00 |
| Wood Chips | 110.00 1) | 27.06 | – | 2.00 | – |
| Pellets | 110.00 1) | 12.14 | – | 2.00 | – |

1) *Reported as $CO_2$ emissions from biomass.*

## Activity data

Total fuel consumption for each of the sub categories of 1.A.4 is taken from (IEA JQ 2008) as presented in Annex 4.

Since (IEA JQ 2008) does not report gas works gas the activity data is taken from the "Austrian Energy Balance" provided by STATISTIK AUSTRIA which is in a different structure but consistent with (IEA JQ 2008).

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.

Table 64 shows the selected share of each heating type for category *1.A.4.b.*

*Table 64: Share of 1.A.4.b heating type on fuel category for the year 2007.*

| | Central Heating | Appartement Heating | Stove |
|---|---|---|---|
| Hard Coal<br>Brown Coal<br>Brown Coal Briquettes<br>Coke | 59.8% | 10.9% | 29.3% |
| Gas oil | 80.7% | 8.2% | 11.1% |
| Residual Fuel Oil, Gas Works Gas, LPG, Petroleum | 100.0% | – | – |
| Natural Gas | 55.8% | 40.8% | 3.5% |
| Fuel Wood | 56.3% | 6.6% | 37.1% |
| Wood Chips, Pellets, other solid biomass | 74.8% | 4.7% | 20.5% |

Figure 14 shows activity data of *1.A.4.b Residential (without mobile machinery)* by type of fuel together with the correlating heating degree days for the years 1990 to 2007.

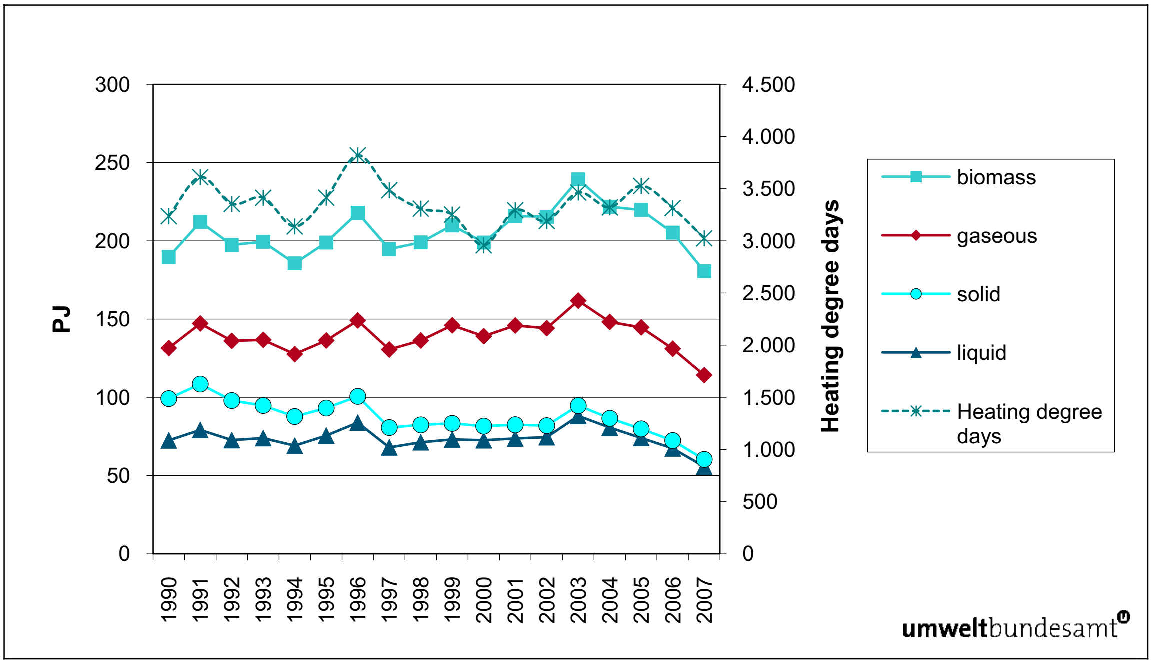


*Figure 14: Energy consumption [PJ] of residential sector by type of fuel and number of heating degree days 1990–2007.*

**Recalculations**

Changes of activity data are based on energy balance recalculation as described in Annex 2.

Changes are due to the revised 2004 and 2006 household micro census evaluation.

Recalculations affect activity data 1999 to 2006 which mainly implies changes in $CO_2$ emissions for natural gas 1999 (+261 Gg $CO_2$) to 2006 (+174 Gg $CO_2$) and minor changes for solid fuels 2006 (-18 Gg $CO_2$). Liquid fuels have been shifted between years and between categories *1.A.4* and *1.A.2 Manufacturing Industries* to better reflect the result of the improved census evaluatuation. Biomass consumption has been revised since 1990 with major changes 2001 to 2006 (+12.8 PJ which is +17%)

Update of heating type split from 2001 onwards to be consistent with the revised 2004 household census evaluation. This affects calculation of $CH_4$, CO, NMVOC, $NO_X$ and other non-GHG emissions from residential heatings.

***<u>1.A.4 Other sectors – mobile sources</u>***

*<u>1.A.4.b Household and Gardening</u>*

*Key Source: No*

The applied methodology is described in the subchapter on mobile sources of 1 A 2 f (see Chapter 3.2.2.9 1.A.2.f Manufacturing Industries and Construction – Other). Activities used for estimating the emissions and the implied emission factors are presented in Table 66.

*Table 65: Greenhouse gas emissions from mobile sources of household and gardening 1990–2007.*

| | $CO_2$ [Gg] | $CH_4$ [Gg] | $N_2O$ [Gg] |
|---|---|---|---|
| 1990 | 144.35 | 0.06 | 0.02 |
| 1991 | 144.69 | 0.06 | 0.02 |
| 1992 | 145.98 | 0.07 | 0.02 |
| 1993 | 146.76 | 0.07 | 0.02 |
| 1994 | 145.20 | 0.06 | 0.03 |
| 1995 | 145.54 | 0.06 | 0.03 |
| 1996 | 144.37 | 0.06 | 0.03 |
| 1997 | 142.99 | 0.06 | 0.03 |
| 1998 | 141.80 | 0.06 | 0.03 |
| 1999 | 141.52 | 0.05 | 0.03 |
| 2000 | 141.60 | 0.05 | 0.03 |
| 2001 | 141.83 | 0.05 | 0.03 |
| 2002 | 141.51 | 0.05 | 0.02 |
| 2003 | 141.13 | 0.05 | 0.02 |
| 2004 | 141.29 | 0.05 | 0.02 |
| 2005 | 139.08 | 0.05 | 0.02 |
| 2006 | 135.51 | 0.04 | 0.02 |
| 2007 | 133.28 | 0.04 | 0.02 |
| *Trend 1990-2007* | -8% | -39% | -30% |

*Table 66: Emission factors and activity data for mobile sources of household and gardening 1990–2007.*

| | Activity | Implied Emission Factors | | |
|---|---|---|---|---|
| | | $CO_2$ | $CH_4$ | $N_2O$ |
| | TJ | T/TJ | kg/TJ | kg/TJ |
| 1990 | 1 921.9 | 75.11 | 33.66 | 12.36 |
| 1991 | 1 926.7 | 75.10 | 33.69 | 12.36 |
| 1992 | 1 943.9 | 75.10 | 33.56 | 12.43 |
| 1993 | 1 977.9 | 74.20 | 33.07 | 12.34 |
| 1994 | 1 957.0 | 74.20 | 33.02 | 12.81 |
| 1995 | 1 963.4 | 74.13 | 31.83 | 13.21 |
| 1996 | 1 947.7 | 74.12 | 31.01 | 13.15 |
| 1997 | 1 930.1 | 74.08 | 30.16 | 13.24 |
| 1998 | 1 914.2 | 74.08 | 29.27 | 13.34 |
| 1999 | 1 912.4 | 74.00 | 28.38 | 13.41 |
| 2000 | 1 913.5 | 74.00 | 27.57 | 13.53 |
| 2001 | 1 917.1 | 73.98 | 26.94 | 13.61 |
| 2002 | 1 912.1 | 74.01 | 26.31 | 12.13 |
| 2003 | 1 907.0 | 74.01 | 26.13 | 11.99 |
| 2004 | 1 909.2 | 74.01 | 25.57 | 10.45 |
| 2005 | 1 892.5 | 73.49 | 24.15 | 10.14 |
| 2006 | 1 896.0 | 71.47 | 22.48 | 9.72 |
| 2007 | 1 880.6 | 70.87 | 20.97 | 8.90 |

### *1.A.4.c Agriculture and Forestry*

*Key Source: Yes ($CO_2$: mobile-diesel)*

In this category emissions from off-road machinery in agriculture and forestry (mainly tractors) are considered.

The applied methodology is described in the subchapter on mobile sources of *1 A 2 f* (see Chapter 3.2.2.9 1.A.2.f Manufacturing Industries and Construction – Other). Activities used for estimating the emissions and the implied emission factors are presented in the following tables.

*Table 67: Greenhouse gas emissions for mobile sources of Agriculture and Forestry.*

| | Agriculture | | | Forestry | | |
|---|---|---|---|---|---|---|
| | $CO_2$ [Gg] | $CH_4$ [Gg] | $N_2O$ [Gg] | $CO_2$ [Gg] | $CH_4$ [Gg] | $N_2O$ [Gg] |
| 1990 | 686 | 0.05 | 0.23 | 84 | 0.03 | 0.02 |
| 1991 | 689 | 0.05 | 0.23 | 79 | 0.02 | 0.02 |
| 1992 | 694 | 0.05 | 0.23 | 80 | 0.02 | 0.02 |
| 1993 | 697 | 0.05 | 0.23 | 81 | 0.02 | 0.02 |
| 1994 | 701 | 0.05 | 0.24 | 84 | 0.02 | 0.02 |
| 1995 | 671 | 0.04 | 0.23 | 80 | 0.02 | 0.02 |
| 1996 | 697 | 0.04 | 0.24 | 84 | 0.02 | 0.02 |
| 1997 | 733 | 0.05 | 0.26 | 87 | 0.02 | 0.03 |

| | Agriculture | | | Forestry | | |
|---|---|---|---|---|---|---|
| | $CO_2$ [Gg] | $CH_4$ [Gg] | $N_2O$ [Gg] | $CO_2$ [Gg] | $CH_4$ [Gg] | $N_2O$ [Gg] |
| 1998 | 720 | 0.04 | 0.26 | 85 | 0.02 | 0.03 |
| 1999 | 727 | 0.04 | 0.27 | 85 | 0.02 | 0.03 |
| 2000 | 706 | 0.04 | 0.26 | 82 | 0.02 | 0.03 |
| 2001 | 728 | 0.04 | 0.27 | 84 | 0.02 | 0.03 |
| 2002 | 723 | 0.04 | 0.27 | 86 | 0.02 | 0.03 |
| 2003 | 693 | 0.04 | 0.25 | 85 | 0.02 | 0.03 |
| 2004 | 714 | 0.04 | 0.26 | 86 | 0.02 | 0.03 |
| 2005 | 751 | 0.04 | 0.26 | 90 | 0.02 | 0.03 |
| 2006 | 729 | 0.04 | 0.25 | 91 | 0.02 | 0.03 |
| 2007 | 708 | 0.04 | 0.24 | 86 | 0.02 | 0.02 |
| *Trend 1990-2007* | *3%* | *-23%* | *4%* | *2%* | *-18%* | *3%* |

*Table 68: Emission factors and activity data for mobile sources of Agriculture and Forestry 1990–2007.*

| | Agriculture | | | | Forestry | | | |
|---|---|---|---|---|---|---|---|---|
| | Activity [TJ] | Implied Emission Factors | | | Activity [TJ] | Implied Emission Factors | | |
| | | $CO_2$ [t/TJ] | $CH_4$ [kg/TJ] | $N_2O$ [kg/TJ] | | $CO_2$ [t/TJ] | $CH_4$ [kg/TJ] | $N_2O$ [kg/TJ] |
| 1990 | 9 267 | 74.1 | 5.1 | 24.8 | 1 130 | 74.4 | 22.8 | 20.7 |
| 1991 | 9 299 | 74.1 | 5.1 | 24.8 | 1 060 | 74.3 | 18.7 | 21.8 |
| 1992 | 9 370 | 74.1 | 5.0 | 24.9 | 1 082 | 74.3 | 19.3 | 21.7 |
| 1993 | 9 421 | 74.0 | 5.0 | 24.9 | 1 091 | 74.1 | 19.2 | 21.6 |
| 1994 | 9 477 | 74.0 | 5.0 | 25.1 | 1 134 | 74.1 | 21.0 | 21.4 |
| 1995 | 9 090 | 73.9 | 4.9 | 25.4 | 1 087 | 73.9 | 20.7 | 21.7 |
| 1996 | 9 442 | 73.9 | 4.8 | 25.8 | 1 139 | 73.9 | 21.1 | 21.9 |
| 1997 | 9 923 | 73.9 | 4.6 | 26.2 | 1 178 | 73.9 | 20.0 | 22.5 |
| 1998 | 9 748 | 73.9 | 4.5 | 26.6 | 1 148 | 73.9 | 19.3 | 22.9 |
| 1999 | 9 865 | 73.7 | 4.4 | 26.9 | 1 159 | 73.8 | 18.7 | 23.2 |
| 2000 | 9 580 | 73.7 | 4.4 | 27.2 | 1 116 | 73.8 | 18.0 | 23.6 |
| 2001 | 9 879 | 73.7 | 4.3 | 27.5 | 1 145 | 73.8 | 17.4 | 23.9 |
| 2002 | 9 816 | 73.7 | 4.2 | 27.5 | 1 160 | 73.8 | 18.2 | 23.5 |
| 2003 | 9 399 | 73.7 | 4.2 | 26.9 | 1 153 | 73.8 | 19.9 | 22.5 |
| 2004 | 9 686 | 73.7 | 4.0 | 26.3 | 1 170 | 73.8 | 18.7 | 22.2 |
| 2005 | 10 344 | 72.6 | 3.8 | 25.4 | 1 231 | 72.9 | 17.5 | 21.6 |
| 2006 | 10 460 | 69.7 | 3.7 | 24.3 | 1 288 | 70.3 | 18.6 | 20.2 |
| 2007 | 10 226 | 69.3 | 3.6 | 23.3 | 1 233 | 69.7 | 17.2 | 19.7 |

#### 3.2.2.16 1.A.5 Other

In this category emissions of military transport (road and aviation) are reported.

**Military Aviation**

The following table presents GHG emissions from military aviation.

*Table 69: Greenhouse gas emissions from military aviation.*

| | $CO_2$ [Gg] | $CH_4$ [Gg] | $N_2O$ [Gg] |
|---|---|---|---|
| | military Kerosene | military Kerosene | military Kerosene |
| 1990 | 32 883 | 2.05 | 1.08 |
| 1991 | 34 971 | 2.16 | 1.15 |
| 1992 | 31 560 | 2.03 | 1.04 |
| 1993 | 37 294 | 2.40 | 1.22 |
| 1994 | 39 461 | 2.47 | 1.30 |
| 1995 | 30 467 | 1.95 | 1.00 |
| 1996 | 36 822 | 2.33 | 1.21 |
| 1997 | 35 024 | 2.10 | 1.15 |
| 1998 | 40 348 | 2.36 | 1.32 |
| 1999 | 39 534 | 2.29 | 1.30 |
| 2000 | 38 777 | 2.43 | 1.27 |
| 2001 | 39 338 | 2.46 | 1.29 |
| 2002 | 39 900 | 2.50 | 1.31 |
| 2003 | 40 462 | 2.53 | 1.33 |
| 2004 | 41 024 | 2.57 | 1.35 |
| 2005 | 41 586 | 2.60 | 1.36 |
| 2006 | 42 148 | 2.64 | 1.38 |
| 2007 | 42 710 | 2.68 | 1.40 |

**Methodological Issues**

For the years 1990–1999 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.

For calculation of $CO_2$ emissions an emission factor of 3 150 kg $CO_2$/Mg fuel has been used, it was taken from (KALIVODA et al. 2002).

CH4 emission factor follows the CORINAIR Guidebook (10% of total VOC emissions, simple methodology).

As recommended in the IPCC GPG, for calculation of $N_2O$ emissions of military flights the IEF of civil aviation domestic LTO was applied as no military specific emission factor was available.

The activity data and the emissions from 2000 to 2007 are an extrapolation of the trend between 1990 and 1999.

**Improvements**

The national amount of kerosene which is used in military aircrafts has to be examined more closely.

**Military Off-Road (without aviation)**

The applied methodology is described in the subchapter on mobile sources of 1 A 2 f (see Chapter 3.2.2.9 1.A.2.f Manufacturing Industries and Construction – Other).

Emission 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 were available. Also no information on the road performance of military vehicles was available, that's why emission estimates only present rough estimations, which were obtained making the following assumptions: for passenger cars and motorcycles the yearly road performance as calculated for civil cars was used. For tanks and other special military vehicles the emission factors for diesel engines > 80 kW was used (see Table 42; 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).

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

*Table 70: Greenhouse gas emissions from Military (Off-Road without Aviation).*

| | $CO_2$ [Gg] | $CH_4$ [Gg] | $N_2O$ [Gg] | Activity [TJ] |
|---|---|---|---|---|
| 1990 | 2.12 | 0.0001 | 0.0008 | 28.7 |
| 1991 | 2.12 | 0.0001 | 0.0008 | 28.6 |
| 1992 | 2.12 | 0.0001 | 0.0008 | 28.6 |
| 1993 | 2.11 | 0.0001 | 0.0008 | 28.5 |
| 1994 | 2.11 | 0.0001 | 0.0008 | 28.5 |
| 1995 | 2.09 | 0.0001 | 0.0008 | 28.3 |
| 1996 | 2.08 | 0.0001 | 0.0008 | 28.1 |
| 1997 | 2.06 | 0.0001 | 0.0008 | 27.9 |
| 1998 | 2.05 | 0.0001 | 0.0008 | 27.7 |
| 1999 | 2.03 | 0.0001 | 0.0008 | 27.6 |
| 2000 | 2.02 | 0.0001 | 0.0008 | 27.5 |
| 2001 | 2.02 | 0.0001 | 0.0008 | 27.4 |
| 2002 | 2.01 | 0.0001 | 0.0008 | 27.3 |
| 2003 | 2.01 | 0.0001 | 0.0008 | 27.2 |
| 2004 | 2.00 | 0.0001 | 0.0008 | 27.2 |
| 2005 | 1.98 | 0.0001 | 0.0007 | 27.2 |
| 2006 | 1.91 | 0.0001 | 0.0006 | 27.4 |
| 2007 | 1.90 | 0.0000 | 0.0006 | 27.5 |
| *Trend 1990-2007* | -10% | -60% | -28% | -4% |

### 3.2.2.17 International Bunkers – Aviation

Emissions from aviation assigned to international bunkers include the transport modes international LTO and international cruise for IFR-flights (International Flight Rules).

*Table 71: Emissions and Activity from International Aviation 1990–2007.*

| | $CO_2$ [Gg] | | $N_2O$ [Gg] | | $CH_4$ [Gg] | Activity [TJ] |
|---|---|---|---|---|---|---|
| | int. LTO | int. cruise | int. LTO | int. cruise | int. LTO | int. cruise |
| | Kerosene | Kerosene | Kerosene | Kerosene | Kerosene | Kerosene |
| 1990 | 90.3 | 795.7 | 0.006 | 0.025 | 0.015 | 11 014 |
| 1991 | 103.0 | 890.8 | 0.006 | 0.028 | 0.016 | 12 330 |
| 1992 | 115.8 | 961.6 | 0.007 | 0.031 | 0.017 | 13 310 |
| 1993 | 128.6 | 1 011.4 | 0.008 | 0.032 | 0.018 | 13 998 |
| 1994 | 141.4 | 1 044.2 | 0.009 | 0.033 | 0.019 | 14 453 |
| 1995 | 154.2 | 1 173.2 | 0.010 | 0.037 | 0.020 | 16 127 |
| 1996 | 164.8 | 1 301.6 | 0.010 | 0.041 | 0.023 | 17 927 |
| 1997 | 175.4 | 1 350.2 | 0.011 | 0.043 | 0.027 | 18 605 |
| 1998 | 186.0 | 1 392.3 | 0.011 | 0.044 | 0.030 | 19 187 |
| 1999 | 190.1 | 1 351.6 | 0.011 | 0.043 | 0.029 | 18 583 |
| 2000 | 210.3 | 1 485.2 | 0.010 | 0.047 | 0.031 | 20 398 |
| 2001 | 199.7 | 1 451.6 | 0.010 | 0.046 | 0.030 | 19 935 |
| 2002 | 233.5 | 1 307.4 | 0.010 | 0.041 | 0.035 | 17 955 |
| 2003 | 243.3 | 1 209.7 | 0.010 | 0.038 | 0.036 | 16 612 |
| 2004 | 290.2 | 1 434.7 | 0.011 | 0.046 | 0.043 | 19 702 |
| 2005 | 270.3 | 1 689.5 | 0.012 | 0.054 | 0.040 | 23 200 |
| 2006 | 267.8 | 1 781.1 | 0.012 | 0.056 | 0.040 | 24 458 |
| 2007 | 289.6 | 1 886.2 | 0.013 | 0.060 | 0.043 | 25 903 |

**Methodological Issues**

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

### 3.2.3 Quality Assurance/Quality Control and Verification

For general QA/QC see Chapter 1.6.

In 2008 STATISTIK AUSTRIA provided an updated documentation for the national energy balance and a document which covers a more actual quantification of uncertainties.

Concerning activity data for sectors *1.A.1* and *1.A.2* there are specific regulations in the Austrian legislation:

- BGBl II No. 1997/331 Feuerungsanlagen-Verordnung
- BGBl 1989/19 Luftreinhalteverordnung für Kesselanlagen
- BGBl 1988/380 Luftreinhaltegesetz für Kesselanlagen
- BGBl 150/2004 Emissionsschutzgesetz für Kesselanlagen - EG K
- BGBl 84/2006 Emissionsschutzgesetz für Kesselanlagen - EG K
- BGBl II No. 2007/292 Emissionserklärungsverordnung - EEV

**Additionally the following sector specific QA/QC procedures have been carried out:**

- activity data check
  - Survey for the "National Emission Trading Allocation Plan" 1 (NAP1) 1990 to 2002 with almost complete data for 1998 to 2002.
  - 1.A.1.a: public report: fuel consumption and energy production by plant (1990).
  - discussion of activity data with Refinery (incl. methodology of $CO_2$ emission calculation) and Iron and Steel Industry
  - check of gas consumption with data from E-Control
  - check of oil consumption with data from Mineral Oil Association
- indicators and analysis (activity data and $CO_2$ emissions)
  - Public "Kyoto Progress" Reports until 2007. Public "Climate Protection" Reports since 2008.
  - energy intensity indicators: Iron and Steel, Cement industry. Refinery. Households
- external review
  - Federal provinces air emission inventory
  - Check of methodology and $CO_2$ emissions by WIFO
- emission factors check
  - check of IEF (time series)
  - NAP1 survey: Country specific $CO_2$ emission factors used in the inventory were widely accepted
  - comparison with IPCC
- time series consistency
  - plausibility checks of dips and jumps
  - yearly public trend report
- recalculations check of activity data (energy balance) and emissions
- Method Documentation with Standard Operation Procedure (SOP)
- „Quick-calculation“ of 1.A activity
- improvement list (external and internal findings)
- link to STATISTIK AUSTRIA, Industrial associations
- calculation by spreadsheets
  - consistent use of energy balance data (central file)
  - documented sources
  - use of Units
  - strictly defined interfaces between spreadsheets/calculation modules
  - unique structure of sheets which do the same
  - use of coding systems (SNAP, SPLIT, NAPFUE)
  - record keeping. Use of write protection
  - unique use of formulas. Special cases are documented /highlighted
  - quick-control checks for data consistency through all steps of calculation

### 3.2.4 Uncertainty

As the overall fuel balance for Austria is expected to be considerably more accurate than source specific information (Statistik Austria, pers. communication), also assessment of uncertainties was performed on the level of the overall energy balance. It was not possible, however, to strictly use this straightforward approach because dealing with all fuel related activities at the same time would make it difficult to provide separation of major source categories; as domestic combustion, industry and power plant would fall in the same category with traffic.

For these reasons, an arbitrary split was drawn between energy use in large sources (covering IPCC sectors 1.A.1, refineries as they are included in 1.B.2, and energy in iron and steel production covered in 2.C.1), transport sources (IPCC sector 1.A.3, but including transport related machinery in 1.A.2, manufacturing industry, and 1.A.4, other sectors like agriculture, forestry and households) and small sources (covering all other combustion sources, specifically the rest of manufacturing industry, 1.A.2, as well as other sectors, 1.A.4. Also 1.A.5, "other" is included which basically covers military energy consumption including transport). Activity uncertainty was assessed separately by fuel for fossil solids (fuel code 102–110), biomass and waste fuels (fuel code 111–118), liquid fuels (fuel codes 203–224 except for black liquor, code 215 which is treated separately) and gaseous fuels (fuel codes above 300). Uncertainty factors have been maintained from previous studies (WINIWARTER & ORTHOFER 2000; CHARLES et al. 1998) and are listed in Table 72. For transport, the respective factors are new and have been taken from an assessment of the overall transport GHG emissions (HAUSBERGER 2005).

*Table 72: Uncertainty parameters for fuel combustion activities.*

| | Fossil solid | Biomass & waste | liquid | Black liquor | Gas |
|---|---|---|---|---|---|
| large sources | 0.5 | 10 | 0.5 | – | 2.0 |
| small sources | 1.0 | 10 | 1.0 | 10.0 | 5.0 |
| transport | | | 3.0 | | |

Uncertainty factors presented account for the generally high quality level of Austrian fuel statistics, which is based on physical measurements (weighing, flow-metering), but data reported in statistics are derived from the respective heat content of fuels. Transformation requires analysis or measurement of the heat content in the fuel. Biomass, waste and black liquor, which are not contained in detail by trade statistics, exhibit a much larger uncertainty.

Emission factors in fuel combustion are also considered to be well-known. $CO_2$ emissions can be derived from stoichiometry. Carbon content of fuels (within gaseous/liquid/solid fuels, respectively) is largely proportional to its heat content. Thus we estimate uncertainty of the emission factor – separately for solid, liquid and gaseous fuels – at 0.5%. Within these respective fuel classes we consider uncertainty correlated.

Even more interesting is the case of methane. A considerable number of seemingly independent emission factors for different emission situation are available. At closer inspection, however, it appears that data presented by STANZEL et al. (1995) and used in OLI actually derive from HC measurements. The fraction of $CH_4$ in total HC combustion exhaust has been estimated by ORTHOFER (1991) at 75% in gaseous fuels, 20% in solid fuels and 25% in liquid fuels. As this percentage is what drives overall uncertainty for methane emission factors, we again have to treat gaseous, liquid and solid fuels as dependent (correlated) parameters. As an indicator of overall uncertainty we may refer to CHARLES et al. (1998) who reported 50% for methane from combustion sources.

For nitrous oxide, emission measurements have been performed by VITOVEC (1991) and resulting uncertainty has been estimated at 20%. This figure has previously been used for Austria, but is not sustainable any more considering the fact that emission factors originally used for an Austrian inventory by ORTHOFER et al. (1995) are now more than 15 years old and refer to a considerably different combustion regime. We now apply 50% (taken from MONNI & SYRI 2003; see also RAMIREZ et al. 2006), a figure which we understand to also include uncertainty due to limited knowledge on the fraction of fluidized bed combustion in the installation park. Emission factors reported for nitrous oxide by STANZEL et al. (1991) and used in OLI originally derive from the GEMIS modelling system, again just one source. Thus they again need to be considered correlated within each fuel class (solid, liquid and gaseous).

### 3.2.5 Recalculations of Category 1.A

This chapter presents the recalculation difference of emissions from fuel combustion activities and its sub categories with respect to the previous submission.

The following major revisions have been carried out:

- Revised off road machinery fuel consumption. This leads to $CO_2$ shifts between all subsectors except 1.A.5 and recalculation of total $N_2O$ emissions which contributes to over 95 % of total GHG recalculations for the years 1990 to 1999.
- Improved model for domestic and military aviation 2001 to 2006.
- Revised energy balance: From 1990 to 1998 minor changes in biomass consumption. From 1999 to 2006 revised domestic model. Shifts of fuel oil and coal gross inland consumption (revision of stock changes) between the years 2000 to 2006.

More detailed figures are presented in Annex 2. The reasons for recalculations are explained in the relevant subchapters.

#### $CO_2$ emissions

Table 73 shows the recalculations of $CO_2$ emissions for the subcategories of sector *1.A Fuel Combustion.*

*Table 73: Recalculation difference of $CO_2$ emissions in [Gg] for Category 1 A Fuel Combustion with respect to previous submission.*

| | 1 A | 1 A 1 | 1 A 2 | 1 A 3 | 1 A 4 | 1 A 5 |
|---|---|---|---|---|---|---|
| 1990 | -0.03 | 0.00 | -758.71 | 1 343.20 | -584.51 | -0.01 |
| 1991 | -0.06 | 0.00 | -766.14 | 1 213.21 | -447.12 | -0.02 |
| 1992 | 0.03 | 0.00 | -760.16 | 1 243.15 | -482.94 | -0.02 |
| 1993 | 0.07 | 0.07 | -710.22 | 1 200.66 | -490.42 | -0.02 |
| 1994 | 0.01 | 0.01 | -723.50 | 1 289.91 | -566.39 | -0.03 |
| 1995 | 0.02 | -0.02 | -678.38 | 1 186.82 | -508.37 | -0.03 |
| 1996 | -0.03 | -0.03 | -562.97 | 1 161.59 | -598.58 | -0.04 |
| 1997 | 0.06 | 0.03 | -603.52 | 1 258.04 | -654.44 | -0.05 |
| 1998 | 0.06 | 0.03 | -550.50 | 1 166.35 | -615.77 | -0.05 |
| 1999 | 12.09 | 0.00 | -817.02 | 1 200.78 | -371.61 | -0.05 |
| 2000 | 11.34 | 0.00 | -749.06 | 1 047.71 | -283.17 | -4.15 |

| | 1 A | 1 A 1 | 1 A 2 | 1 A 3 | 1 A 4 | 1 A 5 |
|---|---|---|---|---|---|---|
| 2001 | -132.95 | 0.00 | -874.00 | 1 122.35 | -379.59 | -1.71 |
| 2002 | -94.57 | 0.00 | -694.57 | 1 171.02 | -571.04 | 0.01 |
| 2003 | -224.76 | 0.00 | -761.70 | 1 060.89 | -477.11 | -46.84 |
| 2004 | 83.99 | 0.53 | -844.99 | 1 065.51 | -73.49 | -63.56 |
| 2005 | -542.42 | -0.61 | -223.60 | 981.55 | -1 223.20 | -76.56 |
| 2006 | 171.69 | 118.93 | 153.49 | 844.72 | -864.05 | -81.40 |

### $CH_4$ emissions

Table 74 shows the recalculations of $CH_4$ emissions for the subcategories of sector *1.A Fuel Combustion.*

*Table 74: Recalculation difference of $CH_4$ emissions in [Gg] for Category 1 A Fuel Combustion with respect to previous submission.*

| | 1 A | 1 A 1 | 1 A 2 | 1 A 3 | 1 A 4 | 1 A 5 |
|---|---|---|---|---|---|---|
| 1990 | -0.14 | 0.00 | -0.06 | 0.02 | -0.10 | 0.00 |
| 1991 | -0.13 | 0.00 | -0.06 | 0.02 | -0.09 | 0.00 |
| 1992 | -0.14 | 0.00 | -0.06 | 0.02 | -0.10 | 0.00 |
| 1993 | -0.14 | 0.00 | -0.06 | 0.02 | -0.10 | 0.00 |
| 1994 | -0.16 | 0.00 | -0.06 | 0.02 | -0.12 | 0.00 |
| 1995 | -0.15 | 0.00 | -0.06 | 0.02 | -0.11 | 0.00 |
| 1996 | -0.16 | 0.00 | -0.05 | 0.01 | -0.12 | 0.00 |
| 1997 | -0.20 | 0.00 | -0.05 | 0.02 | -0.16 | 0.00 |
| 1998 | -0.19 | 0.00 | -0.05 | 0.01 | -0.15 | 0.00 |
| 1999 | -0.14 | 0.00 | -0.05 | 0.01 | -0.11 | 0.00 |
| 2000 | -0.09 | 0.00 | -0.04 | 0.01 | -0.06 | 0.00 |
| 2001 | 0.86 | 0.00 | -0.04 | 0.01 | 0.89 | 0.00 |
| 2002 | 1.59 | 0.00 | -0.04 | 0.01 | 1.62 | 0.00 |
| 2003 | 2.64 | 0.00 | -0.04 | 0.00 | 2.68 | 0.00 |
| 2004 | 2.71 | 0.00 | -0.03 | 0.00 | 2.75 | 0.00 |
| 2005 | 2.46 | 0.00 | -0.01 | 0.00 | 2.48 | 0.00 |
| 2006 | 2.70 | 0.00 | 0.03 | 0.00 | 2.67 | 0.00 |

### $N_2O$ emissions

Table 75 shows the recalculations of $N_2O$ emissions for the subcategories of sector *1.A Fuel Combustion.*

*Table 75: Recalculation difference of $N_2O$ emissions in [Gg] for Category 1 A Fuel Combustion with respect to previous submission.*

| | 1 A | 1 A 1 | 1 A 2 | 1 A 3 | 1 A 4 | 1 A 5 |
|---|---|---|---|---|---|---|
| 1990 | -0.42 | 0.00 | -0.26 | 0.03 | -0.19 | 0.00 |
| 1991 | -0.38 | 0.00 | -0.27 | 0.03 | -0.14 | 0.00 |
| 1992 | -0.39 | 0.00 | -0.26 | 0.03 | -0.16 | 0.00 |

| | 1 A | 1 A 1 | 1 A 2 | 1 A 3 | 1 A 4 | 1 A 5 |
|---|---|---|---|---|---|---|
| 1993 | -0.37 | 0.00 | -0.25 | 0.03 | -0.16 | 0.00 |
| 1994 | -0.41 | 0.00 | -0.26 | 0.03 | -0.18 | 0.00 |
| 1995 | -0.38 | 0.00 | -0.24 | 0.03 | -0.17 | 0.00 |
| 1996 | -0.36 | 0.00 | -0.19 | 0.03 | -0.20 | 0.00 |
| 1997 | -0.41 | 0.00 | -0.22 | 0.03 | -0.22 | 0.00 |
| 1998 | -0.37 | 0.00 | -0.20 | 0.03 | -0.20 | 0.00 |
| 1999 | -0.34 | 0.00 | -0.18 | 0.03 | -0.19 | 0.00 |
| 2000 | -0.26 | 0.00 | -0.13 | 0.03 | -0.15 | 0.00 |
| 2001 | -0.23 | 0.00 | -0.13 | 0.03 | -0.13 | 0.00 |
| 2002 | -0.21 | 0.00 | -0.13 | 0.03 | -0.11 | 0.00 |
| 2003 | -0.16 | 0.00 | -0.09 | 0.02 | -0.08 | 0.00 |
| 2004 | -0.12 | 0.00 | -0.08 | 0.03 | -0.07 | 0.00 |
| 2005 | -0.09 | 0.00 | -0.06 | 0.03 | -0.05 | 0.00 |
| 2006 | -0.07 | 0.00 | -0.05 | 0.02 | -0.04 | 0.00 |

**Emissions in Gg $CO_2$ equivalent**

Table 76 shows the recalculations in [Gg $CO_2$ equivalent] for the subcategories of sector *1.A Fuel Combustion.*

*Table 76: Recalculation difference of GHG emissions in [Gg $CO_2$ equivalent] for Category 1 A Fuel Combustion with respect to previous submission.*

| | 1 A | 1 A 1 | 1 A 2 | 1 A 3 | 1 A 4 | 1 A 5 |
|---|---|---|---|---|---|---|
| 1990 | -133.44 | 0.00 | -841.70 | 1 354.18 | -645.91 | -0.01 |
| 1991 | -120.57 | 0.00 | -849.87 | 1 222.98 | -493.67 | -0.02 |
| 1992 | -123.44 | 0.00 | -843.19 | 1 253.01 | -533.24 | -0.02 |
| 1993 | -118.81 | 0.07 | -787.69 | 1 210.19 | -541.35 | -0.02 |
| 1994 | -130.75 | 0.01 | -804.86 | 1 300.21 | -626.08 | -0.03 |
| 1995 | -119.66 | -0.02 | -753.90 | 1 196.31 | -562.03 | -0.03 |
| 1996 | -115.83 | -0.03 | -624.11 | 1 170.93 | -662.57 | -0.04 |
| 1997 | -130.28 | 0.03 | -672.40 | 1 267.97 | -725.84 | -0.05 |
| 1998 | -118.21 | 0.03 | -612.25 | 1 175.77 | -681.71 | -0.05 |
| 1999 | -95.85 | 0.00 | -874.29 | 1 210.43 | -431.95 | -0.04 |
| 2000 | -70.78 | 0.00 | -791.47 | 1 056.78 | -331.88 | -4.21 |
| 2001 | -186.95 | 0.00 | -916.56 | 1 131.80 | -400.48 | -1.70 |
| 2002 | -127.56 | 0.00 | -735.99 | 1 180.84 | -572.43 | 0.02 |
| 2003 | -217.53 | 0.00 | -791.68 | 1 068.46 | -446.40 | -47.91 |
| 2004 | 102.88 | 0.49 | -870.93 | 1 075.17 | -36.97 | -64.88 |
| 2005 | -517.91 | -0.61 | -241.65 | 990.10 | -1 187.82 | -77.93 |
| 2006 | 205.36 | 118.63 | 138.61 | 850.86 | -819.97 | -82.78 |

### 3.2.6 Planned Improvements

At current no relevant improvements are planned.

## 3.3 Comparison of the Sectoral Approach with the Reference Approach

### 3.3.1 Comparison of $CO_2$ emissions

At the following $CO_2$ emissions from the sectoral and reference approach are compared and explanations for the differences are provided.

Table 77 presents $CO_2$ emissions of sectoral and reference approach.

*Table 77: $CO_2$ emissions of sectoral and reference approach.*

| Year | Reference Approach | | | | Sectoral Approach | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Liquid [Gg $CO_2$] | Solid [Gg $CO_2$] | Gaseous [Gg $CO_2$] | Total [Gg $CO_2$] | Liquid [Gg $CO_2$] | Solid [Gg $CO_2$] | Gaseous [Gg $CO_2$] | Other [Gg $CO_2$] | Total [Gg $CO_2$] |
| 1990 | 28 208 | 28 208 | 12 238 | 56 362 | 28 138 | 13 924 | 11 301 | 732 | 54 094 |
| 1991 | 30 741 | 30 741 | 12 939 | 60 451 | 30 615 | 14 518 | 11 940 | 805 | 57 878 |
| 1992 | 29 819 | 29 819 | 12 705 | 55 480 | 29 349 | 10 666 | 12 000 | 956 | 52 972 |
| 1993 | 30 890 | 30 890 | 13 399 | 55 939 | 30 758 | 9 495 | 12 453 | 675 | 53 381 |
| 1994 | 30 146 | 30 146 | 13 782 | 55 739 | 30 127 | 9 379 | 13 111 | 820 | 53 437 |
| 1995 | 30 751 | 30 751 | 15 048 | 59 298 | 30 336 | 10 741 | 14 339 | 839 | 56 255 |
| 1996 | 33 169 | 33 169 | 16 017 | 62 697 | 32 950 | 10 760 | 15 287 | 1 073 | 60 070 |
| 1997 | 32 633 | 32 633 | 15 437 | 62 388 | 32 150 | 11 318 | 14 720 | 1 017 | 59 206 |
| 1998 | 34 924 | 34 924 | 15 848 | 63 323 | 34 274 | 8 905 | 15 136 | 818 | 59 133 |
| 1999 | 32 907 | 32 907 | 16 125 | 61 510 | 32 617 | 9 208 | 15 406 | 819 | 58 049 |
| 2000 | 32 037 | 32 037 | 15 388 | 61 577 | 31 862 | 10 438 | 14 684 | 832 | 57 816 |
| 2001 | 34 274 | 34 274 | 16 309 | 65 163 | 34 119 | 11 260 | 15 629 | 955 | 61 963 |
| 2002 | 35 337 | 35 337 | 16 494 | 66 711 | 35 303 | 11 136 | 15 792 | 1 124 | 63 355 |
| 2003 | 38 080 | 38 080 | 17 833 | 71 890 | 38 407 | 12 640 | 17 070 | 1 261 | 69 378 |
| 2004 | 38 569 | 38 569 | 17 622 | 71 953 | 38 447 | 12 274 | 16 917 | 1 384 | 69 021 |
| 2005 | 38 631 | 38 631 | 19 307 | 73 618 | 38 082 | 11 973 | 18 508 | 1 312 | 69 875 |
| 2006 | 38 231 | 38 231 | 17 605 | 71 668 | 37 671 | 11 765 | 16 792 | 1 761 | 67 989 |
| 2007 | 37 023 | 37 023 | 16 476 | 68 449 | 35 605 | 10 974 | 15 812 | 1 752 | 64 143 |

Table 78 presents the difference of $CO_2$ emissions in percent between reference and sectoral approach.

*Table 78: Difference of $CO_2$ emissions by type of fuel in percent.*

| Year | Liquid | Solid | Gaseous | Total |
|---|---|---|---|---|
| 1990 | 0.25% | 14.31% | 8.29% | 4.19% |
| 1991 | 0.41% | 15.52% | 8.36% | 4.45% |
| 1992 | 1.60% | 21.47% | 5.87% | 4.74% |
| 1993 | 0.43% | 22.70% | 7.60% | 4.79% |
| 1994 | 0.06% | 25.92% | 5.12% | 4.31% |
| 1995 | 1.37% | 25.67% | 4.94% | 5.41% |
| 1996 | 0.66% | 25.57% | 4.77% | 4.37% |
| 1997 | 1.50% | 26.50% | 4.87% | 5.38% |
| 1998 | 1.90% | 40.94% | 4.71% | 7.09% |
| 1999 | 0.89% | 35.52% | 4.67% | 5.96% |
| 2000 | 0.55% | 35.57% | 4.80% | 6.50% |
| 2001 | 0.45% | 29.49% | 4.35% | 5.16% |

| Year | Liquid | Solid | Gaseous | Total |
|---|---|---|---|---|
| 2002 | 0.10% | 33.62% | 4.44% | 5.30% |
| 2003 | -0.85% | 26.40% | 4.47% | 3.62% |
| 2004 | 0.32% | 28.42% | 4.17% | 4.25% |
| 2005 | 1.44% | 30.97% | 4.31% | 5.36% |
| 2006 | 1.49% | 34.56% | 4.84% | 5.41% |
| 2007 | 3.98% | 36.23% | 4.19% | 6.71% |

*Positive numbers indicate that $CO_2$ emissions from the reference approach are higher than emissions from the sectoral approach.*

**Explanation of differences**

- In the reference approach the IPCC default net calorific values are used. In the sectoral approach country-specific net calorific values are taken to calculate the energy consumption.
- The selected emission factors (carbon content) of the two approaches are different, especially for coal.
- *Liquid Fuels:* Energy balance is mass-balanced but not carbon balanced. Fuel category *Other Oil* is an aggregation of several fuel types and therefore it is difficult to quantify a reliable carbon emission factor for the reference approach. The reference approach takes a share of feedstocks used for plastics and solvent production as non-carbon stored. In the sectoral approach a share of emissions from the waste incineration of plastics is included in category *1 A 1 a Public Electricity and Heat Production*. Emissions from solvent use are included in category *3 Solvent and Other Products Use*. In the sectoral approach a share of municipal solid waste without energy recovery is considered in category 6C for 1990 and 1991.
- *Diesel:* In the Reference Approach $CO_2$ emissions from diesel are fully accounted as fossil emissions while in the sectoral the share of mixed biofuels is accounted as biogenic.
- *Solid fuels:* The Reference Approach includes process emissions from blast furnaces and steel production which are included in category *2.C Metal Production* as well as process emissions from carbide production which are included in category *2.B.4 Carbide Production*. In the sectoral approach plant specific $CO_2$ emission factors are used for large coal boilers since 2005.
- *Gaseous fuels:* The national approach uses country specific carbon contents and heating values different to IPCC default factors. Process emissions from ammonia-production are included in category *2 B 1 Ammonia Production*.
- *Other fuels:* The sectoral approach considers waste as an additional fuel type (e.g. municipal solid waste, hazardous waste and industrial fuel waste)
- *Carbon Stored:* The reference approach uses IPCC default values for "fraction of carbon stored".

**Quantification of differences**

- By quantifying the difference between the two approaches the remaining difference is between -1.1 to +1.6%. Note that this may be interpreted as emissions according to the sectoral approach (plus process emissions) being even higher than emissions according to the reference approach.
- Currently it is not possible to quantify the amount of solvents and plastic products which are imported or exported by products, bulk or waste.

Table 79 presents the differences which can be easily quantified. Positive numbers indicate $CO_2$ emissions not included in the sectoral approach. Negative numbers indicate $CO_2$ emissions which are not considered by the reference approach. The remaining differences are mainly due to the use of country specific emission factors and NCVs for the sectoral approach and the use of "default fractions of carbon stored" for the reference approach.

*Table 79: Quantification of differences.*

| Year | Natural Gas(1) [Gg $CO_2$] | 2.B.1 (3) [Gg $CO_2$] | Coke Oven Coke(4) [Gg $CO_2$] | Other Fuels [Gg $CO_2$] | Biofuels(5) [Gg $CO_2$] | Total [Gg $CO_2$] | Remaining Total Difference(2) |
|---|---|---|---|---|---|---|---|
| 1990 | 162 | 826 | 2 704 | -732 | 0 | 2 960 | -1,2% |
| 1991 | 168 | 884 | 2 722 | -805 | 0 | 2 969 | -0,7% |
| 1992 | 167 | 595 | 2 458 | -956 | 0 | 2 263 | 0,4% |
| 1993 | 171 | 831 | 2 526 | -675 | 0 | 2 854 | -0,5% |
| 1994 | 177 | 556 | 2 767 | -820 | 0 | 2 680 | -0,7% |
| 1995 | 194 | 583 | 3 136 | -839 | 0 | 3 075 | -0,1% |
| 1996 | 205 | 597 | 2 918 | -1 073 | 0 | 2 648 | 0,0% |
| 1997 | 196 | 591 | 3 316 | -1 017 | 0 | 3 086 | 0,2% |
| 1998 | 200 | 585 | 3 214 | -818 | 0 | 3 181 | 1,6% |
| 1999 | 203 | 590 | 3 102 | -819 | 0 | 3 076 | 0,6% |
| 2000 | 193 | 582 | 3 489 | -832 | 0 | 3 432 | 0,5% |
| 2001 | 204 | 551 | 3 449 | -955 | 0 | 3 249 | -0,1% |
| 2002 | 205 | 573 | 3 879 | -1 124 | 0 | 3 533 | -0,3% |
| 2003 | 220 | 625 | 3 721 | -1 261 | 0 | 3 305 | -1,1% |
| 2004 | 218 | 568 | 3 650 | -1 384 | 0 | 3 052 | -0,2% |
| 2005 | 239 | 598 | 4 128 | -1 312 | 236 | 3 889 | -0,2% |
| 2006 | 217 | 638 | 4 206 | -1 761 | 908 | 4 208 | -0,7% |
| 2007 | 205 | 560 | 4 214 | -1 752 | 1 122 | 4 349 | -0,1% |

1) *Deviation due to the use of different carbon emissions factors, losses and statistical differences.*

2) *(RA-SA)/SA. Negative numbers indicate that $CO_2$ emissions from the reference approach are lower than emissions from the sectoral approach.*

3) *Process emissions of natural gas used for ammonia production.*

4) *Process emissions of coke oven coke used in blast furnaces. Emissions are allocated to 2 C 1 Iron and Steel Production.*

5) *Share of biofuels in diesel.*

### 3.3.2 Comparison of energy consumption

Table 80 compares the energy consumption of the two approaches.

*Table 80: Energy consumption of sectoral and reference approach.*

| Year | Reference Approach | | | | Sectoral Approach | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | **Liquid [TJ]** | **Solid [TJ]** | **Gaseous [TJ]** | **Total [TJ]** | **Liquid [TJ]** | **Solid [TJ]** | **Gaseous [TJ]** | **Other [TJ]** | **Total [TJ]** |
| 1990 | 432 378 | 168 749 | 219 239 | 820 366 | 377 044 | 139 889 | 203 981 | 8 990 | 729 904 |
| 1991 | 466 404 | 177 293 | 231 794 | 875 491 | 409 400 | 146 161 | 215 528 | 10 079 | 781 168 |
| 1992 | 457 038 | 137 588 | 227 610 | 822 236 | 393 087 | 108 336 | 216 608 | 12 009 | 730 039 |
| 1993 | 465 382 | 123 589 | 240 044 | 829 015 | 413 984 | 96 290 | 224 788 | 9 775 | 744 837 |
| 1994 | 456 982 | 125 316 | 246 908 | 829 205 | 406 119 | 95 062 | 236 666 | 10 527 | 748 374 |
| 1995 | 462 033 | 142 854 | 269 583 | 874 471 | 408 678 | 108 495 | 258 830 | 10 916 | 786 920 |
| 1996 | 500 852 | 143 595 | 286 941 | 931 388 | 444 819 | 109 225 | 275 944 | 14 015 | 844 004 |
| 1997 | 500 232 | 152 325 | 276 551 | 929 108 | 433 477 | 114 973 | 265 706 | 13 122 | 827 278 |
| 1998 | 529 597 | 133 791 | 283 920 | 947 308 | 461 986 | 90 343 | 273 204 | 12 285 | 837 817 |
| 1999 | 501 567 | 132 620 | 288 876 | 923 063 | 438 953 | 92 348 | 278 086 | 11 500 | 820 886 |
| 2000 | 490 110 | 150 040 | 275 681 | 915 831 | 431 049 | 105 431 | 265 047 | 12 180 | 813 706 |
| 2001 | 523 921 | 154 736 | 292 169 | 970 825 | 461 205 | 113 931 | 282 109 | 14 383 | 871 629 |
| 2002 | 537 674 | 157 556 | 295 485 | 990 716 | 477 374 | 112 595 | 285 061 | 16 278 | 891 307 |
| 2003 | 576 106 | 169 462 | 319 481 | 1 065 050 | 515 489 | 128 178 | 308 120 | 18 244 | 970 030 |
| 2004 | 586 519 | 167 417 | 315 695 | 1 069 631 | 516 071 | 125 150 | 305 363 | 22 110 | 968 694 |
| 2005 | 581 444 | 166 102 | 345 876 | 1 093 422 | 518 802 | 123 397 | 334 173 | 20 402 | 996 774 |
| 2006 | 584 636 | 167 881 | 315 391 | 1 067 908 | 521 623 | 121 604 | 303 198 | 28 613 | 975 037 |
| 2007 | 561 309 | 158 896 | 295 161 | 1 015 366 | 498 433 | 113 486 | 285 501 | 30 268 | 927 688 |

Energy consumption is lower in the sectoral approach because

(i) non–energy use of fuels is not considered in the sectoral approach except the share that is considered in fuel waste and reported as "Other Fuels",

(ii) transformation and distribution losses are not considered in the sectoral approach and

(iii) net calorific values for the different fuel types in the two approaches are different.

For solid fuels the difference is additionally caused by transformation losses from coking coal to coke oven coke and from coke oven coke and fuel oil to blast furnace gas which are not considered in the sectoral approach.

## 3.4 Feedstocks

Non-energy use of fuels is considered in the national energy balance. Below explanations for the reported non-energy use is provided together with information on where $CO_2$ emissions due to the manufacture, use and disposal of carbon containing products are considered.

For fraction of carbon stored the IPCC default values are applied for all fuels except for coke oven coke, of which the amount of carbon stored in steel was calculated.

**Lubricants**

manufacture: emissions are assumed to be included in total emissions from category *1 A 1 b* petroleum refinery.

use: emissions from the use of motor oil are included in $CO_2$ emissions from transport. VOC emissions from lubricants used in rolling mills are considered in category *2 C 1*. It is assumed that other uses of lubricants do not result in VOC or $CO_2$ emissions due to the low vapour pressure of lubricants.

disposal: emissions from incineration of lubricants (waste oil) are either included in categories *1 A 1 a* and *1 A 2* if waste oil is used as fuels or in category *6 C* respectively if energy is not recovered.

**Bitumen**

manufacture: emissions from the production of bitumen are assumed to be included in total emissions of category *1 A 1 b* petroleum refinery.

use: indirect $CO_2$ emissions from the use of bitumen for road paving and roofing that should be reported in categories *2 A 5* and *2 A 6* are included in sector *3 solvent and other product use*.

disposal: $CO_2$ emissions from the disposal from bitumen are assumed to be negligible. Recycling is not considered.

**Natural Gas**

manufacture: emissions from the use of natural gas as a feedstock in ammonia production are accounted for in the industrial processes sector (category *2 B 1*).

use/disposal: not applicable, no $CO_2$ emissions result from the use or disposal of ammonia.

**Coke oven coke**

manufacture: emissions from the production of coke are considered in category *1 A 2 a*.

use: $CO_2$ emissions from coke used in iron and steel industry are reported under *2 C*.

disposal: not applicable.

**Other bituminous coal**

In [IEA JQ 2008] non energy use is reported for the manufacture of electrodes.

manufacture: No information about emissions from manufacture of electrodes is currently available. Therefore it is not clear if emissions are not estimated or not applicable.

use: Emissions from the use of electrodes are considered in category *2 B 4* carbide production and *2 C* metal production.

disposal: not applicable.

**Other oil products**

manufacture: emissions from the production of ethylene and propylene are included in total emissions of category *1 A 1 b petroleum refinery*. $CO_2$ emissions from solvent use are considered in sector *3 solvent and other product use*.

use: $CO_2$ emissions from solvent use are considered in sector *3*.

<u>disposal</u>: emissions from the disposal of plastics in landfills are considered in *6 A* and from the use of plastic waste as a fuel in *1 A 2*; emissions from the incineration of plastic in waste without energy recovery is included in *6 C*; emissions from incineration of plastics in waste with energy recovery are considered in *1 A 1 a*.

## 3.5 Fugitive Emissions (CRF Category 1.B)

### 3.5.1 Source Category Description

In the year 2007 1.1% of national total emissions arise from IPCC Category *1 B Fugitive Emissions*. The only key source identified within this category is 1.B.2.b Natural Gas – $CH_4$.

#### 3.5.1.1 Emission Trends

Table 81 presents GHG emissions arising from this category, their share and trend from 1990 to 2007.

*Table 81: Greenhouse gas emissions from Category 1 B Fugitive Emissions.*

| | GHG emissions [Gg $CO_2$ equivalent] | | |
|---|---|---|---|
| | **Total** | **$CO_2$** | **$CH_4$** |
| 1990 | 486.75 | 102.03 | 384.72 |
| 1991 | 509.76 | 111.03 | 398.73 |
| 1992 | 536.56 | 120.03 | 416.54 |
| 1993 | 547.40 | 112.03 | 435.38 |
| 1994 | 576.71 | 127.53 | 449.19 |
| 1995 | 599.16 | 127.03 | 472.14 |
| 1996 | 569.60 | 71.03 | 498.57 |
| 1997 | 637.63 | 120.51 | 517.12 |
| 1998 | 670.08 | 141.83 | 528.25 |
| 1999 | 720.15 | 170.53 | 549.62 |
| 2000 | 730.01 | 164.53 | 565.48 |
| 2001 | 756.49 | 182.73 | 573.76 |
| 2002 | 763.78 | 167.03 | 596.75 |
| 2003 | 841.67 | 233.04 | 608.63 |
| 2004 | 863.08 | 210.04 | 653.05 |
| 2005 | 876.16 | 205.04 | 671.13 |
| 2006 | 930.92 | 232.04 | 698.88 |
| 2007 | 942.42 | 237.04 | 705.38 |
| *Share 2007* | 100% | 25% | 75% |
| *Trend 1990-2007* | 94% | 132% | 83% |

### 3.5.1.2 Completeness

Table 82 gives an overview of the IPCC 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 subcategories. A "✓" indicates that emissions from this sub-category have been estimated.

As can be seen in the table, emissions from solid fuel transformation (production of coke oven coke) are included in the energy sector (sub category *Iron and Steel*), because the only solid fuel transformation occurring in Austria is one coking plant as part of an integrated iron and steel site.

Furthermore, emissions from oil and from gas exploration and production are reported together under oil production (as oil and gas are extracted together at most sites) except $CO_2$ emissions from sour gas processing, which is reported separately under gas extraction.

Regarding petroleum refining, all $CO_2$ emissions, thus including flaring, are reported in the Energy Sector, as these are emissions due to combustion. Fugitive $CO_2$ losses are considered negligible. In category *1.B* only $CH_4$ and NMVOC emissions, included venting, are considered.

*Table 82: Overview of subcategories of Category 1.B Fugitive Emissions: transformation into SNAP Codes and status of estimation.*

| IPCC Category | SNAP | Status | |
|---|---|---|---|
| | | $CO_2$ | $CH_4$ |
| **1 B 1 a Coal Mining and Handling** | | | |
| i Underground Mines | 050102 Underground mining | NO | NO |
| ii Surface Mines | 050101 Open cast mining | NA | ✓ |
| **1 B 1 b Solid Fuel Transformation** | | IE[1)] | IE[1)] |
| **1 B 2 a Oil** | | | |
| i Exploration | 0502 Extraction, 1st treatment and loading of liquid fossil fuels | IE[2)] | IE[2)] |
| ii Production | | ✓ | ✓ |
| iii Transport | 050502 Transports and Depots | IE[2)] | IE[2)] |
| iv Refining/Storage | 0401 Processes in Petroleum Industries | NA[3)] | ✓ |
| v Distribution of oil products | 0504 Liquid fuel distribution<br>0505 Petrol distribution | NA | NA[4)] |
| **1 B 2 b Natural Gas** | | | |
| i Exploration | 0503 Extraction, 1st treatment and loading of gaseous fossil fuels | NA | IE[2)] |
| ii Production/Processing | | ✓[2)] | |
| iii Transmission | 050601 Pipelines/Storage | ✓ | ✓ |
| iv Distribution | 050603 Distribution Networks | NA | ✓ |
| v Other Leakage | | NO | NO |
| **1 B 2 c Venting/Flaring** | | IE[5)] | IE[6)] |

1) *included in 1 A 2 a Iron and Steel*

2) *1 B 2 a i Oil Exploration, 1 B 2 a iii Transport, 1 B 2 b Natural Gas Exploration and 1 B 2 b I Natural Gas Production/Processing, except $CO_2$ emissions from processing of sour gas, are included in 1 B 2 a ii.*

3) *$CO_2$ emissions due to combustion are included in 1 A 1 b Petroleum Refining, fugitive $CO_2$ emissions are assumed to be negligible.*

4) *also includes storage in storage tanks and refinery dispatch station – only NMVOC emissions are estimated as $CH_4$ emissions are assumed to be negligible.*

5) *included in 1 A 1 b Petroleum Refining*

6) *included in 1 B 2 a iv Petroleum Refining*

## 3.5.2 Methodological issues

### 3.5.2.1 1.B.1.a Fugitive Emissions from Fuels – Coal Mining

*Emissions:* $CH_4$

*Key Source: No*

This category covers methane emissions from one brown coal surface mine. $CH_4$ emissions from this category decreased by more than 50% from 1990 to 1999 due to lower mining activities. In the last years $CH_4$ emissions remain quite stable, but decrease strongly from 2003 to 2004 by minus 80%, following the trend of coal mined (see Table 83). Coal mining was stopped in 2007, thus the overall trend from the base year to 2007 is minus 100%.

Emissions are calculated by multiplying the amount of brown coal produced (= activity data) by the CORINAIR default emission factor of 214 g $CH_4$/ Mg coal (Emission Factor Data Base #11378[23]). Activity data are taken from the national energy balance, except for 2005 and 2006, because no activity is reported there, but in the yearbook of the *Association of Mining and Steel*.

*Table 83: Activity data (brown coal produced) and $CH_4$ emissions for Fugitive Emissions from Fuels – Coal Mining 1990–2007.*

| Year | Coal Mined [Mg] | $CH_4$ emissions [Gg] |
|---|---|---|
| 1990 | 2 447 710 | 0.524 |
| 1991 | 2 080 726 | 0.445 |
| 1992 | 1 746 756 | 0.374 |
| 1993 | 1 691 675 | 0.362 |
| 1994 | 1 369 217 | 0.293 |
| 1995 | 1 297 919 | 0.278 |
| 1996 | 1 108 558 | 0.237 |
| 1997 | 1 130 839 | 0.242 |
| 1998 | 1 140 651 | 0.244 |
| 1999 | 1 137 888 | 0.244 |
| 2000 | 1 254 605 | 0.268 |
| 2001 | 1 193 970 | 0.256 |
| 2002 | 1 411 819 | 0.302 |
| 2003 | 1 152 383 | 0.247 |
| 2004 | 235 397 | 0.050 |
| 2005 | 6 168 | 0.001 |
| 2006 | 6 677 | 0.001 |
| 2007 | NO | NO |

[23] http://www.ipcc-nggip.iges.or.jp/EFDB/main.php

### 3.5.2.2 1.B.2.a Fugitive Emissions from Fuels – Oil

*Emissions:* $CH_4$, $CO_2$

*Key Source:* *No*

In this category fugitive emissions from oil refining ($CH_4$) and $CO_2$ and $CH_4$ emissions from combined oil and gas production are considered. $CO_2$ emissions from the refinery resulting from combustion processes (including flaring) are included in *1 A 1 b Petroleum Refining*.

For transport, distribution and storage only NMVOC emissions are estimated, the $CH_4$ content of the NMVOC emissions is assumed to be negligible.

#### Refining

Methane emissions from refining are calculated using IPCC Tier 1 methodology (reference manual chapter 1.8).

Emissions are calculated by multiplying the amount of crude oil input (= activity data) by an emission factor. Activity data are taken from the national energy balance (see Table 84).

The implied emission factor of 31.66 $CH_4$ g/t crude oil resulted from multiplying an average value of 745 kg $CH_4$/PJ crude oil input for methane emissions from this category (selected from table 1-58 of the IPCC Reference Manual) by the net calorific value of 42.5 GJ/t oil (taken from the national energy balance).

#### Production

The amount of gas produced was reported by the *Association of the Austrian Petroleum Industry* (see Table 84).

Methane emissions for the years 1992 to 2006 from combined oil and gas production was also reported by the *Association of the Austrian Petroleum Industry*, they were calculated according to „SHELL Paper Environment/Storage – References 1) USA EPA1986, AP-42 and 2) E&P Forum 1994, Report 2.59/197".

$CO_2$ emissions from production were also reported by the *Association of the Austrian Petroleum Industry*, they have been calculated according to the composition of the raw gas (the reported $CO_2$ emissions refer to $CO_2$ that has been separated from the raw gas).

*Table 84: Activity data (Crude Oil Refined and Gas Produced, respectively) and emissions for Fugitive Emissions from Fuels – Oil Refining and Production 1990–2007.*

| | Refining | | Production | | | | |
|---|---|---|---|---|---|---|---|
| **Year** | **Crude Oil Refined [Gg]** | **$CH_4$ [Gg]** | **Gas Produced [Mio m³]** | **$CH_4$ [Gg]** | **IEF $CH_4$ [kg/ 1 000 m³]** | **$CO_2$ [Gg]** | **IEF $CO_2$ [kg/ 1 000 m³]** |
| 1990 | 7 952 | 0.25 | 1 288 | 4.56 | 3.54 | 43 | 33 |
| 1991 | 8 273 | 0.26 | 1 326 | 4.56 | 3.44 | 43 | 32 |
| 1992 | 8 732 | 0.28 | 1 437 | 4.56 | 3.17 | 40 | 28 |
| 1993 | 8 522 | 0.27 | 1 488 | 4.54 | 3.05 | 37 | 25 |
| 1994 | 8 898 | 0.28 | 1 355 | 4.50 | 3.32 | 48 | 35 |
| 1995 | 8 619 | 0.27 | 1 482 | 4.41 | 2.97 | 38 | 26 |
| 1996 | 8 754 | 0.28 | 1 492 | 4.47 | 3.00 | 41 | 27 |

| Refining | | | Production | | | | |
|---|---|---|---|---|---|---|---|
| Year | Crude Oil Refined [Gg] | $CH_4$ [Gg] | Gas Produced [Mio m³] | $CH_4$ [Gg] | IEF $CH_4$ [kg/ 1 000 m³] | $CO_2$ [Gg] | IEF $CO_2$ [kg/ 1 000 m³] |
| 1997 | 9 374 | 0.30 | 1 428 | 4.55 | 3.18 | 31 | 22 |
| 1998 | 9 190 | 0.29 | 1 568 | 4.39 | 2.80 | 61 | 39 |
| 1999 | 8 635 | 0.27 | 1 741 | 4.15 | 2.38 | 90 | 52 |
| 2000 | 8 240 | 0.26 | 1 805 | 4.03 | 2.23 | 72 | 40 |
| 2001 | 8 799 | 0.28 | 1 954 | 4.1 | 2.1 | 88 | 45 |
| 2002 | 8 947 | 0.28 | 2 014 | 4.18 | 2.08 | 84 | 42 |
| 2003 | 8 819 | 0.28 | 2 030 | 3.92 | 1.93 | 133 | 66 |
| 2004 | 8 442 | 0.27 | 1 963 | 5.11 | 2.6 | 122 | 62 |
| 2005 | 8 743 | 0.28 | 1 637 | 5.21 | 3.18 | 122 | 75 |
| 2006 | 8 472 | 0.27 | 1 819 | 5.51 | 3.03 | 140 | 77 |
| 2007 | 8 546 | 0.27 | 1 848 | 5.62 | 3.04 | 142 | 77 |

#### 3.5.2.3 1.B.2.b Fugitive Emissions from Fuels – Natural Gas

*Emissions:* $CH_4$, *$CO_2$*

*Key Source: Yes ($CH_4$)*

$CH_4$ emissions from *1.B.2.b Natural gas* is a key source because of the contribution both to the level of all years of the greenhouse gas inventory and to the trend. In 2007 fugitive $CH_4$ emissions from natural gas contributed 0.7% to total greenhouse gas emissions in Austria.

In this category $CO_2$ emissions from sour gas processing, $CH_4$ emissions from gas distribution and $CO_2$ and $CH_4$ emissions from gas transmission and storage are reported.

$CO_2$ emissions from this category mainly arise from sour gas processing; the trend is increasing emissions due to increasing gas production. Gas transmission is only a minor source of $CO_2$ emissions.

*Sour Gas Processing*

$CO_2$ emissions from natural gas production (sour gas processing) are reported by the *Association of the Austrian Petroleum Industry* (see Table 85) and were calculated from sour gas composition. Activity data for natural gas production are reported by the *Association of the Austrian Petroleum Industry* (see Table 85).

*Distribution*

Emissions from natural gas distribution are calculated using the mean IPCC default emission factor of 0.615 Mg $CH_4$ per km of distribution mains (IPCC GPG Table 2.16).

Activity data for natural gas distribution were taken from publications from the *Austrian Natural Gas and District Heat Association* and from direct information from E-Control (Austrian Energy Regulator).

*Transmission, Storage*

Pipeline lengths and natural gas stored were taken from annual reports of the *Association of the Austrian Petroleum Industry* (if no value was available for a certain year, the value of the year before or after was used) and from direct information from E-Control (Austrian Energy Regulator).

Emission factors were taken from the IPCC GPG Table 2.16 (for transmission sum of lower values for venting and fugitives; for storage the lower value).

*Table 85: Activity data and emissions for Fugitive Emissions from Fuels – Natural Gas Distribution and Sour Gas Processing 1990–2007.*

| Year | Natural Gas Distribution | | Sour Gas Processing | |
|---|---|---|---|---|
| | Gas network [km] | $CH_4$ Emissions [Gg] | Sour Gas Prod. [1 000 m³] | $CO_2$ Emissions [Gg] |
| 1990 | 15 200 | 9.35 | 248 090 | 59 |
| 1991 | 16 396 | 10.08 | 285 901 | 68 |
| 1992 | 17 779 | 10.93 | 357 135 | 80 |
| 1993 | 19 051 | 11.72 | 321 653 | 75 |
| 1994 | 20 743 | 12.76 | 363 582 | 80 |
| 1995 | 22 358 | 13.75 | 405 638 | 89 |
| 1996 | 23 391 | 14.39 | 136 737 | 30 |
| 1997 | 24 661 | 15.17 | 406 177 | 89 |
| 1998 | 25 792 | 15.86 | 367 195 | 81 |
| 1999 | 27 300 | 16.79 | 352 318 | 81 |
| 2000 | 28 800 | 17.71 | 358 357 | 93 |
| 2001 | 29 700 | 18.27 | 393 492 | 95 |
| 2002 | 31 500 | 19.37 | 347 513 | 83 |
| 2003 | 32 000 | 19.68 | 408 198 | 100 |
| 2004 | 33 800 | 20.79 | 373 099 | 88 |
| 2005 | 34 750 | 21.37 | 338 349 | 83 |
| 2006 | 35 350 | 21.74 | 402 990 | 92 |
| 2007 | 35 720 | 21.97 | 444 029 | 95 |

*Table 86: Activity data and emissions for Fugitive Emissions from Fuels – Natural Gas Transmission and Storage 1990–2007.*

| Year | Natural Gas Transmission (Pipelines Fugitive & Venting) | | | Natural Gas Storage | |
|---|---|---|---|---|---|
| | Pipelines [km] | $CH_4$ Emissions [Gg] | $CO_2$ Emissions [Gg] | Natural Gas Stored [Mm³] | $CH_4$ Emissions [Gg] |
| 1990 | 1 032 | 2.99 | 0.03 | 1 500 | 0.65 |
| 1991 | 1 032 | 2.99 | 0.03 | 1 500 | 0.65 |
| 1992 | 1 032 | 2.99 | 0.03 | 1 625 | 0.70 |
| 1993 | 1 032 | 2.99 | 0.03 | 1 980 | 0.85 |
| 1994 | 1 032 | 2.99 | 0.03 | 1 329 | 0.57 |

| Year | Natural Gas Transmission (Pipelines Fugitive & Venting) | | | Natural Gas Storage | |
|---|---|---|---|---|---|
| | Pipelines [km] | $CH_4$ Emissions [Gg] | $CO_2$ Emissions [Gg] | Natural Gas Stored [Mm³] | $CH_4$ Emissions [Gg] |
| 1995 | 1 032 | 2.99 | 0.03 | 1 820 | 0.78 |
| 1996 | 1 238 | 3.59 | 0.03 | 1 820 | 0.78 |
| 1997 | 1 238 | 3.59 | 0.03 | 1 820 | 0.78 |
| 1998 | 1 238 | 3.59 | 0.03 | 1 820 | 0.78 |
| 1999 | 1 358 | 3.94 | 0.03 | 1 820 | 0.78 |
| 2000 | 1 358 | 3.94 | 0.03 | 1 665 | 0.72 |
| 2001 | 1 358 | 3.94 | 0.03 | 1 132 | 0.49 |
| 2002 | 1 358 | 3.94 | 0.03 | 789 | 0.34 |
| 2003 | 1 430 | 4.15 | 0.04 | 1 651 | 0.71 |
| 2004 | 1 430 | 4.15 | 0.04 | 1 716 | 0.74 |
| 2005 | 1 430 | 4.15 | 0.04 | 2 207 | 0.95 |
| 2006 | 1 548 | 4.49 | 0.04 | 2 962 | 1.27 |
| 2007 | 1 548 | 4.49 | 0.04 | 2 886 | 1.24 |

### 3.5.3 QA/QC

This source category is covered by the general QA/QC of the greenhouse gas inventory in Chapter 1.6. Additional checks performed are cross-checks between activities reported by the operators and activities from national statistics, wherever possible.

### 3.5.4 Uncertainty

For the key source 1.B.2.b Natural Gas – $CH_4$ an uncertainty estimate was made that was calculated from the combination of estimated uncertainties of the sub-sources.

*Transmission*: The total pipeline length crossing Austria is assumed to be well known (5% uncertainty). The uncertainty of the EF is estimated according to the range given in the GPG (40%).

*Storage*: The uncertainty of the AD (20%) results from the fact that the value reported for natural gas stored corresponds to the meter reading at the end of the respective year and not to a mean value of daily meter readings. The uncertainty of the EF is assumed to be high (100%), because of the wide range that is given in the GPG.

*Distribution*: The total length of distribution mains is assumed to be well known (5% uncertainty) The uncertainty of the EF is estimated according to the range given in the GPG (15%).

This leads to the combined uncertainty (using the Tier 1 approach, with weights for the contribution to total source emissions) of 4% for AD, 14% for EF, resulting in a total uncertainty of emissions of 15%.

### 3.5.5 Recalculations

***Update of activity data***

*1.B.2.a Refining/Storage: Activity data for 2005 and 2006 was updated according to data from the national energy balance*

### 3.5.6 Planned improvements

Detailed information on fugitive emissions from natural gas distribution, transmission and storage have been collected in a national study for the year 1999. It is planned to investigate the possibility of deriving national emission factors from this information and thus implementing a higher Tier method for calculation of emissions from 1.B.2.b Natural gas in the future.

# 4 INDUSTRIAL PROCESSES (CRF SECTOR 2)

## 4.1 Sector Overview

This chapter includes information on and descriptions of methodologies used for estimating greenhouse gas emissions as well as references for activity data and emission factors reported under IPCC Category *2 Industrial Processes* for the period from 1990 to 2007.

Emissions from this category comprise emissions from the following sub categories: *Mineral Products*, *Chemical Industry*, *Metal Production* and *Consumption of Halocarbons and* $SF_6$.

Only process related emissions are considered in this Sector; emissions due to fuel combustion in manufacturing industries are allocated in IPCC Category *1 A 2 Fuel Combustion – Manufacturing Industries and Construction* (see Chapter 3).

Categories where emissions are not occurring because there is no such production in Austria, and categories that are not estimated or included elsewhere are summarized in Table 94.

### 4.1.1 Emission Trends

In the year 2007, 12.8% of national total greenhouse gas emissions (without LULUCF) originnated from industrial processes, the same as in the base year 1990.

Greenhouse gas emissions from the industrial processes sector fluctuate during the period; they reach a minimum in 1993, which is mainly due to termination of primary aluminium production in Austria in 1992 which is an important source for PFC emissions. Since then emissions are slightly increasing, mainly due to increasing emissions from consumption of fluorinated compounds and iron and steel industry. From 2003 to 2004 emissions decrease again due to a strong decrease of $N_2O$ emissions from Chemical Industry. Since then emissions are increasing again due to strongly increasing activities in the iron and steel industry.

In 2007, greenhouse gas emissions from Category *2 Industrial Processes* amount to 11 277 Gg $CO_2$ equivalent compared to 10 111 Gg in the base year.

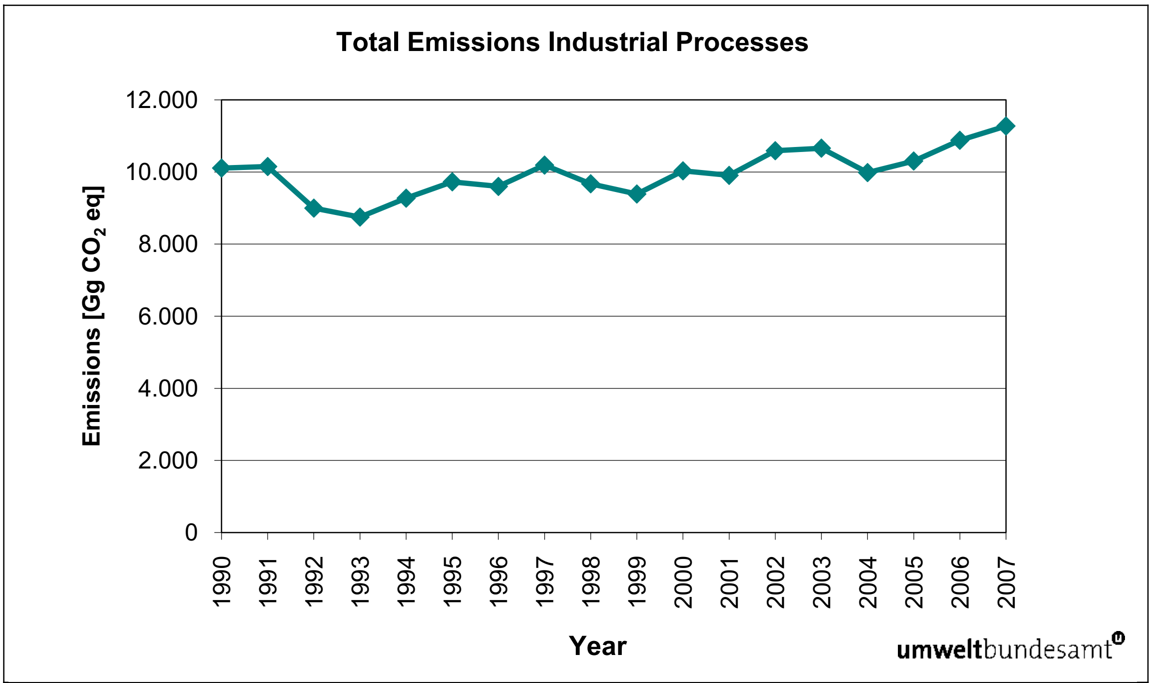


*Figure 15: GHG emissions from IPCC Sector 2 Industrial Processes 1990–2007.*

### Emission trends by gas

Table 87 presents greenhouse gas emissions of the industrial processes sector as well as their share in total greenhouse gas emissions from that sector in the base year and in 2007.

*Table 87: Greenhouse gas emissions from 2 Industrial Processes by gas in the base year and in 2007.*

| GHG | Base year* | 2007 | Base year* | 2007 |
|---|---|---|---|---|
| | $CO_2$ equivalent [Gg $CO_2$e] | | [%] | |
| Total | 10 110.82 | 11 277.19 | *100.0%* | *100%* |
| $CO_2$ | 7 579.11 | 9 535.22 | *75.0%* | *84.6%* |
| $CH_4$ | 14.83 | 19.05 | *0.1%* | *0.2%* |
| $N_2O$ | 912.02 | 270.01 | *9.0%* | *2.4%* |
| HFCs | 23.03 | 860.63 | *0.2%* | *7.6%* |
| PFCs | 1 079.24 | 182.71 | *10.7%* | *1.6%* |
| $SF_6$ | 502.58 | 409.58 | *5.0%* | *3.6%* |

* *1990 for all gases*

The most important GHG of the industrial processes sector is carbon dioxide with 84.6% of emissions from this category in 2007, followed by HFCs with 7.6%, $SF_6$ with 3.6%, $N_2O$ with 2.4%, PFCs with 1.6% and finally $CH_4$ with 0.2%.

*Table 88: Emissions from IPCC Category 2 Industrial Processes by gas from 1990–2007 and their trend.*

| GHG emissions [Gg $CO_2$e] | | | | | | | |
|---|---|---|---|---|---|---|---|
| | Total | $CO_2$ | $CH_4$ | $N_2O$ | HFCs | PFCs | $SF_6$ |
| 1990 | 10 111 | 7 579 | 15 | 912 | 23 | 1 079 | 503 |
| 1991 | 10 153 | 7 425 | 15 | 927 | 45 | 1 087 | 653 |
| 1992 | 8 999 | 6 939 | 14 | 837 | 49 | 463 | 698 |
| 1993 | 8 751 | 6 853 | 15 | 879 | 157 | 53 | 794 |
| 1994 | 9 275 | 7 183 | 15 | 825 | 207 | 59 | 986 |
| 1995 | 9 729 | 7 382 | 14 | 857 | 267 | 69 | 1 139 |
| 1996 | 9 601 | 7 081 | 15 | 874 | 347 | 66 | 1 218 |
| 1997 | 10 193 | 7 671 | 15 | 863 | 427 | 97 | 1 120 |
| 1998 | 9 674 | 7 315 | 15 | 897 | 495 | 45 | 908 |
| 1999 | 9 391 | 7 162 | 15 | 923 | 542 | 64 | 684 |
| 2000 | 10 034 | 7 766 | 15 | 952 | 596 | 72 | 633 |
| 2001 | 9 907 | 7 694 | 14 | 786 | 694 | 82 | 637 |
| 2002 | 10 591 | 8 261 | 15 | 807 | 781 | 87 | 641 |
| 2003 | 10 662 | 8 205 | 15 | 883 | 863 | 102 | 594 |
| 2004 | 9 985 | 8 154 | 15 | 281 | 897 | 126 | 513 |
| 2005 | 10 306 | 8 697 | 16 | 274 | 908 | 125 | 286 |
| 2006 | 10 881 | 9 105 | 19 | 280 | 861 | 136 | 480 |
| 2007 | 11 277 | 9 535 | 19 | 270 | 861 | 183 | 410 |
| Trend 1990-2007 | 12% | 26% | 28% | -70% | 3637% | -83% | -19% |

### *$CO_2$ emissions*

As can be seen in Figure 16, $CO_2$ emissions from the industrial processes sector fluctuate during the period from 1990 to 2000; since 2001 the emissions tend upwards mainly due to increasing emissions from metal production. In 2007 $CO_2$ emissions from *Industrial Processes* amount to 9 535 Gg $CO_2$ equivalent, which corresponds to an increase of 26% compared to base year emissions.

About 58% of $CO_2$ emissions originate from *Metal Production* (mainly *Iron and Steel Production*) and about 37% from *Mineral Products*. The rest originates from *Chemical Industry* (mainly *Ammonia Production*).

### *$CH_4$ emissions*

As can be seen in Figure 16, $CH_4$ emissions from Industrial Processes fluctuate over the period from 1990 to 2004, since then they show an increasing trend, mainly due to augmented capacity in ethylene production. In 2007 emissions are 28% above base year level.

$CH_4$ emissions from this sector mainly arise from *Chemical Industry (Production of Urea and Fertilizers, Ethylene and Ammonia);* a minor source for $CH_4$ emissions is *Metal Production (Electric Furnace Steel Plants, Rolling Mills)*.

### *$N_2O$ emissions*

$N_2O$ emissions from this sector arise from *Nitric Acid Production (Chemical Industry)*. As can be seen in Figure 16, $N_2O$ emissions from the industrial processes sector fluctuate until 2000. From 2000 to 2001 emissions drop by 17%; this is due to the introduction of a new catalyst in the nitric acid plant. After an increase until 2003, emissions decrease strongly from 2003 to 2004 by 68%. This decrease is due to the installation of a $N_2O$ decomposition facility in the nitric acid plant.

In 2007, $N_2O$ emissions from *Industrial Processes* are 70% below the level of the base year.

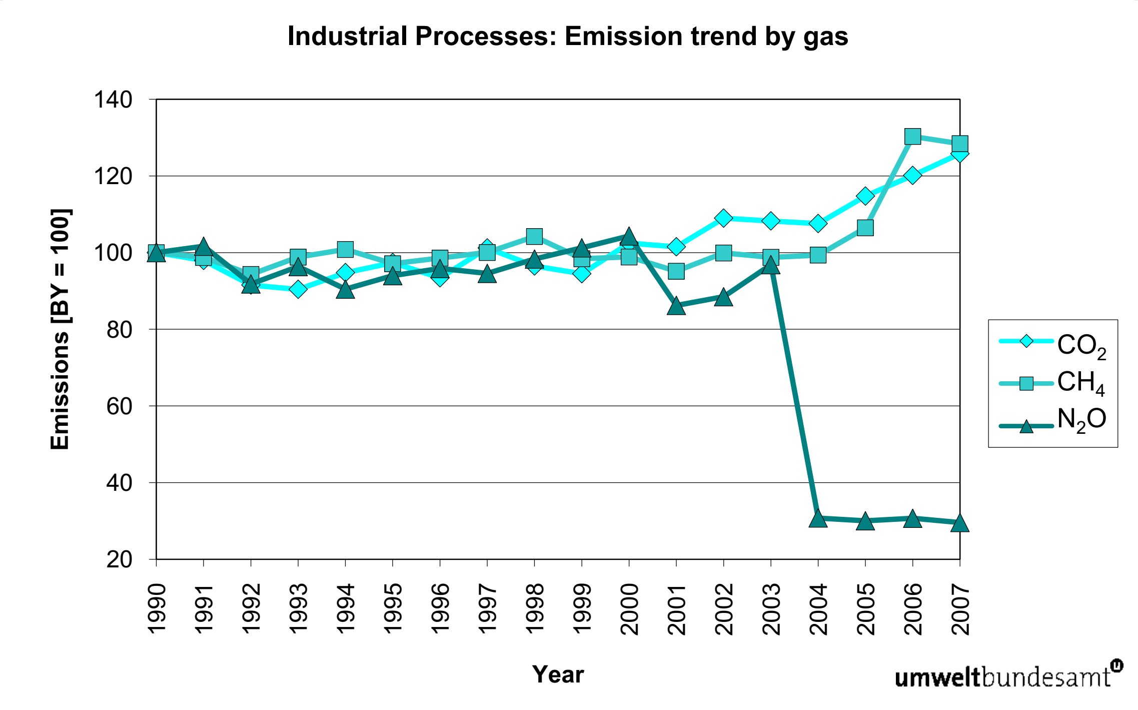


*Figure 16: $CO_2$, $CH_4$ and $N_2O$ emissions from Industrial Processes 1990–2007 in index form (base year = 100).*

### *HFC emissions*

As can be seen in Figure 17, HFC emissions increase remarkably during the period from 1990 to 2005. From 2005 to 2007 emissions decreased by 5.2% to 861 Gg $CO_2$ equivalents, which is about 40 times the level of the base year (1990).

HFC emissions mainly arise from *Refrigeration and Air Conditioning Equipment* and *Foam Blowing*.

### *PFC emissions*

As can be seen in Figure 17, PFC emissions decrease remarkably during the period from 1990 to 2006. In 1990 PFC emissions amount to 1 079 Gg $CO_2$ equivalent, they decrease until 1993 to around 53 Gg $CO_2$ equivalent due to the termination of primary aluminium production in 1992 which was the major source for PFC emissions. Since then PFC emissions increased, and in the year 2007 they amounted to 183 Gg $CO_2$ equivalent, which is 83% below the level of the base year (1990). In 2007 PFC emissions only arise from semiconductor manufacture.

### *$SF_6$ emissions*

As can be seen in Figure 17, $SF_6$ emissions increase at the beginning of the period and reach a maximum in 1996, since then $SF_6$ emissions are decreasing again. The strong decrease between 2004 and 2005 is explained by a lower $SF_6$ use in Semiconductor Manufacture. The subsequent increase in 2006 is due to emissions from disposal of noise insulating windows. In 2007 $SF_6$ emissions amount to 410 Gg $CO_2$ equivalent, 19% below the level of the base year (1990).

In 2007 $SF_6$ emissions arise mainly from semiconductor manufacture, electric equipment and noise insulating windows.

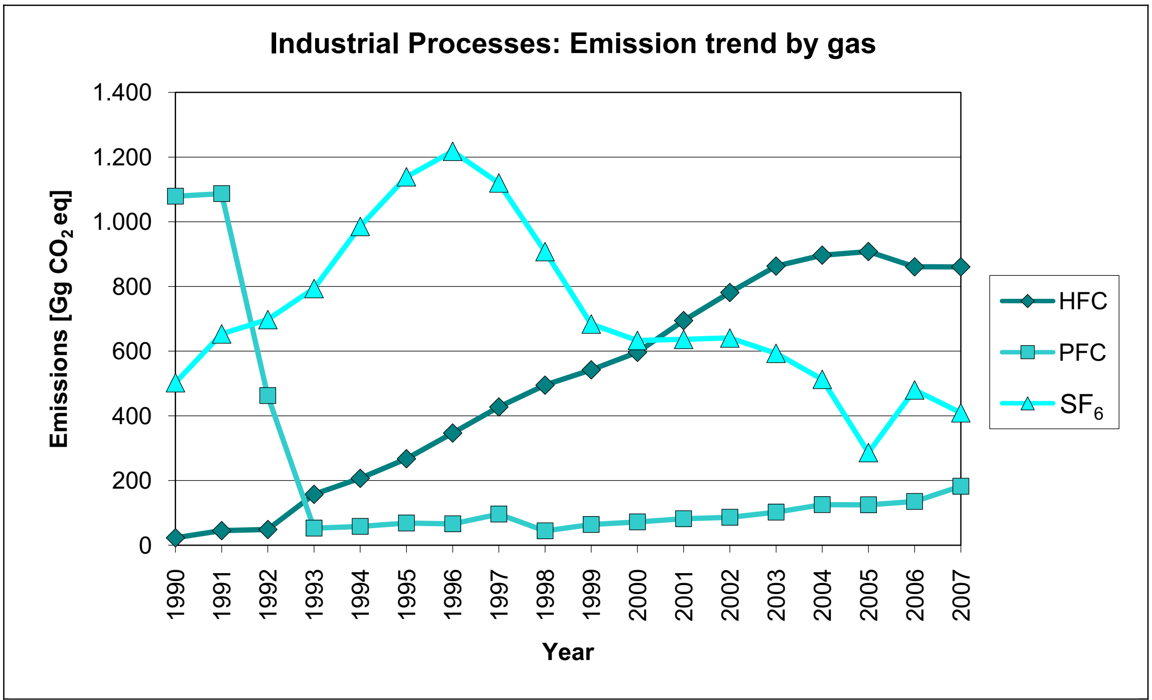


*Figure 17: HFC, PFC and $SF_6$ emissions from Industrial Processes 1990–2007.*

### Emission trends by sources

The main sources of greenhouse gas emissions in the industrial processes sector are *Metal Production* and *Mineral Products*, which cause 49% and 31%, respectively, of the emissions from this sector in 2007 (see Table 89).

Emissions from processes in *Iron and Steel Production* are the most important single source of the industry sector. It is also one of the ten most important sources of Austria's greenhouse gas inventory (see below and Chapter 1.5.1).

*Table 89: Greenhouse gas emissions from IPCC Category 2 Industrial Processes by sector, their share and trend for the base year and 2007.*

| | Emissions [Gg $CO_2$e] | | Share [%] | | Trend BY–2007 |
|---|---|---|---|---|---|
| | BY* | 2007 | BY* | 2007 | |
| 2 Industrial Processes | 10 110.82 | 11277.19 | 100.0% | 100.0% | 11.5% |
| A Mineral Products | 3 269.05 | 3505.54 | 32.3% | 31.1% | 7.2% |
| B Chemical Industry | 1 511.91 | 819.59 | 15.0% | 7.3% | -45.8% |
| C Metal Production | 5 028.54 | 5499.14 | 49.7% | 48.8% | 9.4% |
| F Consumption of Halocarbons and $SF_6$ | 301.33 | 1452.91 | 3.0% | 12.9% | 382.2% |

* *1990 for all gases*

Figure 18 and Table 90 present greenhouse gas emissions from IPCC Category *2 Industrial Processes* by sub category for the years 1990 to 2007.

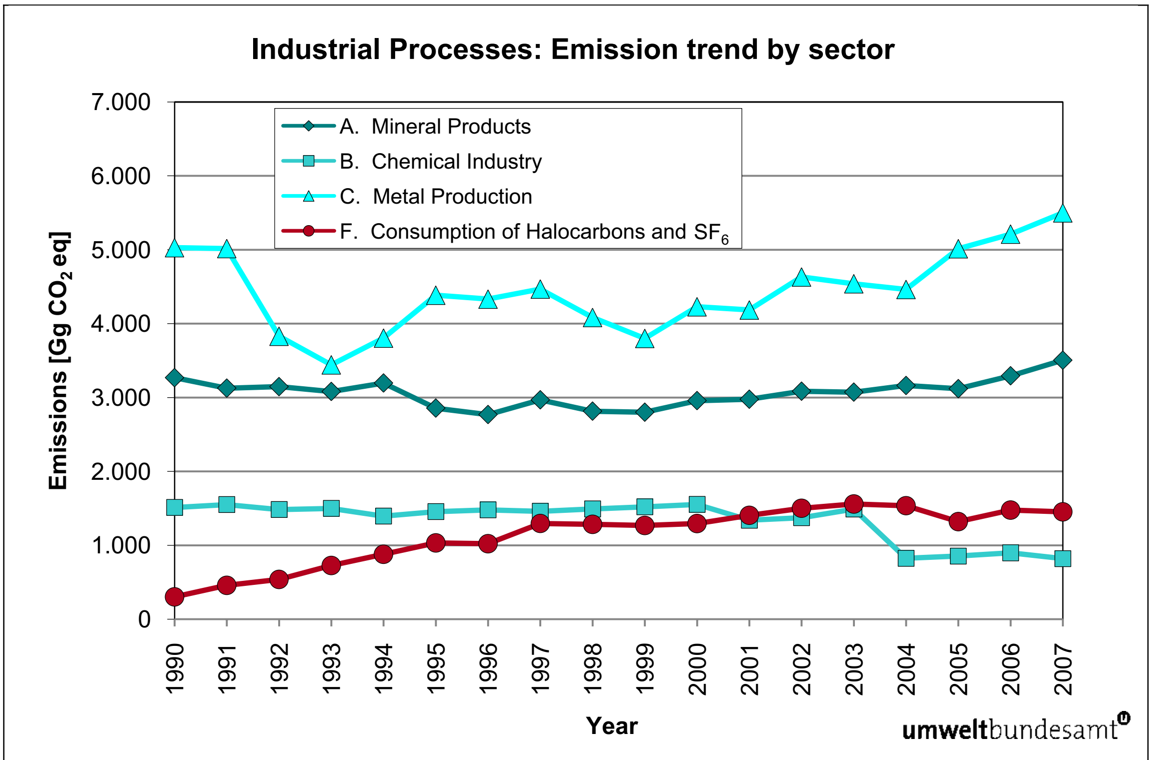


*Figure 18: Emissions from IPCC Category 2 Industrial Processes per sub sector 1990–2007.*

*Table 90: Total greenhouse gas emissions from 1990–2007 by subcategories of Category 2 Industrial Processes.*

| | GHG emissions [Gg $CO_2$ equivalent] | | | | |
|---|---|---|---|---|---|
| | **2 Total** | **2.A** | **2.B** | **2.C** | **2.F** |
| 1990 | 10 111 | 3 269 | 1 512 | 5 029 | 301 |
| 1991 | 10 153 | 3 127 | 1 551 | 5 016 | 458 |
| 1992 | 8 999 | 3 147 | 1 484 | 3 830 | 538 |
| 1993 | 8 751 | 3 082 | 1 499 | 3 443 | 727 |
| 1994 | 9 275 | 3 196 | 1 395 | 3 805 | 878 |
| 1995 | 9 729 | 2 857 | 1 455 | 4 385 | 1 032 |
| 1996 | 9 601 | 2 769 | 1 479 | 4 332 | 1 020 |
| 1997 | 10 193 | 2 969 | 1 460 | 4 468 | 1 295 |
| 1998 | 9 674 | 2 815 | 1 492 | 4 084 | 1 283 |
| 1999 | 9 391 | 2 801 | 1 521 | 3 801 | 1 268 |
| 2000 | 10 034 | 2 958 | 1 553 | 4 228 | 1 294 |
| 2001 | 9 907 | 2 977 | 1 340 | 4 185 | 1 405 |
| 2002 | 10 591 | 3 085 | 1 373 | 4 632 | 1 501 |
| 2003 | 10 662 | 3 073 | 1 490 | 4 540 | 1 559 |
| 2004 | 9 985 | 3 163 | 824 | 4 463 | 1 536 |
| 2005 | 10 306 | 3 120 | 853 | 5 014 | 1 320 |
| 2006 | 10 881 | 3 294 | 899 | 5 212 | 1 477 |
| 2007 | 11 277 | 3 506 | 820 | 5 499 | 1 453 |

### *2.A Mineral Products*

Greenhouse gas emissions increased by 7% from 1990 to 2007 in this sub-category. In this sub-category emissions from *Magnesia Sinter Production* and Soda ash use decreased between 1990 and 2007. Emissions from *Lime Production, Limestone and Dolomite Use and Bricks* increased and emissions from *Cement Production* exceed base year level in 2007, after a minimum in 1995–1996.

Only $CO_2$ emissions arise from this category.

### *2.B Chemical Industry*

For the source *Chemical Industry* greenhouse gas emissions remain quite stable over the period from 1990 to 2003. From 2003 to 2004 emissions decrease by 45%, because of implemented mitigation techniques in the nitric acid production. In 2007 emissions are 46% below the level of the base year.

The main sources of this sub-category are $CO_2$ emissions from ammonia production and $N_2O$ emissions from nitric acid production.

### *2.C Metal Production*

Greenhouse gas emissions from *Metal Production* fluctuated over the period, which is mainly a result of a drop in PFC emissions from primary aluminium production which was terminated in 1992, and a strong increase in $CO_2$ emissions from *Iron and Steel Production* (+55%). The overall trend is a increase by 9% related to emissions of the base year (1990).

The main source of this sector is $CO_2$ emissions from pig iron production.

***2.F Consumption of Halocarbons and $SF_6$***

In 2007 greenhouse gas emissions are nearly 5 times higher than base year emissions for the sub-category *Consumption of Halocarbons and $SF_6$.* This increase is mainly due to the higher consumption of HFCs as substitutes for ozone depleting substances (*ODS Substitutes*).

## 4.1.2 Key Categories

The methodology and results of the key category analysis is presented in Chapter 1.5.1. Table 91 summarizes the key sources in the IPCC Sector *2 Industrial Processes*.

*Table 91: Key categories of Sector 2 Industrial Processes.*

| IPCC Category | Source Categories | Key Sources | |
|---|---|---|---|
| | | GHG | KS-Assessment |
| 2.A.1 | Cement Production | $CO_2$ | LA90,07 |
| 2.A.2 | Lime Production | $CO_2$ | All |
| 2.A.3 | Limestone and Dolomite Use | $CO_2$ | LA07 |
| 2.A.7.b | Magnesia Sinter Plants | $CO_2$ | All |
| 2.B.1 | Ammonia Production | $CO_2$ | LA90,07 |
| 2.B.2 | Nitric Acid Production | $N_2O$ | LA90, TA |
| 2.C.1 | Iron and Steel Production | $CO_2$ | All |
| 2.C.3 | Aluminium production | PFCs | LA90, TA |
| 2.C.3 | Aluminium production | $CO_2$ | TA |
| 2.C.4 | $SF_6$ used in Al and Mg Foundries | $SF_6$ | TA |
| 2.F.1/2/3/4/5 | ODS Substitutes | HFCs | LA07, TA |
| 2.F.7 | Semiconductor Manufacture | FCs | LA07 |
| 2.F.9 | Other Sources of SF6 | $SF_6$ | Q |

*LA90 = Level Assessment 1990*

*LA07 = Level Assessment 2007*

*TA = Trend Assessment BY–2007*

*Q = Qualitative Assessment*

In the base year (1990), 12.5% of total greenhouse gas emissions in Austria originate from the 13 key categories of the industrial processes sector the same percentage as in 2007. These key categories cover 97% of total emissions from IPCC Sector *2 Industrial Processes.* The most important key category is *Iron and Steel Production* which has a share of 6.2% in total emissions in 2007. Emissions from *Cement Production* contribute 2.4% to total emissions 2007 and 1.0% of total emissions originate from *ODS Substitutes*. All other key categories of the industrial processes sector had a share of less than 1% in national total greenhouse gas emissions in 2007 (see Table 92).

*Table 92: Level Assessment for the base year and 2007 for the key categories of Category 2 Industrial Processes.*

| IPCC Category | Source Categories | GHG | Level Assessment | |
|---|---|---|---|---|
| | | | BY | 2007 |
| 2.A.1 | Cement Production | $CO_2$ | 2.6% | 2.4% |
| 2.A.2 | Lime Production | $CO_2$ | 0.5% | 0.7% |
| 2.A.3 | Limestone and Dolomite Use | $CO_2$ | 0.3% | 0.3% |
| 2.A.7.b | Magnesia Sinter Plants | $CO_2$ | 0.6% | 0.4% |
| 2.B.1 | Ammonia Production | $CO_2$ | 0.7% | 0.5% |
| 2.B.2 | Nitric Acid Production | $N_2O$ | 1.2% | 0.3% |
| 2.C.1 | Iron and Steel Production | $CO_2$ | 4.5% | 6.2% |
| 2.C.3 | Aluminium production | PFCs | 1.3% | 0.0% |
| 2.C.3 | Aluminium production | $CO_2$ | 0.2% | 0.0% |
| 2.C.4 | $SF_6$ used in Al and Mg Foundries | $SF_6$ | 0.3% | 0.0% |
| 2.F.1/2/3/4/5 | ODS Substitutes | HFCs | 0.0% | 1.0% |
| 2.F.7 | Semiconductor Manufacture | FCs | 0.2% | 0.3% |
| 2.F.9 | Other Sources of $SF_6$ | $SF_6$ | 0.2% | 0.3% |

## 4.1.3 Methodology

The general method for estimating emissions for the industrial processes sector, as recommended by the IPCC, involves multiplying production data for each process by an emission factor per unit of production.

In some categories emission and production data were reported directly by industry or associations of industries and thus represent plant specific data. Methodologies are described for all IPCC categories.

For the sub category *2.B.1 Ammonia Production* the applied methodology is similar to the IPCC Tier 2 including accounting for C bound using CS parameters and also accounting for emissions from urea to avoid double counting of emissions. As this method also uses country specific parameters it is – in terms of the QMS – a CS method. Consequently, this method was officially approved by the accreditation body in April 2008.

Detailed information on the methodology can be found in the corresponding subchapters.

### 4.1.3.1 Emission data reported under the European Emission Trading Scheme (ETS)

Verified $CO_2$ emissions reported under the EU ETS were available for the years 2005-2007. These emissions have been incorporated in the inventory as far as possible (see respective sub-chapters for more information). The relevant sources are 2.A.1 Cement Production, 2.A.2 Lime Production, 2.A.3 Limestone and Dolomite Use, 2.A.4 Soda Ash Use, 2.A.7a Bricks production, 2.A.7b Magnesia Sinter Plants and 2.C.1 Iron and Steel. Special attention was given to time-series consistency. Furthermore the background data for the emission calculations under the ETS were used for further QA/QC checks.

### 4.1.4 Uncertainty Assessment

In this year's submissions uncertainty estimates for all key sources based on the IPCC GPG, on the uncertainty study cited in Chapter 1.7 and on expert judgement by Umweltbundesamt are provided (see Table 93, explanations see respective subchapters).

*Table 93: Uncertainty assessment for key sources of Sector 2 Industrial Processes.*

| IPCC Category | Source Categories | Uncertainty [%] | | |
|---|---|---|---|---|
| | | Activity data | Emission factor | Emission estimate |
| 2.A.1 | Cement Production – $CO_2$ | 5.0 | 2.0 | 5.4 |
| 2.A.2 | Lime Production – $CO_2$ | 20.0 | 5.0 | 20.6 |
| 2.A.3 | Limestone and Dolomite Use – $CO_2$ | 19.6 | 2.0 | 19.7 |
| 2.A.7.b | Magnesia Sinter Plants – $CO_2$ | 2.0 | 5.0 | 5.4 |
| 2.B.1 | Ammonia Production – $CO_2$ | 2.0 | 4.6 | 5.0 |
| 2.B.2 | Nitric Acid Production – $N_2O$ | 0.0 | 5.0 | 5.0 |
| 2.C.1 | Iron and Steel Production – $CO_2$ | 0.5 | 0.5 | 0.7 |
| 2.C.3 | Aluminium production – PFC | 0.0 | 50.0 | 50.0 |
| 2.C.3 | Aluminium production – $CO_2$ | 2.0 | 0.5 | 2.1 |
| 2.C.4 | $SF_6$ used in Al and Mg Foundries – $SF_6$ | 0.0 | 5.0 | 5.0 |
| 2.F.1/2/3/4/5 | ODS Substitutes – HFC | 20 | 50 | 53.9 |
| 2.F.7 | Semiconductor Manufacture – FC | 5 | 10 | 11.2 |
| 2.F.9 | Other Sources of $SF_6$ | 25 | 50 | 55.9 |

### 4.1.5 Quality Assurance and Quality Control (QA/ QC)

For the Austrian Inventory an internal quality management system has been established. The QC procedures defined in the QMS correspond to general QC Tier 1 procedures defined in the IPCC GPG. For further information see Chapter 1.6.

Concerning measurement and documentation of emission data the Commission Decision 2004/156/EC establishes guidelines for the monitoring and reporting of greenhouse gas emissions pursuant to Directive 2003/87/EC of the European Parliament and of the Council that establishes a scheme for greenhouse gas emission allowance trading within the Community (EU ETS).

This decision provides general guidelines on emission reporting and verification as well as sector specific guidelines on the methodologies to account for process specific $CO_2$ emissions. These include guidance on calculations and measurements at different level of detail, similar to the different Tier methods in the IPCC guidelines.

The implementation of the European directive in Austria is furthermore supplemented by specific national regulations: the Austrian Emissions Certificate Trading Act[24] and the Ordinance regarding Monitoring and Reporting of Greenhouse Gas Emissions[25].

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[24] "*Emissionszertifikate-Gesetz*", Federal Law Gazette I No. 46/2004

[25] „*Verordnung des Bundesministers für Land- und Forstwirtschaft, Umwelt und Wasserwirtschaft über die Überwachung und Berichterstattung betreffend Emissionen von Treibhausgasen*", Federal Law Gazette II No. 458/2004

Furthermore, most of the plants that are reporting emission data – this includes plants that are not obliged to participate in the EU ETS – have quality management systems according to the ISO 9000-series or similar systems.

### 4.1.6 Recalculations

Compared to last year's inventory only few recalculations were made. A summary of these changes is presented below:

***Update of activity data:***

*2.A.3. Limestone and Dolomite Use:* A transcription error of limestone and dolomite use in glass industry was corrected for 2006.

*2.A.4. Soda ash use*: A transcription error of soda ash use in glass industry was corrected for 2006.

*2.B.1. Ammonia Production*:
Process-specific $CO_2$ emissions from ammonia production for 2004 were recalculated as the underlying activity data used for the calculation (non-energy use of natural gas) was updated in the national energy balance.

*2.C.1. Iron and Steel:*
Process-specific $CO_2$ emissions from pig iron production for 2006 were recalculated as the underlying activity data used for the calculation (non-energy use of coke) was updated in the national energy balance.

*2.C.2. Ferroalloys:* Activity data for 2006 was updated.

*2.F.2. Foam blowing:* Potential emissions have been updated for the years 2005–2006 according to new information provided by foam producers.

*2.F.4. Aerosols and 2.F.5 Solvents:*
Potential emissions have been updated for the years 2002–2006 according to recalculations of the Austrian GDP in these years.

**Improvements of methodologies and emission factors:**

*2.A.3. Limestone and Dolomite Use:* Plant specific emission factors became available for the sub-category limestone use for desulphurization. $CO_2$ emissions were updated accordingly for the years 2005 and 2006.

For further information see the recalculation sections of the respective subchapters of this chapter and the tables presented in Chapter 9.

### 4.1.7 Completeness

Table 94 gives an overview of the IPCC 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 subcategories. A "✓" indicates that emissions from this sub-category have been estimated, the grey shaded cells are those also shaded in the CRF.

*Table 94: Overview of subcategories of Category 2 Industrial Processes: transformation into SNAP Codes and status of estimation.*

| | IPCC Category | SNAP | | Status | | |
|---|---|---|---|---|---|---|
| | | | | $CO_2$ | $CH_4$ | $N_2O$ |
| **2.A** | **MINERAL PRODUCTS** | | | | | |
| 2.A.1 | Cement Production | 040612 | Cement (decarbonising) | ✓ | NA | NA |
| 2.A.2 | Lime Production | 040614 | Lime (decarbonising) | ✓ | NA | NA |
| 2.A.3 | Limestone and Dolomite Use | 040618 | Limestone and Dolomite Use | ✓ | NA | NA |
| 2.A.4 | Soda Ash Production and Use | 040619 | Soda Ash Production and Use | ✓ | NA | NA |
| 2.A.5 | Asphalt Roofing | 040610 | Roof covering with asphalt materials | IE[1)] | NA | NA |
| 2.A.6 | Road Paving with Asphalt | 040611 | Road paving with asphalt | IE[1)] | NA | NA |
| 2.A.7 | *Other* | | | | | |
| | *2.A.7.a Bricks* | 040617 | Bricks (decarbonising) | ✓ | NA | NA |
| | *2.A.7.b Magnesit Sinter* | 040617 | Other – Magnesia Sinter Plants | ✓ | NA | NA |
| **2.B** | **CHEMICAL INDUSTRY** | | | | | |
| 2.B.1 | Ammonia Production | 040403 | Ammonia | ✓ | ✓ | NA |
| 2.B.2 | Nitric Acid Production | 040402 | Nitric acid | ✓ | NA | ✓ |
| 2.B.3 | Adipic Acid Production | 040521 | Adipic acid | NA | NA | NO[2)] |
| 2.B.4 | Carbide Production | 040412 | Calcium carbide production | ✓ | NA[3)] | NA |
| 2.B.5 | Other | 040407<br>040408 | NPK fertilisers<br>Urea | ✓ | ✓ | NA |
| 2.B.5 | Other | 040501 | Ethylene production | NA | ✓ | NA |
| **2.C** | **METAL PRODUCTION** | | | | | |
| 2.C.1 | Iron and Steel Production | 040202<br>040206<br>040207<br>040208 | Blast furnace charging<br>Basic oxygen furnace steel plant<br>Electric furnace steel plant<br>Rolling mills | ✓ | ✓ | NA |
| 2.C.2 | Ferroalloys Production | 040302 | Ferro alloys | ✓ | NA | NA |
| 2.C.3 | Aluminium Production | 040301 | Aluminium production (electrolysis) – except $SF_6$ | ✓/NO[4)] | ✓/NO[4)] | NA |
| 2.C.4 | $SF_6$ Used in Aluminium and Magnesium Foundries | 040301<br>040304 | Aluminium Production – $SF_6$ only<br>Magnesium Production – $SF_6$ only | | $SF_6$ ✓ | |
| 2.C.5 | *Other* | | | | | |
| **2.D** | **OTHER PRODUCTION** | | | | | |
| 2.D.1 | *Pulp and Paper* | | | | | |
| 2.D.1 | *Food and Drink* | | | NA[5)] | NA | NA |

| | IPCC Category | | SNAP | HFCs, PFCs, $SF_6$ |
|---|---|---|---|---|
| **2.E** | **PRODUCTION OF HALOCARBONS AND SULPHUR HEXAFLUORIDE** | 0408 | Production of halocarbons and sulphur hexaflouride | NO[(6)] |
| **2.F** | **CONSUMPTION OF HALOCARBONS AND SULPHUR HEXAFLUORIDE** [7)] | 0605 | Use of HFC, PFC and $SF_6$ | |
| 2.F.1 | Refrigeration and Air Conditioning Equipment | | | ✓ |
| 2.F.2 | Foam Blowing | | | ✓ |
| 2.F.3 | Fire Extinguishers | | | ✓ |
| 2.F.4 | Aerosols | | | ✓ |
| 2.F.5 | Solvents | | | ✓ |
| 2.F.6 | Other applications using ODS substitutes | | | NO |
| 2.F.7 | Semiconductor Manufacture | | | ✓ |
| 2.F.8 | Electrical Equipment | | | ✓ |
| 2.F.9 | *Other* | | | ✓ |

1) *Emissions are included in Sector 3 Solvent and Other Product Use.*

2) *There is no adipic acid production in Austria.*

3) *Silicon carbide is not produced in Austria.*

4) *Primary aluminium production was terminated in 1992.*

5) *$CO_2$ emissions from this source are of biogenic origin.*

6) *There is no production of halocarbons or $SF_6$ in Austria.*

7) *No corresponding SNAP category is presented here as the actual estimation is based on IPCC Categories.*

### 4.1.8 Planned Improvements

The data availability problem in this sector that occurred in previous submissions is solved for all key categories. The ordinance that regulates monitoring and reporting in the context of the EU Emissions Trading scheme in Austria also regulates that data reported from the plant operators can be used for the inventory (see Chapter 1.2).

During the in-country review of the initial report of Austria (February 2007) the ERT encouraged to further investigate whether emissions occur from foam manufacturing/installation (or other ODS substitute applications) to determine whether emissions are currently being underestimated. A study has been contracted that will evaluate this; results are expected for submission 2010.

## 4.2 Mineral Products (CRF Source Category 2.A)

### 4.2.1 Cement Production (2.A.1)

#### 4.2.1.1 Source Category Description

*Emissions:* $CO_2$

*Key Source:* Yes ($CO_2$)

$CO_2$ emissions from cement production is a key source because of its contribution to the level of the greenhouse gas inventory of base year and 2007. In 2007 $CO_2$ emissions from cement production contributed 2.4% to total greenhouse gas emissions in Austria (see Table 92).

In this category process specific $CO_2$ emissions are reported, emissions due to combustion are reported in the energy sector (category *1.A.2.f*).

Process specific $CO_2$ is emitted during the production of clinker (calcination process) when calcium carbonate ($CaCO_3$) is heated in a cement kiln up to temperatures of about 1 300°C. During this process calcium carbonate is converted into lime (CaO – Calcium Oxide) and $CO_2$.

Table 95 presents the process-related $CO_2$ emissions from the production of cement for the period from 1990 to 2007.

*Table 95: $CO_2$ emissions from decarbonising from cement production 1990–2007.*

| Year | Process specific $CO_2$ emissions [Gg] | Clinker [t/a] | IEF [kg/$t_{Cl}$] |
|---|---|---|---|
| 1990 | 2 033 | 3 693 539 | 551 |
| 1991 | 2 005 | 3 635 462 | 552 |
| 1992 | 2 105 | 3 820 397 | 551 |
| 1993 | 2 032 | 3 678 293 | 552 |
| 1994 | 2 102 | 3 791 131 | 555 |
| 1995 | 1 631 | 2 929 973 | 557 |
| 1996 | 1 634 | 2 915 956 | 560 |
| 1997 | 1 761 | 3 103 312 | 567 |
| 1998 | 1 599 | 2 869 035 | 557 |
| 1999 | 1 607 | 2 891 785 | 556 |
| 2000 | 1 712 | 3 052 974 | 561 |
| 2001 | 1 720 | 3 061 338 | 562 |
| 2002 | 1 736 | 3 118 227 | 557 |
| 2003 | 1 754 | 3 119 808 | 562 |
| 2004 | 1 790 | 3 222 802 | 555 |
| 2005 | 1 797 | 3 221 167 | 558 |
| 2006 | 1 954 | 3 653 477 | 535 |
| 2007 | 2 131 | 3 992 376 | 534 |

$CO_2$ emissions (see Table 95) are quite constant from 1990 to 1994; 1995 they drop by 21.7% compared to the previous year, due to a drop in clinker production of almost 20%. This drop is due to an economic turndown in cement industry and the shutdown of one clinker oven. Since 1995 emissions as well as production of cement are slowly increasing again with only minor fluctuations. The overall trend from 1990 to 2007 is plus 4.8%.

### 4.2.1.2 Methodological Issues

Emissions were estimated using a country specific method similar to the IPCC Tier 2 methodology.

Activity data (clinker production) as well as emission data were taken from studies on emissions from the Austrian cement production industry (HACKL & MAUSCHITZ 1995, 1997, 2001, 2003 and MAUSCHITZ 2004). The studies cover the years 1988 to 2003.

In these studies process-specific $CO_2$ emissions and $CO_2$ emissions due to combustion are presented separately. In the course of these studies all cement production plants in Austria were investigated. The determination of the emission data took place by inspection of every single plant, recording and evaluation of plant specific records and also plant specific measurements and analysis carried out by independent scientific institutes.

Activity data and emissions for 2004 were reported directly by the Association of the Austrian Cement Industry as well as activity data for 2005-2007. For 2005-2007 verified $CO_2$ emissions, reported under the ETS, were used for the inventory. These data cover the whole cement industry in Austria. The methodology for these emission calculations is the same like in the years before.

$CO_2$ emissions from the raw meal calcination (decarbonising) were calculated from the raw meal composition:

$$M_{(CO2\ calc)} = \sum_k (m_{(raw\ meal)})_k \bullet x_{(CaCO3)k} \bullet (44.0088/100.0892)$$

Whereas:

*m ..... mass stream [kg/a]*

*x ...... mass portion*

*k ...... for the $k^{th}$ cement plant*

The raw meal composition was determined at every Austrian plant, considering also the $MgCO_3$ content of the raw meal. Based on this data and plant specific production data total emissions from this source were calculated.

With the used methodology no cement kiln dust (CKD) correction factor has to be considered. However, in the Austrian plants cement kiln dust is returned back into the process.

### 4.2.1.3 Source specific QA/QC

The analysis of the raw material was carried out by independent scientific institutes. Clinker production was checked with a publication from the Association of the Austrian Cement Industry to ensure completeness.

#### 4.2.1.4 Uncertainty Assessment

As the applied methodology is based on plant specific data, the uncertainty of activity data is assumed to be low (5%). According to the IPCC GPG (p. 3.14) the uncertainty of the $CO_2$ emission factor for Tier 2 is low (1–2%). In the Austrian method the uncertainty derives basically from the raw meal composition as the uncertainty for the stochiometric emission factor is negligible; thus, the uncertainty of the emission factor is assumed to be 2%. This results in a combined uncertainty of 5.4% (according to the IPCC GPG Table 3.2, the uncertainty for emissions using Tier 2 methodology (based on clinker production data) is 5–10%).

#### 4.2.1.5 Recalculations

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

### 4.2.2 Lime Production (2.A.2)

#### 4.2.2.1 Source Category Description

*Emissions:* $CO_2$

*Key Source:* *Yes* ($CO_2$)

$CO_2$ emissions from lime production is a key category because of its contribution to the total inventory's level in base year and 2007 and to the trend of emissions of the total greenhouse gas inventory. In the year 2006 emissions from this category contributed 0.6% to the total amount of greenhouse gas emissions in Austria (see Table 92).

$CO_2$ is emitted during the calcination step of lime production. Calcium carbonate ($CaCO_3$) in limestone and calcium/ magnesium carbonates in dolomite rock ($CaCO_3$•$MgCO_3$) are decomposed to form $CO_2$ and quicklime (CaO) or dolomite quicklime (CaO•MgO) respectively.

Table 96 presents activity data for this category (lime produced) as well as $CO_2$ emissions from lime production for the period from 1990 to 2007.

*Table 96: Activity data and $CO_2$ emissions for Lime production 1990–2007.*

| Year | $CO_2$ emissions Gg] | Lime Produced [t/a] | $CO_2$ IEF [kg/Mg] |
|---|---|---|---|
| 1990 | 396 | 512 610 | 773 |
| 1991 | 361 | 477 135 | 757 |
| 1992 | 355 | 462 392 | 768 |
| 1993 | 365 | 479 883 | 761 |
| 1994 | 390 | 518 544 | 753 |
| 1995 | 395 | 522 934 | 755 |
| 1996 | 383 | 505 189 | 758 |
| 1997 | 412 | 549 952 | 750 |
| 1998 | 454 | 594 695 | 763 |
| 1999 | 453 | 595 978 | 760 |
| 2000 | 498 | 654 437 | 760 |
| 2001 | 507 | 666 633 | 760 |
| 2002 | 547 | 719 246 | 760 |

| Year | $CO_2$ emissions Gg] | Lime Produced [t/a] | $CO_2$ IEF [kg/Mg] |
|---|---|---|---|
| 2003 | 577 | 756 140 | 763 |
| 2004 | 601 | 788 790 | 762 |
| 2005 | 579 | 760 464 | 761 |
| 2006 | 586 | 780 873 | 750 |
| 2007 | 596 | 782 000 | 762 |

The overall trend for $CO_2$ emissions from this category is increasing emissions, in the year 2007 emissions were 50% higher than 1990 (see Table 96).

#### 4.2.2.2 Methodological Issues

Emissions were estimated using a country specific method based on detailed production data.

Activity data and emission values were reported by the *Association of the Stone & Ceramic Industry.* For 2005-2007 verified $CO_2$ emissions reported under the ETS were used for the inventory. These data cover the whole lime producing industry in Austria. The methodology for this emission calculation is the same like in the years before.

The reported $CO_2$ emission data is based on data of each lime production plant in Austria, considering the CaO and MgO content either from limestone or lime at the different plants and calculating $CO_2$ emissions from the stoichiometric ratios (using IPCC default emission factors).

#### 4.2.2.3 Source specific QA/QC

Lime production was checked with statistical data. The IEF are compared with IPCC default values. The Association of the Stone & Ceramic Industry reported total $CO_2$ emissions, which were compared with the ETS data and found to accord.

#### 4.2.2.4 Uncertainty Assessment

The uncertainty of the emission factor derives basically from the raw-material composition and is assumed to be 5%.

Uncertainties for activity data are considered to be low as it is based on plant specific data of all Austrian plants, we assumed 5%.

However, according to the IPCC GPG (p 3.22) omission of non-marketed lime production may lead to an error of +100% or more. In Austria there is some non-marketed lime production in chemical industry that is reported under 2.A.3. $CO_2$ emissions from the lime production step in the calcium carbide production are included in 2.B.4. Non-marketed lime production is also known in the sugar industry from the data submitted on the first national allocation plan for the European Emission Trading Scheme (ETS). However, in sugar industry the sugar-beet juice is purified by addition of lime milk and $CO_2$, which reacts again to $CaCO_3$. According to the declarations of the operators this process results even in a $CO_2$ sink. Thus, the processes in sugar production were considered to be $CO_2$ neutral. Apart from the already-mentioned lime production in the chemical industry, in calcium carbide production and in the sugar industry, there is no identified non-marketed lime production in Austria.

To address the possibility of non-identified, non-marketed lime production a systematic uncertainty of plus 15% is added to the previously mentioned random uncertainty of 5%.

This leads to a combined uncertainty of 20.6% (calculating with the plus 20% of activity data).

#### 4.2.2.5 Recalculations

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

### 4.2.3 Limestone and Dolomite Use (2.A.3)

#### 4.2.3.1 Source Category Description

*Emissions:* $CO_2$

*Key Source:* *Yes* ($CO_2$)

$CO_2$ emissions from limestone and dolomite use is a key category because of its contribution to the total inventory's level for the year 2007. In the year 2007 emissions from this category contributed 0.3% to the total amount of greenhouse gas emissions in Austria (see Table 92).

In this category $CO_2$ emissions from decarbonising of limestone and dolomite in the glass industry, in the iron and steel industry, the limestone use for desulphurization and in chemical industry are considered.

Emissions from this category increased by 36% between 1990 and 2007 mainly due to increased limestone use in iron and steel industries.

*Table 97: Activity data and $CO_2$ emissions for Limestone and Dolomite Use 1990–2007.*

| Year | $CO_2$ emissions [Gg] | Limestone Used [t/a] | Dolomite Used [t/a] |
|---|---|---|---|
| 1990 | 222 | 479 376 | 24 020 |
| 1991 | 225 | 481 769 | 27 646 |
| 1992 | 205 | 439 897 | 24 463 |
| 1993 | 205 | 439 433 | 24 485 |
| 1994 | 220 | 471 505 | 26 212 |
| 1995 | 251 | 542 377 | 26 225 |
| 1996 | 227 | 487 657 | 26 225 |
| 1997 | 254 | 551 173 | 24 457 |
| 1998 | 264 | 573 724 | 24 457 |
| 1999 | 247 | 533 213 | 26 826 |
| 2000 | 276 | 601 844 | 22 624 |
| 2001 | 271 | 587 220 | 26 573 |
| 2002 | 290 | 634 620 | 23 477 |
| 2003 | 296 | 638 899 | 30 368 |
| 2004 | 297 | 655 220 | 19 208 |
| 2005 | 291 | 644 921 | 21 241 |
| 2006 | 296 | 659 230 | 23 405 |
| 2007 | 303 | 671 994 | 24 914 |

#### 4.2.3.2 Methodological Issues

Emissions were estimated using the methodology and the default emission factor of the IPCC guidelines for the years 1990–2004.

Activity data for limestone and dolomite used in glass industry were reported by the *Association of Glass Industry* for the years 2002–2004, for the years before activity data was estimated using a constant ratio of limestone and dolomite used per ton of glass produced (glass production was reported by the *Association of Glass Industry* for all years). This ratio includes the use of recycled glass for the total amount of glass produced. This value fits very well also for the following years and was considered to also reflect well the situation in the past, because glass recycling is common practice in Austria since the late 1970ies.

Activity data for limestone used in blast furnaces for the years 1998 to 2002 was reported directly by the plant operator of the two integrated iron and steel production sites that operate blast furnaces. For the years before and until 2004 activity data was estimated using the average ratio of limestone used per ton of pig iron produced of the years 1998–2002.

For 2005-2007 verified $CO_2$ emissions and activity data, reported under the ETS, were used for the inventory. These data cover limestone and dolomite use in the glass, the iron and steel and chemical industry.

Activity data for limestone used for desulphurization were taken from a national report on desulphurization technologies in Austria (WINDSPERGER & HINTERMEIER 2002). The time series was constructed with the help of plant specific $SO_2$ emission declarations from the annual steam boiler database. For 2005 additional information due to emissions reported under the ETS was included.

For calculation of $CO_2$ emissions the IPCC default emission factors of 440 kg $CO_2$/t limestone and 477 kg $CO_2$/t dolomite were used. Since 2005 ETS background data provided more detailed information on the actual carbon content of the limestone and dolomite used. Therefore, the IEFs since 2005 are slightly different to the IPCC default values.

#### 4.2.3.3 Source specific QA/QC

Limestone and dolomite use in glass industry is checked with glass production figures.

#### 4.2.3.4 Uncertainty Assessment

According to the IPCC GPG (Table. 3.4) the uncertainty of the $CO_2$ emission factor is ±2%. This derives from the uncertainty about the composition and fractional purity of limestone in $CaCO_3$ (or of dolomite in $CaCO_3 \cdot MgCO_3$) per tonne of total raw material.

Uncertainty of activity data derives mainly from omission of limestone and dolomite use in unidentified industries. For limestone it is assumed to be plus 20% and minus 10%, because the use in iron and steel industry covers the major part and this is included. Dolomite use covers only glass industry, therefore the uncertainty is assumed to be high (plus 100%). This results in a combined uncertainty of activity data of 19.6%, using the higher limits and taking into account their respective shares in total emissions from this sector; and leads to a combined uncertainty of emissions of 19.7%.

#### 4.2.3.5 Recalculations

A transcription error of limestone and dolomite use in glass industry was corrected for 2006. Plant specific emission factors became available for the sub-category limestone use for desulphurization and CO2 emissions were updated accordingly for the years 2005 and 2006. This lead to a decrease of emissions by 0.2%.

### 4.2.4 Soda Ash Production and Use (2.A.4)

#### 4.2.4.1 Source Category Description

*Emissions:* $CO_2$

*Key Source:* *No*

In this category $CO_2$ emissions from decarbonising of soda used in glass industry is considered.

In Austria Soda ash was produced by the Solvay process only which is $CO_2$-neutral except for coke used for calcination of limestone. This coke used in soda ash production was considered as fuel in the energy sector (subcategory 1 A 2 c).

In 2007 emissions from soda ash use contributed 0.02% to total emissions in Austria. The following table presents $CO_2$ emissions from this category.

*Table 98: Activity data and $CO_2$ emissions for Soda Use 1990–2007.*

| Year | $CO_2$ emissions [Gg] | Soda Used [t/a] |
|---|---|---|
| 1990 | 19 | 46 690 |
| 1991 | 22 | 53 737 |
| 1992 | 20 | 47 551 |
| 1993 | 20 | 47 593 |
| 1994 | 21 | 50 950 |
| 1995 | 21 | 50 975 |
| 1996 | 21 | 50 975 |
| 1997 | 20 | 47 539 |
| 1998 | 20 | 47 539 |
| 1999 | 22 | 52 144 |
| 2000 | 18 | 43 976 |
| 2001 | 21 | 51 652 |
| 2002 | 19 | 45 633 |
| 2003 | 19 | 45 263 |
| 2004 | 12 | 28 559 |
| 2005 | 15 | 36 876 |
| 2006 | 16 | 38 814 |
| 2007 | 17 | 41 539 |

#### 4.2.4.2 Methodological Issues

Emissions were estimated using the methodology and the default emission factor of the IPCC guidelines.

Activity data for soda used in glass industry were reported from the *Association of Glass Industry* for the years 2002–2004, for the years before activity data was estimated using a constant ratio of soda used per ton of glass produced, taken from the data reported for 2002 (glass production was reported by the *Association of Glass Industry* for all years). This ratio includes the use of recycled glass for the total amount of glass produced. This value fits very well also for the following years and was considered to also reflect well the situation in the past, because glass recycling is common practice in Austria since the late 1970ies.

For 2005-2007 verified $CO_2$ emissions and activity data, reported under the ETS, were considered for the inventory. These data cover soda ash use in the glass industry.

For calculation of $CO_2$ emissions from 1990 to 2004 the IPCC default emission factor of 415 kg $CO_2$/t soda was used. For 2005-2007 ETS background data provided more detailed information on the actual carbon content of the soda ash used. Therefore, the IEF since 2005 slightly differs from the IPCC default value.

#### 4.2.4.3 Recalculations

A transcription error of soda ash use in glass industry was corrected for 2006. This lead to an increase of emissions by 0.4%.

### 4.2.5 Asphalt Roofing (2.A.5) and Road Paving with Asphalt (2.A.6)

Emissions previously reported under these categories resulted from asphalt roofing production and bitumen production as well as pre-painting before the asphalt roofing or road paving. However, these emissions are already accounted for in the solvents sector, that's why emissions are reported as included elsewhere "IE".

### 4.2.6 Mineral Products – Other (2.A.7)

#### 4.2.6.1 Source Category Description

In this category bricks (decarbonising) and magnesia sinter production are addressed.

#### 4.2.6.2 Bricks Production

*Emissions:* *$CO_2$*

*Key Source:* *No*

This category includes $CO_2$ emissions from the production of bricks where $CO_2$ is generated through decomposition of the carbonate content of the raw materials.

Table 99 presents $CO_2$ emissions from bricks production for the period from 1990 to 2007. $CO_2$ emissions from bricks production had a maximum in 1995/1996, following brick production. In the year 2007 emissions from this category contributed 0.1% to the total amount of greenhouse gas emissions in Austria.

**Methodological Issues**

No IPCC methodology is available for this source.

Emission values for the years 1998–2001 were reported by the *Association of the Stone & Ceramic Industry*. The reported $CO_2$ emission data is based on data of the different brick production sites in Austria, considering the carbonate contents of raw materials used for bricks production at the different plants and calculating $CO_2$ emissions from the stoichiometric ratios (using IPCC default emission factors). For 2005-2007 verified $CO_2$ emissions, reported under the ETS, were used for the inventory. These data cover the whole brick industry in Austria.

Activity data for the production of bricks was taken from national statistics (STATISTIK AUSTRIA), for 1996 the value of 1995 was used due to lack of data. From the IEF for 1998 emissions of the years before 1998 were calculated; and the IEF from 2001 was used to calculate emissions after 2001.

Table 99 presents activity data for production of bricks and $CO_2$ emissions for this category for the period from 1990 to 2007.

*Table 99: Activity data and $CO_2$ emissions for Bricks Production 1990–2007.*

| Year | $CO_2$ emissions [Gg] | Bricks [t/a] | $CO_2$ IEF |
|---|---|---|---|
| 1990 | 116 | 2 230 000 | 52.23 |
| 1991 | 122 | 2 333 852 | 52.23 |
| 1992 | 126 | 2 412 902 | 52.23 |
| 1993 | 135 | 2 593 236 | 52.23 |
| 1994 | 140 | 2 675 473 | 52.23 |
| 1995 | 149 | 2 848 716 | 52.23 |
| 1996 | 149 | 2 848 716 | 52.23 |
| 1997 | 137 | 2 625 046 | 52.23 |
| 1998 | 134 | 2 557 448 | 52.23 |
| 1999 | 122 | 2 184 773 | 55.62 |
| 2000 | 116 | 1 954 855 | 59.30 |
| 2001 | 124 | 1 959 395 | 63.15 |
| 2002 | 120 | 1 904 142 | 63.15 |
| 2003 | 116 | 1 833 557 | 63.15 |
| 2004 | 134 | 2 116 786 | 63.15 |
| 2005 | 128 | 2 170 069 | 58.99 |
| 2006 | 130 | 2 130 866 | 60.98 |
| 2007 | 130 | 2 331 709 | 55.73 |

The increasing IEF between 1998 and 2001 is due to a switch in porous material used in brick production. Previously mainly sawdust was used, whereas nowadays residual fibre material from paper industry is used. Furthermore, $CaCO_3$ is added for moisture compensation.

Generally, fluctuations in the IEF occur because of different brick types produced. The higher the density of the particular brick, the more $CO_2$ is emitted during production. High and low density bricks have different properties. Consequently, fluctuating quantities of brick types are produced from year to year depending on the demand.

### Recalculations

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

#### 4.2.6.3 Magnesia Sinter Production

*Emissions:* $CO_2$

*Key Source:* Yes ($CO_2$)

This category includes $CO_2$ emissions from the production of magnesia sinter. $CO_2$ emission from magnesia sinter production is a key category both due to the contribution to total emissions of base year and 2007 and also with regard to the trend assessment. In 2007 it contributed 0.4% to the total amount of greenhouse gas emissions in Austria (see Table 92).

During production of magnesia sinter $CO_2$ is generated during the calcination step, when magnesite ($MgCO_3$) is sintered at high temperatures in a kiln to produce MgO. Magnesia sinter is processed in the refractory industry.

Table 100 presents $CO_2$ emissions from production of magnesia sinter for the period from 1990 to 2007. $CO_2$ emissions from magnesia sinter plants vary over the period from 1990 to 2007 with an overall decreasing trend. In 2007 emissions are 32% less than in 1990.

Fluctuations in $CO_2$ emissions from this category are explained by:

- Varying implied emission factors that reflect different qualities of sinter produced and proportions of sinter/caustic sinter production.
- Varying production figures. The decrease in production figures between 1990 and 1992 results from a more efficient sinter production process due to a higher quality of the magnesite raw material.

**Methodological Issues**

No IPCC methodology is available for this source.

Emission values and activity data were directly reported by the only company in Austria sintering magnesia. For 2005-2007 verified $CO_2$ emissions, reported under the ETS, were taken for the inventory.

Emissions are calculated stoichiometrically according to Calculation method B: Alkali Oxides (2004/156/EC Guidelines for the monitoring and reporting of GHG emissions, Annex X). The composition of the oxides are measured using X-ray fluorescence analysis.

Table 100 presents activity data and $CO_2$ emissions from this category for the period from 1990 to 2007.

*Table 100:$CO_2$ emissions from Magnesia Sinter Production 1990–2007.*

| Year | $CO_2$ Emissions [Gg] | Magnesite [t] | $CO_2$ IEF [kg/Mg] |
|---|---|---|---|
| 1990 | 481 | 966 066 | 498 |
| 1991 | 392 | 795 932 | 492 |
| 1992 | 336 | 675 284 | 498 |
| 1993 | 325 | 670 294 | 484 |
| 1994 | 323 | 669 260 | 482 |
| 1995 | 410 | 753 575 | 544 |
| 1996 | 355 | 744 726 | 477 |
| 1997 | 384 | 801 273 | 480 |
| 1998 | 345 | 716 869 | 482 |
| 1999 | 350 | 716 959 | 488 |

| Year | $CO_2$ Emissions [Gg] | Magnesite [t] | $CO_2$ IEF [kg/Mg] |
|---|---|---|---|
| 2000 | 339 | 699 707 | 485 |
| 2001 | 334 | 691 278 | 483 |
| 2002 | 374 | 766 887 | 487 |
| 2003 | 311 | 651 332 | 478 |
| 2004 | 329 | 655 236 | 501 |
| 2005 | 310 | 638 749 | 485 |
| 2006 | 312 | 608 737 | 513 |
| 2007 | 329 | 691 994 | 476 |

**Source specific QA/QC**

The calculation is based on a European recognized standard method. Order of magnitude and time-series checks are performed. The operator is contacted in case of inconsistencies. The operator reported total $CO_2$ emissions, which were compared with the ETS data and found to accord.

**Uncertainty Assessment**

Emissions were calculated based on stoichiometric ratios and this is a fixed number, therefore the uncertainty of the emission factor is the uncertainty of raw material composition which is estimated to be about 5%. The uncertainty of activity data is assumed to be low (2%) as there is only one plant in Austria and data is obtained from this plant.

**Recalculations**

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

## 4.3 Chemical Industry (CRF Source Category 2.B)

### 4.3.1 Ammonia Production (2.B.1)

#### 4.3.1.1 Source Category Description

*Emissions:* *$CO_2$ and $CH_4$*

*Key source:* *Yes ($CO_2$)*

$CO_2$ emissions from production of ammonia is a key category due to the contribution to the level of total emissions of the Austrian greenhouse gas inventory of base year and 2007. In 2007 it contributed 0.5% to the total amount of greenhouse gas emissions in Austria (see Table 92).

Ammonia ($NH_3$) is produced by catalytic steam reforming of natural gas or other light hydrocarbons (e.g. liquefied petroleum gas, naphtha) – in Austria natural gas is used. By way of these processes the feedstock is reformed with steam in a heated primary reformer and subsequently with air in a second reformer in order to produce the synthesis gas. $CO_2$ is produced by stoichiometric conversion and is mainly emitted during the primary reforming step.

One half of the methane introduced in the synthesis is $CH_4$ that is generated in the so called methanator: small amounts of CO and $CO_2$, remaining in the synthesis gas, are poisonous for the ammonia synthesis catalyst and have to be removed by conversion to $CH_4$ in the methanator. The other half is recycled methane that has not been converted in the reforming step. Only a small part of the methane is actually emitted as leakage during start-ups of the ammonia production, the main part is used as a fuel in the primary reformer.

Table 101 presents $CO_2$ and $CH_4$ emissions from ammonia production as well as ammonia production figures and natural gas input for the period from 1990 to 2007.

Emissions vary during the period and follow closely the trend in ammonia production. $CO_2$ emissions reach a first minimum in 1994 and a second in 2001, both due to low production figures. In 2007 $CO_2$ emissions are 8% lower than in the base year.

#### 4.3.1.2 Methodological Issues

Activity data since 1990 and $CH_4$ emission data from 1994 onwards were reported directly to the Umweltbundesamt by the only ammonia producer in Austria and thus represent plant specific data. The composition of the synthesis gas is measured regularly. $CH_4$ emissions are calculated from the measured synthesis gas composition and the number and duration of start-ups. The implied emission factor for $CH_4$ that was calculated from activity and emission data from 1994 was applied to calculate emissions of the years 1990 to 1993 as no emission data was available for these years.

$CH_4$ emission factors of ammonia plants depend largely on the number of shutdowns and start ups during the year. Especially a start up after a turn around with exchange of catalyst in some of the reactors of the plant (as in 1998) needs a prolonged start up procedure. This causes an increase of emissions without increased production of ammonia.

$CO_2$ emissions are calculated from the natural gas input – Tier 2 method of the IPCC guidelines – (non-energy use from the national energy balance) with a standard emission factor (55.4 t/TJ). For the years 1990, 1991 and 1993 natural gas input was calculated from ammonia production with the conversion factor 0.451 t/t $NH_3$, because natural gas input in the Energy Balance exceeded by far ammonia production capacity in these years.

In this methodology it is assumed that the total amount of carbon in natural gas is fully converted to $CO_2$ and emitted at once. But, according to information from the producer, there are also fugitive $CH_4$ emissions during start-ups of the ammonia production. Therefore, these $CH_4$ – emissions are reported as $CH_4$ – emissions, they are not converted and are subtracted from total $CO_2$ emissions to avoid double counting. Furthermore, $CO_2$ and $CH_4$ emissions from urea production are reported, that both derive directly from ammonia (see chapter 4.3.4.2 for further information). These emissions are reported under urea production – where they occur – and are also subtracted from total $CO_2$ emissions from ammonia production to avoid double counting of emissions. $CO_2$ is directly subtracted and $CH_4$ is converted to $CO_2$ by multiplying with the stoichiometric ratio (44/12) and subsequently subtracted.

According to the IPCC guidelines no account should be taken for intermediate binding of $CO_2$ in downstream manufacturing processing and products. Nevertheless in the Austrian ammonia production facility melamine is produced from urea, a product in which carbon can be considered to be stored for a long time. Melamine is primarily used to produce melamine resin, which when combined with formaldehyde produces a very durable thermoset plastic. Melamine is fire resistant and heat tolerant and has a highly stable structure. Thus, account was taken for the carbon bound in the melamine production. Carbon stored was calculated stoichiometrically from urea input for melamine production, and was subtracted from the total $CO_2$ emissions.

Table 101 shows all the relevant parameters for the calculation of $CO_2$ emissions from ammonia production. The resulting $CO_2$ IEF (with respect to ammonia) is decreasing over time, because of the increasing melamine production.

*Table 101: Activity data, emissions and implied emission factors for $CO_2$ and $CH_4$ emissions from ammonia production 1990–2007.*

| Year | Ammonia Produced [t] | Natural gas input [TJ] | Carbon stored [Gg C] | $CO_2$ Emissions [Gg] | IEF $CO_2$ [kg/ t Ammonia] | $CH_4$ Emissions [Mg] |
|---|---|---|---|---|---|---|
| 1990 | 461 000 | 10 239 | 13.6 | 517 | 1 121 | 62.2 |
| 1991 | 475 000 | 10 550 | 10.4 | 546 | 1 149 | 64.1 |
| 1992 | 432 000 | 10 735 | 11.2 | 553 | 1 280 | 58.3 |
| 1993 | 469 000 | 10 417 | 10.2 | 539 | 1 149 | 63.3 |
| 1994 | 444 000 | 10 036 | 13.1 | 507 | 1 142 | 59.9 |
| 1995 | 473 000 | 10 518 | 12.2 | 537 | 1 136 | 61.2 |
| 1996 | 484 772 | 10 781 | 15.7 | 539 | 1 111 | 59.1 |
| 1997 | 479 698 | 10 669 | 15.8 | 532 | 1 109 | 81.1 |
| 1998 | 484 449 | 10 554 | 15.9 | 525 | 1 084 | 102.0 |
| 1999 | 490 493 | 10 644 | 15.9 | 530 | 1 081 | 54.8 |
| 2000 | 482 333 | 10 504 | 17.2 | 518 | 1 074 | 60.0 |
| 2001 | 448 176 | 9 945 | 21.2 | 472 | 1 054 | 51.0 |
| 2002 | 464 028 | 10 336 | 23.3 | 486 | 1 048 | 68.8 |
| 2003 | 510 887 | 11 278 | 26.6 | 526 | 1 030 | 47.3 |
| 2004 | 510 024 | 10 253 | 27.1 | 468 | 917 | 56.4 |
| 2005 | 478 427 | 10 795 | 25.7 | 503 | 1 051 | 93.9 |
| 2006 | 502 286 | 11 512 | 25.9 | 542 | 1 079 | 105.1 |
| 2007 | 441 299 | 10 115 | 23.4 | 473 | 1 073 | 140.6 |

#### 4.3.1.3 Source specific QA/QC

Emission factor is consistent with emission factor used in fuel combustion. Natural gas input from energy balance is checked for plausibility with ammonia production figures.

#### 4.3.1.4 Uncertainty assessment

As activity data are obtained from the only ammonia plant in Austria and from the national energy balance, uncertainty is rated as very low (2%). Also the emission factor and other conversion factors are considered to have low uncertainties. Thus, the quality of emission estimates is rated as "high" (5% uncertainty).

#### 4.3.1.5 Recalculations

Process-specific CO2 emissions from ammonia production for 2004 were recalculated as the underlying activity data used for the calculation (non-energy use of natural gas) was updated in the national energy balance.

### 4.3.2 Nitric Acid Production (2.B.2)

#### 4.3.2.1 Source Category Description

*Emission:* $N_2O$, $CO_2$

*Key Source:* Yes ($N_2O$)

$N_2O$ emissions from nitric acid production is a key source due to the contribution to the level of total emissions of the Austrian greenhouse gas inventory in the year 1990 and to the trend of emissions. In 2007 it contributed 0.3% to the total amount of greenhouse gas emissions in Austria (see Table 92).

Nitric acid ($HNO_3$) is manufactured from ammonia ($NH_3$). In a first step $NH_3$ reacts with air to NO and $NO_2$ and is then transformed with water to $HNO_3$.

Ammonia used as feedstock (gaseous or liquid) in the nitric acid plant always contains small amounts of methane, which is dissolved in ammonia. By burning ammonia on an alloy catalyst – which is the basis of the nitric acid process – a small amount of $CO_2$ is produced and leads to $CO_2$ emissions in the tail gas.

In Austria there is only one producer of nitric acid.

Table 102 presents $N_2O$ and $CO_2$ emissions from production of nitric acid for the period from 1990 to 2006.

$N_2O$ emissions fluctuate during the period 1990 to 2000, but follow generally the trend of nitric acid production. The increase of IEF between 1993 and 1994 is due to the closing down of part of a production facility that contributed to total emissions with lower specific $N_2O$ emissions per produced $HNO_3$. Since 2000 two strong drops in emissions can be observed that are not due to variations in production figures. From 2000 to 2001 emissions decrease by 17% due to the introduction of a new catalyst in the nitric acid plant; the IEF decreased from an average of 5.7 kg $N_2O$/t nitric acid, to about 5.0 kg $N_2O$/t nitric acid. From 2003 to 2004 emissions drop by 68% due to the installation of a $N_2O$ decomposition facility in the nitric acid plant; the IEF decreased from an average of 5.0 kg $N_2O$/t nitric acid, to about 1.6 kg $N_2O$/t nitric acid. In 2007 emissions are 70% below base year emissions.

$CO_2$ emissions also varied over the period from 1990–2007 following the trend of nitric acid production closely until 1999. Specific emissions decreased since 2000 due to process optimization (also see implied emission factors in Table 102).

#### 4.3.2.2 Methodological Issues

Following the IPCC Guidelines plant specific measurement data was collected.

Activity and emission data of $N_2O$ emissions was obtained directly from the plant operator. Since 1998, emissions are measured continuously. Based on the analysed emission data of 1998 and due to the fact that the production technology has not changed between 1990 and 1998 emission factors per ton of product were calculated for the used technologies (nitric acid is produced at one site in up to five plants with different technologies; some of the plants were closed since 1990, two are still in operation). With these estimates of plant specific emission factors and the production volume of the individual plants the total emission of $N_2O$ per year was calculated.

Activity and emission data of $CO_2$ emissions from the years 1994 onwards have been reported directly to the Umweltbundesamt by the plant operator and thus represent plant specific data. $CO_2$ emissions are measured discontinuously in the exhaust gas flow. The implied emission factor that was calculated from activity and $CO_2$ emission data from 1994 was applied to calculate $CO_2$ emissions of the years 1990 to 1993 as no $CO_2$ emission data was available for these years.

*Table 102:Activity data, emissions and implied emission factors for $N_2O$ and $CO_2$ emissions from Nitric Acid Production 1990–2007.*

| Year | Nitric Acid Produced [t] | $N_2O$ Emissions [Mg] | $CO_2$ Emissions [Gg] | IEF $N_2O$ [kg/t] | IEF $CO_2$ [kg/t] |
|---|---|---|---|---|---|
| 1990 | 529 998 | 2 942 | 0.41 | 5.55 | 0.78 |
| 1991 | 534 910 | 2 991 | 0.42 | 5.59 | 0.78 |
| 1992 | 484 731 | 2 702 | 0.38 | 5.57 | 0.78 |
| 1993 | 513 224 | 2 835 | 0.40 | 5.52 | 0.78 |
| 1994 | 467 391 | 2 662 | 0.36 | 5.70 | 0.78 |
| 1995 | 484 016 | 2 765 | 0.37 | 5.71 | 0.76 |
| 1996 | 495 738 | 2 820 | 0.38 | 5.69 | 0.76 |
| 1997 | 489 376 | 2 783 | 0.36 | 5.69 | 0.73 |
| 1998 | 504 977 | 2 893 | 0.38 | 5.73 | 0.75 |
| 1999 | 512 797 | 2 979 | 0.40 | 5.81 | 0.78 |
| 2000 | 533 715 | 3 070 | 0.37 | 5.75 | 0.69 |
| 2001 | 510 800 | 2 537 | 0.36 | 4.97 | 0.71 |
| 2002 | 522 410 | 2 604 | 0.37 | 4.98 | 0.70 |
| 2003 | 558 226 | 2 850 | 0.41 | 5.10 | 0.73 |
| 2004 | 572 719 | 906 | 0.41 | 1.58 | 0.71 |
| 2005 | 557 870 | 884 | 0.41 | 1.59 | 0.74 |
| 2006 | 579 623 | 904 | 0.42 | 1.56 | 0.72 |
| 2007 | 499 402 | 871 | 0.36 | 1.74 | 0.71 |

#### 4.3.2.3 Source specific QA/QC

Measurements are done by accredited testing body with internationally recognized standard methods. Order of magnitude and time-series checks are performed and operator is contacted in case of inconsistencies.

#### 4.3.2.4 Uncertainty assessment

According to (WINIWARTER 2008) uncertainty is mainly affected by EF uncertainty (20%). The EF uncertainty is based on a national study from the beginning of the 1990ies and is considered to be valid for base year emissions. For recent years an uncertainty of 5% was considered to be more appropriate because the analyses of $N_2O$ concentrations changed from discontinous measurements to online spectroscopic measurements.

#### 4.3.2.5 Recalculations

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

### 4.3.3 Calcium Carbide Production (2.B.4)

#### 4.3.3.1 Source Category Description

*Emission:* $CO_2$

*Key Source:* *No*

Calcium carbide is made by heating calcium carbonate and subsequently reducing CaO with carbon – both steps lead to emissions of $CO_2$.

This source is only a minor source of $CO_2$ emissions in Austria: in 2007, emissions from this source contribute 0.04% to national total emissions.

#### 4.3.3.2 Methodological Issues

Emissions were estimated using a country specific methodology.

Activity data were directly reported by the plant operator of the only carbide production plant in Austria.

An emission factor of 1.2957 t/t carbide obtained from industry was applied. It was obtained by summing the emission factors for the carbonate and coke step up:

- Production of lime needed for calcium carbide production: 0.7153 t/t carbide
- Calcium carbide production: 0.5804 t/t carbide

*Table 103:Activity data and emissions for $CO_2$ emissions from Calcium Carbide Production 1990–2007.*

| Year | Calcium Carbide [t] | $CO_2$ Emissions [Gg] |
|---|---|---|
| 1990 | 28 951 | 38 |
| 1991 | 27 159 | 35 |
| 1992 | 31 896 | 41 |
| 1993 | 25 374 | 33 |
| 1994 | 19 406 | 25 |
| 1995 | 20 236 | 26 |
| 1996 | 25 324 | 33 |
| 1997 | 25 313 | 33 |
| 1998 | 27 043 | 35 |
| 1999 | 25 047 | 32 |
| 2000 | 37 130 | 48 |
| 2001 | 36 026 | 47 |
| 2002 | 31 488 | 41 |
| 2003 | 32 010 | 41 |
| 2004 | 27 613 | 36 |
| 2005 | 27 677 | 36 |
| 2006 | 23 557 | 31 |
| 2007 | 28 004 | 36 |

#### 4.3.3.3 Recalculations

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

### 4.3.4 Chemical Industry – Other: Production of Fertilizers and Urea (2.B.5)

#### 4.3.4.1 Source Category Description

*Emission:* $CH_4$, $CO_2$

*Key Source: No*

This category includes $CH_4$ and $CO_2$ emissions from the production of urea and from the production of fertilizers (NPK as well as calcium ammonium nitrate). There is only one producer of urea in Austria, it is also the main producer of fertilizers in Austria.

This source is only a minor source in Austria: in 2007, total emissions from this source contribute 0.02% to national total emissions.

$CO_2$ emissions from the production of fertilizers varied over the period following the trend of fertilizer production. They first decreased, reaching a minimum in 1997 and since then increased again. In 2007 emissions from this category are 33% lower than in 1990 (see Table 104).

#### 4.3.4.2 Methodological Issues

No IPCC methodology is available for these sources.

Data for urea production were directly reported by the Austrian producer of urea and thus represent plant-specific data. Urea is a downstream manufacturing process of ammonia production. The input gases for urea production are $NH_3$ and $CO_2$; the latter is also formed in the ammonia production. In urea production $CO_2$ is emitted at start-ups of the process and emissions are calculated by the number and duration of start-ups. Ammonia always contains a small amount of non-reacted $CH_4$ that is released when $NH_3$ reacts to urea. These $CH_4$ emissions are calculated from the ammonia input in the urea production process and the methane content of the ammonia.

$CH_4$ emissions from the production of urea were reported for the years 2002–2007. For the years before no data is available; therefore the implied emission factor for the year 2002 was used for all years. $CO_2$ emissions are reported by the operator since 1995. The IEF from this year was applied to calculate emissions from the previous years.

Data for fertilizer production for 1990 to 1994 were taken from national statistics (STATISTIK AUSTRIA), for 1995 to 2007 production data were reported directly by the main producer of fertilizers in Austria.

Emission data for $CO_2$ emissions from the production of fertilizers for 1994 to 2007 were directly reported by industry and thus represent plant–specific data. With the emission and activity data from 1994 an implied emission factor for 1994 was calculated and applied for the years 1993 to 1990. However, there is an inconsistency in the time series (see subchapter on time series consistency below). $CO_2$ emissions from fertilizer production were calculated by industry using a mass balance approach.

$CH_4$ emissions from the production of fertilizers were reported for the years 2002–2007; these data became available due to a measurement programme for $CH_4$ at the plant starting in 2002. For the years before no data is available; therefore the implied emission factor for the year 2002 was used for all years.

Table 104 presents activity data, emissions and implied emission factors for $CH_4$ and $CO_2$ emissions from *Fertilizer Production* and *Urea Production* for the period from 1990 to 2007.

*Table 104: Activity data, emissions and implied emission factors for $CO_2$ and $CH_4$ emissions from NPK-fertilizer Production and Urea Production 1990–2007.*

| Year | Urea Production | | | Fertilizer Production | | | |
|---|---|---|---|---|---|---|---|
| | Urea Production [t] | $CO_2$ [Gg] | $CH_4$ [Mg] | Fertilizer Production [t] | $CO_2$ [Gg] | IEF $CO_2$ [kg/t] | $CH_4$ [Mg] |
| 1990 | 282 000 | 0.27 | 108.4 | 1 388 621 | 30.26 | 21.79 | 183.5 |
| 1991 | 295 000 | 0.29 | 113.4 | 1 273 467 | 27.75 | 21.79 | 168.3 |
| 1992 | 259 000 | 0.25 | 99.5 | 1 182 595 | 37.75 | 31.92 | 156.3 |
| 1993 | 305 000 | 0.30 | 117.2 | 1 250 804 | 33.53 | 26.81 | 165.3 |
| 1994 | 360 000 | 0.35 | 138.3 | 1 222 578 | 22.27 | 18.22 | 161.6 |
| 1995 | 393 000 | 0.40 | 151.0 | 916 265 | 19.55 | 21.34 | 121.1 |
| 1996 | 417 705 | 0.30 | 160.5 | 940 313 | 18.07 | 19.22 | 124.3 |
| 1997 | 392 017 | 0.35 | 150.6 | 924 856 | 17.22 | 18.62 | 122.2 |
| 1998 | 395 288 | 0.29 | 151.9 | 977 212 | 18.68 | 19.12 | 129.2 |
| 1999 | 408 386 | 0.24 | 156.9 | 988 662 | 19.65 | 19.88 | 130.7 |
| 2000 | 390 185 | 0.22 | 149.9 | 1 022 983 | 20.59 | 20.13 | 135.2 |
| 2001 | 367 218 | 0.26 | 141.1 | 959 698 | 19.75 | 20.58 | 126.9 |
| 2002 | 389 574 | 0.35 | 149.7 | 1 013 767 | 23.61 | 23.29 | 134.0 |
| 2003 | 447 450 | 0.18 | 163.0 | 1 073 940 | 24.07 | 22.41 | 134.0 |
| 2004 | 442 252 | 0.14 | 165.8 | 1 090 069 | 24.03 | 22.05 | 126.0 |
| 2005 | 416 407 | 0.21 | 155.8 | 1 043 916 | 23.94 | 22.93 | 148.6 |
| 2006 | 429 243 | 0.22 | 162.1 | 1 092 182 | 26.32 | 24.10 | 149.4 |
| 2007 | 384 402 | 0.43 | 144.1 | 892 680 | 20.16 | 22.58 | 118.2 |

#### 4.3.4.3 Time Series Consistency/Planned improvements

The time series of fertilizer production is not consistent with respect to activity data. Whereas the date obtained from STATISTIK AUSTRIA for the period from 1990 to 1994 cover data for the total production in Austria the data for the period 1995 to 2007 reflect only the production of the largest Austrian producer. It is planned to investigate possibilities to improve time series consistency.

#### 4.3.4.4 Recalculations

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

### 4.3.5 Chemical Industry – Other: Ethylene Production (2.B.5)

#### 4.3.5.1 Source Category Description

*Emission:* $CH_4$

*Key Source:* No

Ethylene is made by steam cracking of petrochemical feedstocks. This production process leads to fugitive methane emissions.

This source is only a minor source of $CH_4$ emissions in Austria; in 2007 emissions contributed 0.01% to national total emissions.

#### 4.3.5.2 Methodological Issues

Emissions were estimated using the IPCC default methodology.

Activity data are the capacity of the only ethylene producing plant in Austria and amount to 350 000 t Ethylene per year until 2005. In 2006 the capacity of the ethylene plant was expanded to 500 000 t. The IPCC default emission factor of 1 g $CH_4$/kg Ethylene production was used to calculate the emissions that amount to 350 tonnes $CH_4$ until 2005 and 500 tonnes $CH_4$ since 2006.

#### 4.3.5.3 Recalculations

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

## 4.4 Metal Production (CRF Source Category 2.C)

### 4.4.1 Iron and Steel (2.C.1)

#### 4.4.1.1 Source Category Description

*Emissions:* $CO_2$, $CH_4$

*Key Category:* Yes ($CO_2$)

In Austria iron and steel production is concentrated mainly at two integrated sites operated by the same company. This company is the only company operating blast furnaces in Austria. Additionally there are some companies operating electric arc furnaces, contributing about 10% to total steel production in Austria.

In this category only process specific $CO_2$ emissions are reported, emissions due to combustion in iron and steel industry are reported in the energy sector (Category *1.A.2.a*).

Process specific $CO_2$ emissions result from the use of reducing agent in pig iron production in blast furnaces and steel production in electric arc furnaces (use of electrodes) as well as from steel production (lowering the carbon content of steel compared to pig iron in electric arc furnaces and basic oxygen furnaces respectively).

Also $CH_4$ emissions from rolling mills and from electric arc furnaces are reported in this category.

$CO_2$ emissions from iron and steel production is an important key category of the Austrian greenhouse gas inventory because of its contribution to the total inventory level for base year and 2007 and because of its contribution to the trend.

In the year 2006, $CO_2$ emissions from production of iron and steel contributed 6.2% to total greenhouse gas emissions in Austria (see Chapter 1.5).

$CH_4$ emissions from this category are negligible; the contribution to national total emissions in 2006 was 0.0001%.

Table 105 presents total $CO_2$ and $CH_4$ emissions from the production of iron and steel for the period from 1990 to 2007. $CO_2$ emissions from *Iron and Steel Production* decrease from 1990 to 1992 and then increase steadily following the trend of pig iron production. In 2007 emissions were % above the level of 1990.

*Table 105:Total $CO_2$ and $CH_4$ emissions from iron and steel 1990–2007.*

| Year | $CO_2$ [Gg] | $CH_4$ [Gg $CO_2$ eq] |
|---|---|---|
| 1990 | 3 546 | 0.047 |
| 1991 | 3 509 | 0.039 |
| 1992 | 3 075 | 0.045 |
| 1993 | 3 145 | 0.051 |
| 1994 | 3 411 | 0.054 |
| 1995 | 3 921 | 0.057 |
| 1996 | 3 703 | 0.050 |
| 1997 | 4 100 | 0.059 |
| 1998 | 3 900 | 0.063 |
| 1999 | 3 759 | 0.061 |
| 2000 | 4 202 | 0.068 |
| 2001 | 4 159 | 0.069 |
| 2002 | 4 607 | 0.068 |
| 2003 | 4 523 | 0.072 |
| 2004 | 4 446 | 0.077 |
| 2005 | 4 995 | 0.079 |
| 2006 | 5 193 | 0.081 |
| 2007 | 5 482 | 0.089 |

#### 4.4.1.2 Methodological Issues

**General Remark**

Total $CO_2$ emissions from the two main integrated iron and steel production sites in Austria are reported directly by industry until 2002. They are calculated by applying a very detailed mass balance approach for carbon. Process specific emissions[26] are calculated by the Umweltbundesamt according to the IPCC good practice guidance; these emissions are subtracted from total $CO_2$ emissions reported by the company. The remaining emissions are reported in the energy sector as emissions due to combustion in category *1.A.2.a Iron and Steel*.

Thus, some shortcomings of the methodology applied for calculating process specific $CO_2$ emissions do not have an effect on national total emissions but only on the split between process specific and combustion specific emissions (for example only carbonatious ore was considered for calculating the split of process specific and combustion specific $CO_2$ emissions from blast furnaces whereas the carbon content of other ore used was not considered; however, the detailed mass balance approach used by the operator does consider all carbon introduced to the process, thus also considering ore other than carbonatious ore).

For the years 2003 and 2004 total $CO_2$ emissions were not reported by industry, thus they were estimated using information from the national energy balance and from the years before (see below and description of category *1.A.2.a*).

[26] Process specific emissions considered are $CO_2$ emissions resulting from the use of reducing agent in pig iron production in blast furnaces and $CO_2$ emissions from steel production resulting from the lowering of the carbon content of steel compared to pig iron in basic oxygen furnaces as well as $CO_2$ emissions from limestone use in blast furnaces. The latter is reported under 2.A.3

For 2005-2007 verified $CO_2$ emissions, reported under the ETS, were taken for the inventory. These data cover $CO_2$ emissions from pig iron, basic oxygen and electric arc furnace steel.

**$CO_2$ emissions from blast furnace pig iron production**

$CO_2$ emissions were calculated following closely the IPCC GPG guidelines Tier 2 approach, applying the default emission factor of table 3.6 of the IPCC GPG:

*$CO_2$ Emissions = Mass of reducing agent * 3.1 t $CO_2$/ t reducing agent + (Mass of Carbon in the Ore – Mass of Carbon in the Crude Iron) * 44/12*

The mass of reducing agent – coke - was taken from the national energy balance (see Annex 4). According to a national study (HIEBLER et al.) 56.3% of coke used in blast furnaces is actually needed as reducing agent, this part is reported as non-energy use in the national energy balance[27].

This non-energy use is used for calculating $CO_2$ emissions from pig iron production in blast furnaces with the equation presented above, as this is assumed to be more accurate than the approach of the GPG where total mass of reducing agent is considered as non-energy use and the resulting emissions as process specific emissions.

Only carbonatious ore was considered for the calculation as no statistical data was available for the amount of other ore[28] (however, the carbon content of iron oxide is only small). Carbon content of the ore was calculated assuming pure ore, thus the factor used for calculating the mass of carbon in the ore was based on the stochiometric ratio of carbon in $FeCO_3$:

*Mass of Carbon in the Ore = Mass of ore * 12/116*

Mass of ore used in pig iron production for the years 1990 to 1995 was taken from national statistics (statistical yearbook of STATISTIK AUSTRIA), the value of 1995 was also used for 1996 and 1997. From 1998–2002 the mass of ore was directly reported by industry; for 2003 the value of the Steel statistical yearbook 2004 was used (IISI 2004). The value for 2004 was estimated with the pig iron production, multiplied by the mean proportion iron ore/pig iron from the years 2000–2003. The values for 2005-2007 correspond to the background data (for consistency reasons just carbonatious ore) given in the ETS report.

Mass of carbon in pig iron was calculated by applying the IPCC default value of 4% carbon in crude steel.

Pig iron production data for 1990 and 1995 to 2001 was taken from national statistics (statistical yearbook of STATISTIK AUSTRIA), data for 1991 to 1994 was taken from www.worldsteel.org; for 2002–2007 pig iron production data were directly reported by industry; activity data reported from industry are validated in the time series in comparison with data from National Statistics, with which they are consistent.

[27] Because of the methodology of the energy balance, the reported amount of non-energy use is not always exactly 56.3%, that's why for calculating emissions total coke use in blast furnaces was taken from the energy balance and from this amount 56.3% was considered as non-energy use.

[28] Carbonatious ore is mined in Austria, thus it is reported in the statistical yearbook.

For 2005–2007 $CO_2$ emissions from non-carbonatious ore – calculated by its C content – and other additives – including plastics and coal fines used as reducing agents – were taken into account additionally. This information became available from background data reported under the ETS. Again it has to be stressed that this additional accounting does not affect total $CO_2$ emissions, but only improves the accuracy of the split made between process and combustion specific emissions.

Activity data, calculated $CO_2$ emission data as well as the implied emission factor for $CO_2$ emissions from pig iron production are presented in Table 106. The trend in IEF values from pig iron production fluctuates until 2005, because $CO_2$ emissions follow closely the coke input (more than 91% of $CO_2$ emissions originate from coke input). Coke input (non-energy-use) from the national energy balance shows a different trend to pig iron production. The reason for this to some extend could be the imperfect separation of total coke input in energy and non-energy use in the national energy balance and the use of other reducing agents that are not directly allocated. Since 2005 the IEF is quite stable, because background data reported under the ETS allowed to account for reducing agents other than coke.

*Table 106:Activity data, emissions and implied emission factors for $CO_2$ emissions from pig iron production 1990–2007.*

| Year | Coke [kt] | Ore [kt] | Pig Iron [kt] | $CO_2$ [Gg] | IEF $CO_2$ [t/kt Pig Iron] |
|---|---|---|---|---|---|
| 1990 | 872 | 2 225 | 3 444 | 3 043 | 883 |
| 1991 | 878 | 2 092 | 3 442 | 3 011 | 875 |
| 1992 | 793 | 1 629 | 3 074 | 2 625 | 854 |
| 1993 | 815 | 1 627 | 3 070 | 2 693 | 877 |
| 1994 | 893 | 1 695 | 3 320 | 2 923 | 880 |
| 1995 | 1 012 | 2 071 | 3 888 | 3 352 | 862 |
| 1996 | 941 | 2 071 | 3 432 | 3 201 | 933 |
| 1997 | 1 070 | 2 071 | 3 972 | 3 519 | 886 |
| 1998 | 1 037 | 1 810 | 4 032 | 3 309 | 821 |
| 1999 | 1 001 | 1 734 | 3 912 | 3 186 | 814 |
| 2000 | 1 125 | 1 879 | 4 320 | 3 568 | 826 |
| 2001 | 1 113 | 1 875 | 4 380 | 3 518 | 803 |
| 2002 | 1 251 | 1 925 | 4 669 | 3 925 | 841 |
| 2003 | 1 200 | 2 119 | 4 677 | 3 838 | 821 |
| 2004 | 1 177 | 2 100 | 4 861 | 3 733 | 768 |
| 2005 | 1 332 | 2 038 | 5 458 | 4 186 | 767 |
| 2006 | 1 357 | 2 130 | 5 565 | 4 366 | 785 |
| 2007 | 1 359 | 2 010 | 5 888 | 4 598 | 781 |

**$CO_2$ emissions from basic oxygen furnace steel production**

$CO_2$ emissions from steel production, which corresponds to steel production at the two integrated sites operating basic oxygen furnaces (BOF), were calculated following the IPCC GPG guidelines Tier 2 approach:

*$CO_2$ Emissions = (Mass of Carbon in the Crude Iron used for Crude Steel – Mass of Carbon in the Crude Steel) * 44/12*

For the years 1990 to 2001 activity data for electric steel production was subtracted from total steel production in Austria taken from national statistics (statistical yearbook of STATISTIK AUSTRIA) to obtain steel production of the two integrated sites operating blast furnaces. For 2002 to 2007 steel production of the two integrated sites operating blast furnaces was directly reported by industry.

The average carbon content of 0.15% for steel was obtained from the operator of the two integrated sites; as mentioned above, the IPCC default value was used for the carbon content of pig iron (4%).

### $CO_2$ and $CH_4$ emissions from electric arc furnace steel production

Emissions were estimated using a country specific methodology.

$CO_2$ emissions for the year 2003 have been reported by each electric steel site in Austria. The IEF calculated for this year (52 kg/t steel) was also used to calculate emissions from the years before and for 2004. For 2005-2007 verified $CO_2$ emissions, reported under the ETS, were taken for the inventory.

For calculating $CH_4$ emissions an emission factor of 5 g $CH_4$/Mg electric steel was applied. An emission factor for VOC emissions from production of steel in Austria was taken from a study published by the Austrian chamber of commerce, section industry (WINDSPERGER & TURI 1997). It was assumed that total VOC emissions are composed of 10% $CH_4$ and 90% NMVOC (expert judgement Umweltbundesamt).

Activity data were obtained from the *Association of Mining and Steel* and thus represent plant specific data.

### $CH_4$ emissions from rolling mills

Emissions were estimated using a country specific methodology.

The emission factor for VOC emissions from rolling mills (1 g VOC/Mg steel) 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).

Activity data as used for calculating $CO_2$ emissions from steel production (see above) was applied.

Table 107 presents steel and electric steel production, $CO_2$ and $CH_4$ emissions and implied emission factors as well as total $CO_2$ emissions from this sector.

*Table 107: Activity data, emissions and implied emission factors for $CO_2$ and $CH_4$ emissions from Steel Production 1990–2007.*

| Year | Steel Production | | | | Electric Steel Production | | | Total $CH_4$ [Mg] | Total $CO_2$ [Gg] |
|---|---|---|---|---|---|---|---|---|---|
| | Steel [kt] | $CO_2$ [Gg] | IEF $CO_2$ [t/kt] | $CH_4$ [Mg] | Electric Steel [kt] | $CO_2$ [Gg] | $CH_4$ [Mg] | | |
| 1990 | 3 921 | 484 | 123 | 0.39 | 370 | 20 | 1.85 | 2.24 | 503 |
| 1991 | 3 896 | 483 | 124 | 0.39 | 290 | 15 | 1.45 | 1.84 | 499 |
| 1992 | 3 592 | 431 | 120 | 0.36 | 361 | 19 | 1.80 | 2.16 | 450 |
| 1993 | 3 738 | 430 | 115 | 0.37 | 411 | 22 | 2.05 | 2.43 | 451 |
| 1994 | 3 968 | 465 | 117 | 0.40 | 431 | 23 | 2.15 | 2.55 | 488 |

| Year | Steel Production | | | | Electric Steel Production | | | Total $CH_4$ [Mg] | Total $CO_2$ [Gg] |
|---|---|---|---|---|---|---|---|---|---|
| | Steel [kt] | $CO_2$ [Gg] | IEF $CO_2$ [t/kt] | $CH_4$ [Mg] | Electric Steel [kt] | $CO_2$ [Gg] | $CH_4$ [Mg] | | |
| 1995 | 4 538 | 545 | 120 | 0.45 | 454 | 24 | 2.27 | 2.72 | 569 |
| 1996 | 4 032 | 481 | 119 | 0.40 | 396 | 21 | 1.98 | 2.38 | 502 |
| 1997 | 4 718 | 557 | 118 | 0.47 | 466 | 25 | 2.33 | 2.80 | 581 |
| 1998 | 4 801 | 565 | 118 | 0.48 | 503 | 27 | 2.51 | 2.99 | 592 |
| 1999 | 4 722 | 548 | 116 | 0.47 | 486 | 26 | 2.43 | 2.90 | 573 |
| 2000 | 5 183 | 605 | 117 | 0.52 | 541 | 29 | 2.70 | 3.22 | 634 |
| 2001 | 5 346 | 613 | 115 | 0.53 | 546 | 29 | 2.73 | 3.26 | 642 |
| 2002 | 5 647 | 654 | 116 | 0.56 | 538 | 28 | 2.69 | 3.26 | 682 |
| 2003 | 5 707 | 655 | 115 | 0.57 | 568 | 30 | 2.84 | 3.41 | 685 |
| 2004 | 5 901 | 680 | 115 | 0.59 | 614 | 32 | 3.07 | 3.66 | 713 |
| 2005 | 6 408 | 763 | 119 | 0.64 | 624 | 45 | 3.12 | 3.76 | 808 |
| 2006 | 6 487 | 778 | 120 | 0.65 | 640 | 49 | 3.20 | 3.85 | 827 |
| 2007 | 6 871 | 826 | 120 | 0.69 | 707 | 58 | 3.53 | 4.22 | 884 |

#### 4.4.1.3 Source specific QA/QC

Coke input from the energy balance is compared with coke input reported by the operator. Pig iron and steel production figures are compared with international published data (International Iron and Steel Institute) to ensure completeness. For 2005-2007 detailed information on the carbon mass balance applied by the company to calculate total emissions from pig iron and BOF steel were available due to the ETS. Thus it was possible to validate $CO_2$ emissions with this background data.

#### 4.4.1.4 Uncertainty Assessment

Iron and steel industry is considered dependent of the energy sector, because the major share of $CO_2$ emissions results from the use of fossil fuel as reducing agent. Thus, the same uncertainty values like for solid fuel combustion in large point sources have been applied, namely 0.5% for activity data and 0.5% for emission factor; this leads to an overall uncertainty for $CO_2$ emissions of 0.7% (WINIWARTER 2008).

#### 4.4.1.5 Recalculations

Process-specific $CO_2$ emissions from pig iron production for 2006 were recalculated, because emissions from plastics used as reducing agents and other additives were correctly allocated from the energy to this sector. These recalculations resulted in a increase of emissions of 2%.

### 4.4.2 Ferroalloys Production (2.C.2)

#### 4.4.2.1 Source Category Description

*Emissions:* $CO_2$

*Key source:* *No*

Ferroalloy production involves a metallurgical reduction process which results in $CO_2$ emissions.

This source is only a minor source of $CO_2$ emissions in Austria: in 2007, emissions from this source contribute 0.02% to national total emissions.

#### 4.4.2.2 Methodological Issues

Emissions were estimated using the IPCC Tier 1b methodology.

According to publications from the *British Geological Survey* (BRITISH GEOLOGICAL SURVEY 2001, 2005–2008) Austria produce ferro-molybdenum, ferro-vanadium and ferro-nickel. Activity data from 1995 to 2006 were directly taken from these publications. As no data were available for 1990–1994 the value from 1995 was taken for these years. For 2007 the trend 1990–2006 was extrapolated.

The emission factor for ferro-nickel of 1.36 t $CO_2$/t product was taken from (SJARDIN 2003) and applied to all ferroalloys as no specific emission factors for ferro-molybdenum and ferro-vanadium were available.

*Table 108:Activity data and emissions from ferroalloy production 1990–2007.*

| Year | Ferroalloy production [kt] | $CO_2$ emissions [Gg] |
|---|---|---|
| 1990 | 15.3 | 20.8 |
| 1991 | 15.3 | 20.8 |
| 1992 | 15.3 | 20.8 |
| 1993 | 15.3 | 20.8 |
| 1994 | 15.3 | 20.8 |
| 1995 | 15.3 | 20.8 |
| 1996 | 13.8 | 18.8 |
| 1997 | 14.2 | 19.3 |
| 1998 | 14.1 | 19.2 |
| 1999 | 13.9 | 18.9 |
| 2000 | 13.9 | 18.9 |
| 2001 | 13.3 | 18.1 |
| 2002 | 12.6 | 17.1 |
| 2003 | 12.3 | 16.7 |
| 2004 | 12.4 | 16.9 |
| 2005 | 13.8 | 18.7 |
| 2006 | 13.8 | 18.7 |
| 2007 | 12.5 | 17.0 |

#### 4.4.2.3 Recalculations

Activity data for the year 2006 has been updated since the last submission. This recalculation resulted in an increase of emissions of 11%.

### 4.4.3 Aluminium Production (2.C.3)

#### 4.4.3.1 Source Category Description

*Emissions:* *PFCs and $CO_2$*

*Key Source:* *Yes (PFCs, $CO_2$)*

This category includes emissions of $CO_2$ and PFCs from aluminium production. Primary aluminium production in Austria was terminated in 1992.

The two PFCs, tetrafluoromethane ($CF_4$) and hexafluoroethane ($C_2F_6$) are emitted from the process of primary aluminium smelting. They are formed during the phenomenon known as the anode effect (AE).

$CO_2$ emissions arise from the consumption of the anode in the production process.

This category is a key category for PFC emissions because of the contribution to the total level of greenhouse gas emissions in the base year; and a key source for both PFC and $CO_2$ emissions due to its trend.

Table 109 presents PFC and $CO_2$ emissions from primary aluminium production for the period from 1990 to 1992.

*Table 109:PFC emissions from primary aluminium production from 1990 to 1992.*

| | 1990 | 1991 | 1992 |
|---|---|---|---|
| PFC emission [Gg $CO_2$-equivalent] | 1 050 | 1 050 | 418 |
| $CO_2$ emissions [Gg] | 158 | 158 | 63 |

#### 4.4.3.2 Methodological Issues

$CO_2$ emissions were calculated by applying the IPCC default emission factor of 1.8 t $CO_2$/t aluminium produced taken from the IPCC guidelines (Table 2.16).

PFC emissions were estimated using the IPCC Tier 3b methodology. The specific $CF_4$ emissions (and $C_2F_6$ emissions respectively) of the anode effect were calculated by applying the following formula (BARBER 1996), (GIBBS & JACOBS 1996), (TABERAUX 1996):

$$kg\ CF_4/t_{Al} = (1.7 \times AE/pot/day \times F \times AE_{min})/CE$$

Where:

*AE/pot/day* *= frequency of occurrence of the anode effect (dependent on type of oxide supply (1,2/day)*

*$t_{Al}$* *= effective production capacity per year [t]*

*$AE_{min}$* *= anode effect duration in minutes (5 min)*

*F* *= fraction of $CF_4$ in the anode gas (13%)*

*CE* *= current efficiency (85%)*

*1.7* *= constant resulting from Faraday's law*

In Austria so called "Søderberg" anodes were used. The frequency of the anode effect (AE/pot/day) was about 1.2 per day. The duration of the anode effect ($AE_{min}$) was in the range of 4 to 6 minutes. The average fraction of $CF_4$ formed in percent of the anode gas (F) can be determined as a function of the duration of the anode effect. International values are about 10% after two minutes, 12% after three minutes and after that there is only a marginal increase. Therefore for Austrian aluminium production a $CF_4$ fraction in the anode gas of 13% was assumed.

Because $C_2F_6$ is formed only during the first minute of the anode effect, the rate of $C_2F_6$ is the higher the shorter the duration of the anode effect is. For the aluminium production in Austria the rate of $C_2F_6$ is about 8% and the current efficiency (CE) about 85.4%.

Activity data were taken from national statistics (88 021 t for 1990 and 1991, and 35 000 t in 1992).

By inserting these data into the formula mentioned above an emission factor of 1.56 kg $CF_4$/t aluminium was calculated.

#### 4.4.3.3 Source specific QA/QC

Country specific parameters were compared with international data.

#### 4.4.3.4 Uncertainty Assessment

The uncertainty for the PFC emission factors ("Søderberg" process) is between 30–80% according to the IPCC GPG (p.3.43). Activity data do not influence the uncertainty of emissions, because PFCs are formed during the anode effect that is associated with the EF. Assuming a mean value for the emission factor, the uncertainty of PFC emissions is 50%.

Uncertainty of $CO_2$ emissions is assumed to be 2%, mainly deriving from AD uncertainty (WINIWARTER 2008).

#### 4.4.3.5 Recalculations

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

### 4.4.4 $SF_6$ Used in Aluminium and Magnesium Foundries (2.C.4)

#### 4.4.4.1 Source Category Description

*Emissions:* *$SF_6$*

*Key Source:* *Yes ($SF_6$)*

This category includes emissions of $SF_6$ from magnesium and aluminium foundries.

This source is a key category because of its contribution to the trend.

In the base year (1990), $SF_6$ emission from aluminium and magnesium foundries contributed 0.3% to the total amount of greenhouse gas emissions in Austria, in the year 2007 no emissions arose from this category (see Table 92).

Table 110 presents $SF_6$ emissions from magnesium and aluminium foundries for the period from 1990 to 2007.

As can be seen in the table below, $SF_6$ emissions have been fluctuating during the period, but the overall trend has been decreasing $SF_6$ emissions; from 1990 to 2000 they decreased by 97%. This decreasing trend is explained by technological advances and the replacement of $SF_6$ by other substances used for surface protection. For the years 2001 and 2002 the value of 2000 was used due to lack of more up to date data; since 2003 the use of $SF_6$ in foundries is prohibited in Austria.

*Table 110:$SF_6$ emissions from magnesium and aluminium foundries 1990–2007.*

| Year | $SF_6$ emissions [Gg] |
|---|---|
| 1990 | 0.0106 |
| 1991 | 0.0116 |
| 1992 | 0.0106 |
| 1993 | 0.0116 |
| 1994 | 0.0156 |
| 1995 | 0.0185 |
| 1996 | 0.0256 |
| 1997 | 0.0146 |
| 1998 | 0.0069 |
| 1999 | 0.0009 |
| 2000 | 0.0003 |
| 2001 | 0.0003 |
| 2002 | 0.0003 |
| 2003–2007 | 0 |

#### 4.4.4.2 Methodological Issues

Emissions were estimated following the IPCC methodology using annual consumption data of $SF_6$.

Information about the amount of $SF_6$ used was obtained directly from the aluminium and magnesium producers in Austria and thus represents plant-specific data (for verification data was checked against data from $SF_6$ suppliers). Actual emissions of $SF_6$ equal potential emissions and correspond to the annual consumption of $SF_6$.

The amount of Magnesium cast, $SF_6$ emissions and the implied emission factors are presented in Table 111 for transparency. For the years 1996–1998 the value from 1995 is reported because the categories in the statistics changed and no activity data for Magnesium cast as reported in the previous years was available.

*Table 111:Magnesium cast, $SF_6$ emissions and IEF 1990–1999.*

| Year | Magnesium cast [t] | $SF_6$ emissions [t] | IEF $SF_6$ [kg/t] |
|---|---|---|---|
| 1990 | 3 080 | 10.0 | 3.2 |
| 1991 | 2 814 | 11.0 | 3.9 |
| 1992 | 2 693 | 10.0 | 3.7 |
| 1993 | 2 491 | 11.0 | 4.4 |
| 1994 | 3 281 | 15.0 | 4.6 |
| 1995 | 3 377 | 17.9 | 5.3 |
| 1996 | 3 377 | 25.0 | 7.4 |
| 1997 | 3 377 | 14.0 | 4.1 |
| 1998 | 3 377 | 6.1 | 1.8 |
| 1999 | 3 600 | 0.2 | 0.1 |

#### 4.4.4.3 Source specific QA/QC

The amount of $SF_6$ used is cross-checked with data from $SF_6$ suppliers. All IEFs are within the range of the Norsk Hydro survey (0.1 to 11 kg/t Mg) cited in the IPCC GPG (p.3.47).

#### 4.4.4.4 Uncertainty Assessment

According to the IPCC GPG (p 3.49) the uncertainty associated with plant $SF_6$ use data is low (5%).

#### 4.4.4.5 Recalculations

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

## 4.5 Consumption of Halocarbons and $SF_6$ (CRF Source Category 2.F)

### 4.5.1 Source Category Description

This category includes the following emission sources: refrigeration and air conditioning equipment, foam blowing, fire extinguishers, aerosols, solvents semiconductor manufacture, electrical equipment and other sources (noise insulation windows, tyres and research).

There is no production of Halocarbons in Austria.

The year 1990 was chosen as base year for HFC, PFC and $SF_6$ emissions.

Potential emissions are reported as sums under category *2.F*, for estimates of actual emissions please refer to the respective sub-categories.

**Emission Trends**

For the source *Consumption of Halocarbons and $SF_6$* greenhouse gas emissions are more than four times higher in 2007 than in the base year 1990. This was mainly due to strongly increasing emissions from the use of HFCs as substitutes for ozone depleting substance (*ODS Substitutes*).

Potential and actual emissions per substance group is presented in Table 112, emissions by sub sector and gas are presented in Table 113 and *Table 114*.

In 2006 actual $SF_6$ emissions exceed potential emissions. This is due to emissions from disposal of noise insulating windows.

*Table 112:Potential and actual emissions of IPCC Category 2 F per substance group [Gg $CO_2$e] 1990–2007.*

| | HFCs [Gg $CO_2$e] | | PFCs [Gg $CO_2$e] | | $SF_6$ [Gg $CO_2$e] | | Total [Gg $CO_2$e] | |
|---|---|---|---|---|---|---|---|---|
| **Year** | **Potential** | **Actual** | **Potential** | **Actual** | **Potential** | **Actual** | **Potential** | **Actual** |
| 1990 | 47.42 | 23.03 | 32.28 | 29.05 | 586.57 | 249.24 | 666.27 | 301.33 |
| 1991 | 60.39 | 45.21 | 40.99 | 36.89 | 839.14 | 376.12 | 940.52 | 458.23 |
| 1992 | 62.98 | 48.68 | 56.70 | 45.08 | 903 | 444.51 | 1 022.68 | 538.26 |
| 1993 | 347.41 | 157.34 | 58.41 | 52.90 | 966.86 | 516.47 | 1 372.67 | 726.71 |
| 1994 | 371.24 | 206.83 | 64.77 | 58.61 | 1 127.73 | 612.86 | 666.27 | 301.33 |

| | HFCs [Gg $CO_2$e] | | PFCs [Gg $CO_2$e] | | $SF_6$ [Gg $CO_2$e] | | Total [Gg $CO_2$e] | |
|---|---|---|---|---|---|---|---|---|
| Year | Potential | Actual | Potential | Actual | Potential | Actual | Potential | Actual |
| 1995 | 727.58 | 267.34 | 75.99 | 68.69 | 1 216.26 | 696.06 | 940.52 | 458.23 |
| 1996 | 982.72 | 346.84 | 73.24 | 66.20 | 942.8 | 607.41 | 1022.68 | 538.26 |
| 1997 | 1 122.46 | 427.42 | 107.20 | 96.75 | 1 098.77 | 770.98 | 1372.67 | 726.71 |
| 1998 | 1 181.44 | 494.89 | 110.71 | 44.65 | 1 268.99 | 743.8 | 1563.74 | 878.30 |
| 1999 | 1 302.90 | 542.20 | 191.14 | 64.44 | 1 027.51 | 661.74 | 2019.82 | 1032.09 |
| 2000 | 1 538.92 | 596.26 | 243.28 | 72.21 | 983.99 | 625.67 | 1998.77 | 1020.45 |
| 2001 | 1 869.98 | 694.45 | 285.95 | 82.02 | 1 025.89 | 628.97 | 2328.43 | 1295.15 |
| 2002 | 1 899.20 | 781.21 | 316.48 | 86.73 | 1 030.86 | 633.19 | 2561.14 | 1283.34 |
| 2003 | 1 923.24 | 862.96 | 380.60 | 102.39 | 812.96 | 593.52 | 2521.55 | 1268.37 |
| 2004 | 1 874.95 | 896.71 | 340.98 | 125.68 | 657.13 | 513.12 | 2766.19 | 1294.14 |
| 2005 | 1 474.95 | 907.91 | 351.35 | 125.22 | 485.67 | 286.50 | 3181.82 | 1405.44 |
| 2006 | 1 346.53 | 860.74 | 380.99 | 135.67 | 414.22 | 480.24 | 3246.54 | 1501.13 |
| 2007 | 1 372.88 | 860.63 | 451.77 | 182.71 | 440.14 | 409.58 | 3116.81 | 1558.87 |

**Key Categories**

For the key category analysis emission data of this category were aggregated as suggested in the IPCC GPG:

- 2.F.1/2/3/4/5 ODS (Ozone Depleting Substances) Substitutes (HFCs),
- 2.F.7 Semiconductor Manufacture (HFCs, PFCs and $SF_6$),
- 2.F.8 Electrical Equipment ($SF_6$) and
- 2.F.9 Other Sources of $SF_6$ ($SF_6$)

Three of these sources have been identified as key categories:

*2.F.1/2/3/4/5 ODS (Ozone Depleting Substances) Substitutes* (HFCs) because of its contribution to total emissions in the year 2007 and to the trend of emissions. In the year 2007 HFC emissions from ODS contributed 1.0% to the total amount of greenhouse gas emissions in Austria, in the base year (1990) 0.0% (see Table 92).

*2.F.7 Semiconductor Manufacture* (HFCs, PFCs and $SF_6$) because of its contribution to the total inventory's level in the year 2007. In the year 2007 emissions from this category contributed 0.3% to the total amount of greenhouse gas emissions in Austria (0.2% in 1990).

*2.F.9 Other Sources of $SF_6$* ($SF_6$) was not identified in the quantitative analysis. Nevertheless it was identified as key in previous years, which makes it key due to the qualitative criteria established in Austria, once key always key (see also Chapter 1.5.1) . In the year 2007 emissions from this category contributed 0.3% to the total amount of greenhouse gas emissions in Austria (0.2% in 1990).

For further information on key categories see Chapter 1.5).

## 4.5.2 Methodological Issues

A study has been contracted out to determine the consumption data and emissions from 1990–2000 for all uses of FCs (UMWELTBUNDESAMT 2001b). In this study, bottom up data for consumption per sector were compared with top-down data from importers and retailers of FCs as well as with data from the national statistics (import/export statistics).

The study also included projections until 2010, these were used to estimate emissions from 2001–2006 for the subcategories *2.F.1 Refrigeration and Air conditioning equipment*, *2.F.3 Fire Extinguishers* and *2.F.9 Other sources of* $SF_6$. For the sub-categories *2.F.7 Semiconductor Manufacture* and *2.F.8 Electrical Equipment* data for these years were available due to the Austrian reporting obligation (see below). The sub-category *2.F.2 Foam blowing* was re-evaluated in a new contracted study (OBERNOSTERER et al 2004). Austrian estimates of emissions from the sources *2.F.4 Aerosols* and *2.F.5 Solvents* are based on a European evaluation of emissions from this sector (HARNISCH & SCHWARZ 2003), subsequently disaggregated to provide a top-down Austrian estimate.

Data about consumption of HFC, PFC and $SF_6$ were determined from the following sources:

- data from national statistics
- data from associations of industry
- direct information from importers and end users

Since 2004 there is also a reporting obligation under the Austrian FC-regulation[29] for users of FCs in the following applications: refrigeration and air-conditioning, foam blowing, semiconductor manufacture, electrical equipment, fire extinguishers and aerosols. Data is either reported electronically with a system set up by the Umweltbundesamt or per mail (electronic or letter) to the Ministry for Environment (these reports are then forwarded to the Umweltbundesamt to be brought together with data from the electronic system).

The first reporting year is 2003, from this year on the end users of FCs are obliged to report annually about the amounts used and recycled. Theoretically, almost the whole activity data used for inventory preparation is covered by the reporting obligation. However, especially the refrigeration sector is very complex, there are numerous small enterprises, and not all of them are organised in an industry association, they are hard to reach and to inform about the reporting obligation. That's why not all enterprises reported their consumption, and the results of the first reporting years could not be used for these applications; however, for the next submission results will be considered as far as possible.

Emissions for all subcategories were estimated using a country specific methodology; emission factors are based on information of experts from the respective industries (except emissions from aerosols and solvents, where IPCC default emission factors are used). For most sources emissions are calculated from annual stocks using emission factors. Additionally emissions can occur during production or disposal of Halocarbons or $SF_6$ containing products. Annual stocks correspond to the amounts of FCs stored in applications in the year before, minus emissions of the year before, plus consumption of the considered year. Potential emissions correspond to the amounts consumed in the considered year.

The following subchapters present emission factors and data sources used for the respective subcategories.

[29] „Industriegas-Verordnung (HFKW-FKW-SF6-VO)" Federal Law Gazette II No. 447/2002

*Table 113:Emissions of IPCC Category 2.F by source 1990–1999.*

| GHG | GWP | Unit | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **2.F.1 Refrigeration and Air Conditioning Equipment** | | | | | | | | | | | | |
| HFC-32 | 650 | t | 0.00 | 0.00 | 0.00 | 0.00 | 0.02 | 0.09 | 0.19 | 0.39 | 0.68 | 1.02 |
| HFC-125 | 2 800 | t | 0.00 | 0.00 | 0.00 | 0.00 | 0.03 | 1.47 | 5.73 | 10.96 | 14.26 | 15.07 |
| HFC-134a | 1 300 | t | 1.35 | 2.12 | 2.83 | 4.14 | 6.11 | 21.76 | 41.51 | 60.79 | 82.01 | 99.66 |
| HFC-152a | 140 | t | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.06 | 0.33 | 0.57 | 0.72 | 0.61 |
| HFC-143a | 3 800 | t | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.39 | 2.52 | 5.59 | 7.92 | 8.94 |
| | **Gg $CO_2$e** | | **1.76** | **2.75** | **3.68** | **5.38** | **8.03** | **33.95** | **79.78** | **131.30** | **177.16** | **206.45** |
| **2.F.2 Foam Blowing** | | | | | | | | | | | | |
| HFC-134a | 1 300 | t | 0.00 | 0.00 | 0.00 | 75.88 | 107.41 | 129.82 | 151.24 | 170.37 | 188.06 | 197.97 |
| HFC-152a | 140 | t | 0.00 | 0.00 | 0.00 | 37.37 | 52.90 | 63.94 | 73.85 | 82.61 | 90.64 | 94.82 |
| | **Gg $CO_2$e** | | **0.00** | **0.00** | **0.00** | **103.88** | **147.04** | **177.72** | **206.95** | **233.05** | **257.17** | **270.64** |
| **2.F.3 Fire Extinguishers** | | | | | | | | | | | | |
| HFC-23 | 11 700 | t | 0.00 | 0.00 | 0.00 | 0.10 | 0.25 | 0.38 | 0.56 | 0.74 | 0.95 | 1.15 |
| HFC-227ea | 2 900 | t | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.05 | 0.15 | 0.24 | 0.35 |
| C4F10 | 7 000 | t | 0.00 | 0.00 | 0.05 | 0.05 | 0.05 | 0.04 | 0.04 | 0.04 | 0.04 | 0.03 |
| | **Gg $CO_2$e** | | **0.00** | **0.00** | **0.35** | **1.50** | **3.18** | **4.78** | **7.02** | **9.30** | **12.05** | **14.74** |
| **2.F.4 Aerosols** | | | | | | | | | | | | |
| HFC-unspecified | Gg $CO_2$e | | 18.88 | 38.44 | 39.58 | 40.11 | 40.71 | 41.64 | 42.58 | 43.53 | 44.71 | 46.25 |
| | **Gg $CO_2$e** | | **18.88** | **38.44** | **39.58** | **40.11** | **40.71** | **41.64** | **42.58** | **43.53** | **44.71** | **46.25** |
| **2.F.5 Solvents** | | | | | | | | | | | | |
| HFC-43-10mee | 1 300 | t | 0.36 | 0.73 | 0.75 | 0.76 | 0.77 | 0.79 | 0.80 | 0.82 | 0.85 | 0.87 |
| | **Gg $CO_2$e** | | **0.46** | **0.94** | **0.97** | **0.99** | **1.00** | **1.02** | **1.05** | **1.07** | **1.10** | **1.14** |
| **2.F.7 Semiconductor Manufacture** | | | | | | | | | | | | |
| HFC-unspecified | Gg $CO_2$e | | 1.93 | 3.07 | 4.44 | 5.81 | 7.18 | 8.53 | 9.74 | 9.43 | 2.96 | 3.23 |
| PFC-unspecified | Gg $CO_2$e | | 29.05 | 36.89 | 44.73 | 52.57 | 58.30 | 68.39 | 65.92 | 96.48 | 44.40 | 64.19 |
| $SF_6$ | 23 900 | t | 4.27 | 7.33 | 9.98 | 12.64 | 15.29 | 17.94 | 13.74 | 20.41 | 18.01 | 16.17 |
| | **Gg $CO_2$e** | | **133.08** | **215.20** | **287.79** | **360.38** | **430.86** | **505.68** | **403.95** | **593.76** | **477.80** | **453.93** |
| **2.F.8 Electrical Equipment** | | | | | | | | | | | | |
| $SF_6$ | 23 900 | t | 0.86 | 0.91 | 0.95 | 1.00 | 1.05 | 1.09 | 1.13 | 1.13 | 1.14 | 1.21 |
| | **Gg $CO_2$e** | | **20.59** | **21.69** | **22.79** | **23.89** | **24.98** | **26.07** | **26.91** | **27.07** | **27.22** | **28.86** |
| **2.F.9 Other sources of SF6** | | | | | | | | | | | | |
| $SF_6$ | 23 900 | t | 5.30 | 7.50 | 7.66 | 7.97 | 9.31 | 10.09 | 10.55 | 10.71 | 11.97 | 10.31 |
| | **Gg $CO_2$e** | | **126.56** | **179.20** | **183.10** | **190.58** | **222.49** | **241.23** | **252.21** | **256.06** | **286.13** | **246.36** |

*Table 114:Emissions of IPCC Category 2.F by source 2000–2007.*

| GHG | GWP | Unit | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 |
|---|---|---|---|---|---|---|---|---|---|---|
| **2.F.1 Refrigeration and Air Conditioning Equipment** | | | | | | | | | | |
| HFC-32 | 650 | t | 1.86 | 2.64 | 3.40 | 4.11 | 4.84 | 5.53 | 6.18 | 6.82 |
| HFC-125 | 2 800 | t | 19.81 | 27.62 | 34.85 | 41.51 | 47.78 | 53.52 | 58.81 | 63.73 |
| HFC-134a | 1 300 | t | 119.00 | 136.73 | 151.46 | 168.53 | 184.45 | 206.17 | 219.61 | 233.62 |
| HFC-152a | 140 | t | 0.66 | 0.70 | 0.74 | 0.78 | 0.81 | 0.84 | 0.86 | 0.89 |
| HFC-143a | 3 800 | t | 12.49 | 19.98 | 26.87 | 33.21 | 39.11 | 44.47 | 49.41 | 53.96 |
| **Gg $CO_2$e** | | | **258.94** | **332.81** | **398.89** | **464.30** | **525.43** | **590.60** | **642.07** | **691.74** |
| **2.F.2 Foam Blowing** | | | | | | | | | | |
| HFC-134a | 1 300 | t | 193.95 | 194.63 | 195.55 | 196.64 | 166.95 | 122.46 | 73.01 | 49.83 |
| HFC-152a | 140 | t | 108.26 | 244.25 | 349.19 | 430.92 | 526.17 | 572.83 | 434.19 | 391.35 |
| **Gg $CO_2$e** | | | **267.30** | **287.21** | **303.10** | **315.96** | **290.70** | **239.40** | **155.70** | **119.57** |
| **2.F.3 Fire Extinguishers** | | | | | | | | | | |
| HFC-23 | 11 700 | t | 1.34 | 1.53 | 1.72 | 1.90 | 1.90 | 1.90 | 1.90 | 1.90 |
| HFC-227ea | 2 900 | t | 0.54 | 0.78 | 1.08 | 1.43 | 1.76 | 2.07 | 2.37 | 2.65 |
| C4F10 | 7 000 | t | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.02 | 0.02 |
| **Gg $CO_2$e** | | | **17.51** | **20.41** | **23.44** | **26.59** | **27.53** | **28.43** | **29.28** | **30.08** |
| **2.F.4 Aerosols** | | | | | | | | | | |
| HFC-unspecified | Gg $CO_2$e | | 47.79 | 49.26 | 50.30 | 50.61 | 47.33 | 43.79 | 26.88 | 10.31 |
| **Gg $CO_2$e** | | | **47.79** | **49.26** | **50.30** | **50.61** | **47.33** | **43.79** | **26.88** | **10.31** |
| **2.F.5 Solvents** | | | | | | | | | | |
| HFC-43-10mee | 1 300 | t | 0.90 | 0.92 | 1.16 | 1.39 | 1.42 | 1.46 | 1.50 | 1.55 |
| **Gg $CO_2$e** | | | **1.17** | **1.20** | **1.50** | **1.81** | **1.84** | **1.89** | **1.95** | **2.02** |
| **2.F.7 Semiconductor Manufacture** | | | | | | | | | | |
| HFC-unspecified | Gg $CO_2$e | | 3.78 | 3.78 | 4.18 | 3.88 | 4.06 | 3.98 | 5.03 | 7.07 |
| PFC-unspecified | Gg $CO_2$e | | 71.98 | 81.80 | 86.52 | 102.20 | 125.49 | 125.04 | 135.50 | 182.55 |
| $SF_6$ | 23 900 | t | 13.86 | 13.86 | 14.02 | 15.77 | 15.87 | 7.05 | 7.04 | 4.15 |
| **Gg $CO_2$e** | | | **407.08** | **416.90** | **425.79** | **483.04** | **508.87** | **297.56** | **308.69** | **288.70** |
| **2.F.8 Electrical Equipment** | | | | | | | | | | |
| $SF_6$ | 23 900 | t | 1.22 | 1.23 | 1.26 | 1.32 | 1.41 | 1.52 | 1.59 | 1.70 |
| **Gg $CO_2$e** | | | **29.09** | **29.36** | **30.05** | **31.46** | **33.67** | **36.30** | **38.06** | **40.74** |
| **2.F.9 Other sources of $SF_6$** | | | | | | | | | | |
| $SF_6$ | 23 900 | t | 11.10 | 11.23 | 11.22 | 7.74 | 4.19 | 3.42 | 11.47 | 11.29 |
| **Gg $CO_2$e** | | | **265.25** | **268.28** | **268.04** | **185.09** | **100.14** | **81.66** | **274.03** | **269.75** |

#### 4.5.2.1 2.F.1 Refrigeration and Air Conditioning Equipment

Consumption data was obtained directly from the most important importers of refrigerants. The stocks of the different subcategories were estimated using information from the most important refrigerant retailers/ importers and experts from the refrigeration branch.

The following table describes what kind of refrigeration and air-conditioning equipment has been considered in which sub-category, and which refrigerants have been used in the respective sub-category in Austria.

From the annual stocks emissions are estimated using emission factors based on expert judgement from experts of the refrigeration branch. The emission factors are presented in Table 115. Annual stocks refer to total stock in Austria, thus import and export of pre-filled equipment is considered indirectly (but not separately).

Remaining refrigerants in products at decommissioning have been estimated. Until 2006 decommissioning becomes relevant for Commercial Refrigeration, Transport and Mobile Air Conditioning (busses and freight vehicles). The estimates have been made taking into account the life-time of refrigeration and air-conditioning equipment (or vehicles in the case of mobile-air conditioning) and the year in which HFC usage in the respective sub-category began. The assumptions for calculating emissions from disposal were for (1) Commercial refrigeration and Transport: 20% disposal loss factor (IPCC GPG p 3.105) and for (2) Mobile air conditioning: until 2001 75%, from 2002 on 25% disposal loss factor[30].

Generally emissions from disposal can be considered to be low, as cooling devices are recycled in Austria, and the refrigerant is usually recovered[31]. There is production of fridges and freezers in Austria (equipment filled at the production site), however emissions from production have not been estimated and are considered to be minor (as emissions from larger devices that are filled after installation clearly dominate total emissions from this sub-category).

*Table 115: Description of sub-categories of 2 F 1 Refrigeration and Air Conditioning Equipment and emission factors used.*

| Sub-category | Description | Used Refrigerants | Emission factors [% of stocks] |
|---|---|---|---|
| Domestic Refrigeration | fridges and freezers at homes | 134a | 1.5% |
| Commercial Refrigeration | fridges and freezers in shops | 134a | 1.5% |
| Transport Refrigeration | chilled loading space of trucks, ships and rail | 134a | 10% |
| Industrial Refrigeration | mainly cooling devices for food trade, also including cooling devices for industrial machines (oil-cooling) | 134a, 401a, 402a, 404a, 407c | 10% until 1999, 8% since 2000 |
| Stationary Air-Conditioning | industrial cooling in chemical industries, food processing and air-conditioning of office buildings, etc.; | 134a, 404a, 407c | as industrial |
| | imported "ready to plug in" mobile refrigeration systems; | | 6% |
| | heat pumps; | | 1% |
| Mobile Air-Conditioning | mobile air-conditioning in passenger cars, busses, freight vehicles and rail. | 134a | 15%<br>5% |

401a, 402a, 404a and 407c are blends containing HFC-32, HFC-125, HFC-134a, HFC-143a and/or HFC-152a, the two former also contain HCFCs.

[30] Since 2002 there is a regulation that old vehicles have to be taken back by retailers for recycling/recovering ("Altfahrzeugeverordnung", BGBl. II Nr. 407/2002 i.d.F. BGBl. II Nr. 168/2005)

[31] There is a regulation that old cooling devices have to be taken back by retailers for recycling/recovering ("Verordnung über die Rücknahme von Kühlgeräten" BGBl. Nr. 408/1992 i.d.F. BGBl. II Nr. 440/2001)

#### 4.5.2.2 2.F.2 Foam Blowing and XPS/PU Plates

HFC emissions from this sub-category are based on a study on HFC used in foam blowing (OBERNOSTERER et al. 2004), that was subcontracted by the Umweltbundesamt.

**Soft foam**

HFC 134a and HFC 152a are used as blowing agents for PU soft foam since 1993 in Austria. The consumption of PU foam cans was estimated using information from the construction industry. An average charge of HFC blowing agent of 85g per can was assumed.

For calculating emissions it is assumed that 50% of the blowing agent is emitted in the first year, and the rest within the following three years. This assumption is based on information from producers.

**Hard foam**

Emissions were calculated from the total consumption of XPS/PU plates in Austria – about 60% of the XPS/PU plates are imported. The consumption per capita of XPS/PU plates in Austria is higher than in all other European countries.

***XPS Plates***

HFC 134a and HFC 152a are used as blowing agents in XPS hard foam in Austria since 1995 and 2000, respectively. Production data and information about the used blowing agent were obtained from Associations of Industry (construction industry) and from producers.

Based on expert judgement it was assumed that HFC 134a has a market share of 10% (since 2000, before 15%) and HFC 152a of 40% (until 2003 60%). In both cases the blowing agent content in the foam is 6.5%.

For HFC 134a it was assumed that 1.2% per year is emitted through diffusion, for HFC 152a it is assumed that 24.2% per year is emitted through diffusion. These assumptions are based on information from producers.

***PU hard foam***

HFC 134a, HFC 245fa and HFC 365mfc are used as blowing agents in PU hard foams (Sandwich, foil-clad and tube) in Austria since 2000. Production data and information about the used blowing agent were obtained from producers and literature.

Based on expert judgement it was assumed that HFC 134a has a market share of 25% for Sandwich foam and 10% for foil-clad foam. In both cases the blowing agent content in the foam is 3%. For HFC 245fa and HFC 365mfc a market share of 5% each for tube foam and a blowing agent content of 12% were assumed.

For HFC 134a it was assumed that about 0.4% per year is emitted through diffusion; for HFC 245fa and HFC 365mfc a diffusion factor of 2.3% was assumed.

HFC 245fa and HFC 365mfc are F-gases that are not regulated under the Convention; this is why emissions of these gases are not included in national totals, but reported in CRF Table 9(b) as additional GHG.

#### 4.5.2.3 2.F.3 Fire Extinguishers

Consumption data were obtained directly from the producers of fire extinguishers.

From 1992 to 1995 1.000 t of $C_4H_{10}$ for the use in fire extinguishers in Austria was sold.

HFC-23 and HFC-227ea in fire extinguishers were first introduced to the Austrian market in 1993 and 1996, respectively.

Based on expert judgement it was assumed that actual emissions are 5% of annual stocks, these emissions include leakage and tests.

#### 4.5.2.4 2.F.4 Aerosols/Metered Dose Inhalers

Information about HFC (HFC 134a) use for technical and medical sprays was obtained for the years 2000, 2003–2007 from producers due to the reporting obligation under the Austrian FC-regulation. Information about HFC use in Novelty Sprays was taken from a European evaluation of emissions from this sector (HARNISCH & SCHWARZ 2003) for the years 1995 and 2001, subsequently disaggregated to provide a top-down Austrian estimate. The other years for HFC use in technical, medical and novelty sprays were estimated using the Austrian GDP as indicator. Since 2004 marketing of novelty sprays is forbidden in Austria. Under the assumption that certain exceptions are allowed and remainders are sold a continous decrease in consumption is assumed.

Emissions were estimated according to the IPCC Guidelines assuming that 50% are emitted in the first year and the rest in the second year.

#### 4.5.2.5 2.F.5 Solvents

Information about HFC-43-10mee used as Solvent was taken from a European evaluation of emissions from this sector (HARNISCH & SCHWARZ 2003) for the years 2001 and 2002, subsequently disaggregated to provide a top-down Austrian estimate. The other years were estimated using the Austrian GDP as indicator.

Emissions were estimated according to the IPCC Guidelines assuming that 50% are emitted in the first year and the rest in the second year.

#### 4.5.2.6 2.F.7 Semiconductor Manufacture (HFC, PFC, $SF_6$)

All consumption data and data about actual emissions from semiconductor manufacture are based on direct information from industry. Because of the confidentiality claimed for consumption data in this industry emissions are reported in the CRF only for the sum of HFC and PFC. Gases and their applications are presented below:

$SF_6$: Isolation-gas for high-voltage measurement/Process-gas for plasma-etching

$CF_4$, $C_2F_6$, $C_3F_8$, $C_4F_8$: Process-gas for plasma-etching/Cleaning chemical vapor deposition

$CHF_3$: Process-gas for plasma-etching

Emissions are calculated according to the formula presented below:

*Emissions = Consumption*(1-emission control technology) * efficiency factor * uptime*

Typical ranges of these parameters are: for emission control technology 0.01–0.95, for efficiency factor 0.75–0.95, and for uptime 0.9. The emission control technology applied is high temperature combustion and elution of HF with typical efficiencies of 65–95% for latest years.

Between 1997/1998 one semiconductor manufacture quadrupled his exhaust air purification capacity reducing emissions remarkable. The emission increases of $CF_4$, $C_2F_6$ and $SF_6$ in the other years are due to increasing semiconductor production.

#### 4.5.2.7 2.F.8 Electrical Equipment ($SF_6$)

Information on $SF_6$ stocks in electrical equipment in 2003–2007 was obtained from energy suppliers and industrial facilities (as mentioned above, there is a reporting obligation for operators of $SF_6$ filled equipment since 2004). For the time series information on new equipment per year and the average $SF_6$ content per equipment type was used; this information was obtained from energy suppliers and experts from industry.

$SF_6$ emissions were calculated based on the assumption that there are no emissions during first filling on site (furthermore, smaller equipment is already filled during manufacture); based on information from experts from industry, it was thus estimated that emissions during service and leakage are 1% of annual stocks.

#### 4.5.2.8 2.F.9 Other Sources of $SF_6$

**Noise insulating windows**

Activity data were estimated based on information from experts from industry.

The average consumption of $SF_6$ was calculated by multiplying the area of $SF_6$ filled insulate glass produced by the average $SF_6$ consumption per square meter glass (11 litre $SF_6/m^2$ – 8 litre filling plus 3 litre losses). The calculated volume was multiplied by a density of 6.18 g/litre.

The actual emissions are the sum of emissions during production and leakage, which is estimated to be 1% of the original $SF_6$ filling. Emissions at disposal became relevant in 2006, because the average life time is estimated to be 25 years and the first $SF_6$ filled windows were introduced in Austria in 1980. They are calculated by assuming that the remaining quantity of $SF_6$ in windows produced in 1980 is emitted this year.

**Tyres**

Information on the amount of $SF_6$ used for filling tyres was obtained from $SF_6$ retailers. Emissions were calculated as one third per year for the three years following consumption.

**Shoes**

Emissions from the imported amount of shoes with $SF_6$ filling was obtained from the producer. It was assumed that all $SF_6$ is emitted at the end of the lifetime of these shoes, which was estimated to be 3 years.

**Research**

$SF_6$ is used in research in electron microscope and other equipment, the annual consumption was estimated to be 100 kg per year until the total estimated stock of 500 kg was reached (1996), emissions are estimated to be 20 kg per year (after 1996 consumption = emissions).

### 4.5.3 Source specific QA/QC

The total consumption of HFC and PFC (potential emissions) since 1990 was checked against import/export statistics to verify the trend. For this comparison only fluorinated (hydro)carbons that are used for production in Austria have been considered as potential emissions. The numbers from the Import/Export statistics are the sum of KN8 29033010 (fluorides) and KN8 29033080A (other fluoride or bromide derivatives of acyclic hydrocarbons). Figure 19 shows that the numbers from the Import/Export statistics agree largely with the total consumption and the trend is definitely verified by this comparison. The deviations that appear as overestimation in potential emissions are explained by the fact that the categories of the statistics are not well defined. Thus it is possible that importers report not always in the above mentioned categories but in other categories that include very generally halogen derivates of acyclic hydrocarbons.

The decrease in the Import/Export statistics in 2006 is due to comparable high numbers reported in export. As can be seen in Figure 19 in 2007 numbers are again of comparable magnitude.

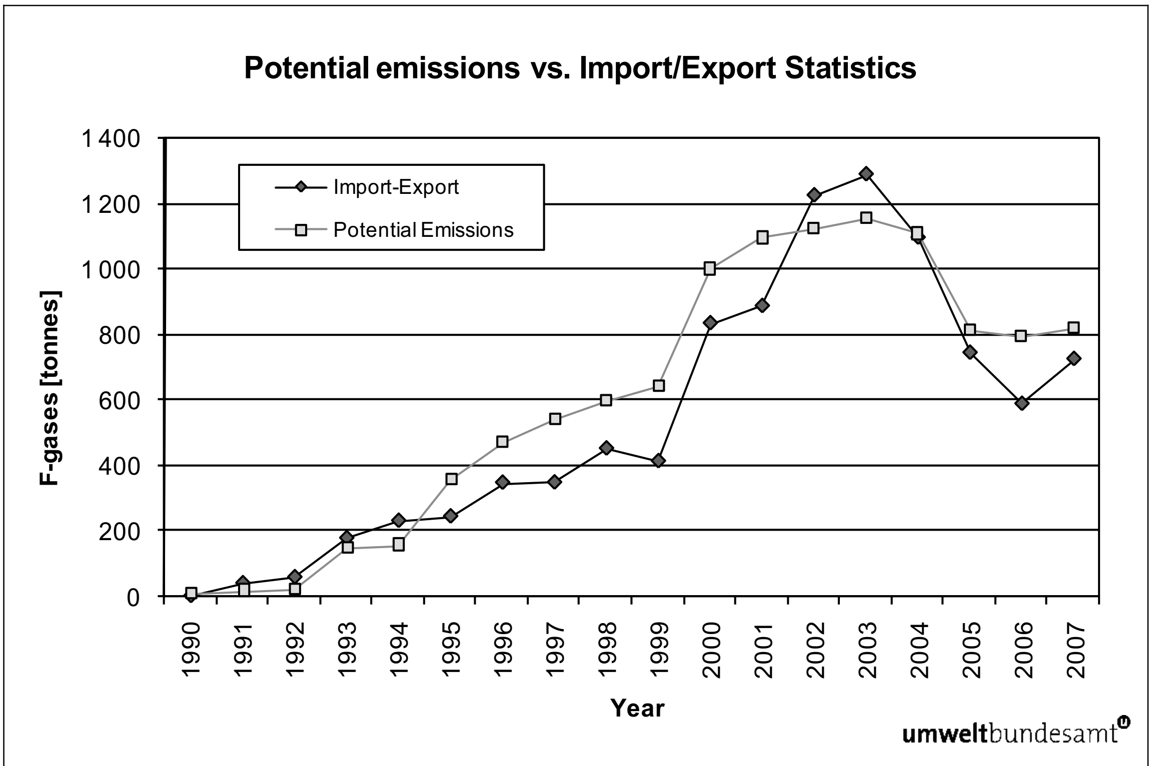


*Figure 19: Comparison of potential emissions and Import/Export statistics.*

### 4.5.4 Uncertainty estimate

For the key sources an uncertainty estimate was made:

#### 4.5.4.1 2.F.1/2/3/4/5 ODS Substitute

Activity data uncertainty is estimated to be 20%, as on the one hand total consumption figures are adjusted with import/export statistics but on the other hand the categories of the statistics do not always distinguish between HFCs and HCFCs for example, resulting in a higher uncertainty.

Apart from the uncertainty of the activity data the following uncertainties occur for emissions from this source:

i. the uncertainty of disaggregating total consumption to sub sectors (which has an effect on emissions as the emission factors used for the different sub categories differ significantly). However, the foam blowing sub sector is small, there are only a few producers that have to be considered and information was available from most of them.

ii. the uncertainty of disaggregation from substance groups (eg. from the import/export statistics) into substances (which affects total GHG emissions because the GWPs differ significantly)

iii. the uncertainty of the emission factors.

The uncertainty of the emission factor is considered to be dominating, it is estimated to be 50%; the other uncertainties were considered to be negligible compared to the emission factor uncertainty.

**2.F.7 Semiconductor Manufacture**

Activity data (consumption) uncertainty is estimated to be low (5%) because information from all considered producers is used for inventory preparation. The uncertainty for emission factors is estimated to be 10%. This leads to a combined uncertainty of emissions of 11.2%.

**2.F.9 Other Use of $SF_6$**

According to emissions, the most important sub source is noise insulating windows. The uncertainty for activity data is estimated to be 25%, emission factor uncertainty is assumed to be relatively high (50%), because it is based on several assumptions.

### 4.5.5 Recalculations

<u>Update of activity data:</u>

*2.F.2. Foam blowing:* Potential emissions have been updated for the years 2005–2006 according to new information provided by foam producers.

*2.F.4. Aerosols and 2.F.5 Solvents:* Potential emissions have been updated for the years 2002–2006 according to recalculations of the Austrian GDP in these years.

Total changes resulted in an increase of 0.2% of emissions of 2.F in 2006.

### 4.5.6 Planned Improvements

As already mentioned above, for the next submission more results from the reporting obligation concerning the use of FCs will be considered as far as possible. Furthermore a new survey is planned covering consumption and emissions in all sub-categories, with a special focus on emissions occuring from manufacturing/installation and disposal. Results of this new survey are expected to be available for the submission in 2010.

# 5 SOLVENT AND OTHER PRODUCT USE (CRF SECTOR 3)

## 5.1 Sector Overview

This chapter describes the methodology used for calculating greenhouse gas emissions from solvent use in Austria. Solvents are chemical compounds, which are used to dissolve substances as paint, glues, ink, rubber, plastic, pesticides or for cleaning purposes (degreasing). After application of these substances or other procedures of solvent use most of the solvents are released into air. Because solvents consist mainly of NMVOC, solvent use is a major source for anthropogenic NMVOC emissions in Austria. Once released into the atmosphere NMVOCs react with reactive molecules (mainly HO-radicals) or high energetic light to finally form $CO_2$.

Estimations for $N_2O$ emissions from other product use (anaesthesia and aerosol cans) are also addressed in this chapter.

### 5.1.1 Emission Trends

In the year 2007, 0.5% of total GHG emissions in Austria (408 Gg $CO_2$ equivalents) originated from *Solvent and Other Product Use*. 61% of these emissions were indirect $CO_2$ emissions, 39% were accounted for by $N_2O$ emissions.

Figure 20 and Table 116 present the trend in total greenhouse gas emissions by subcategories.

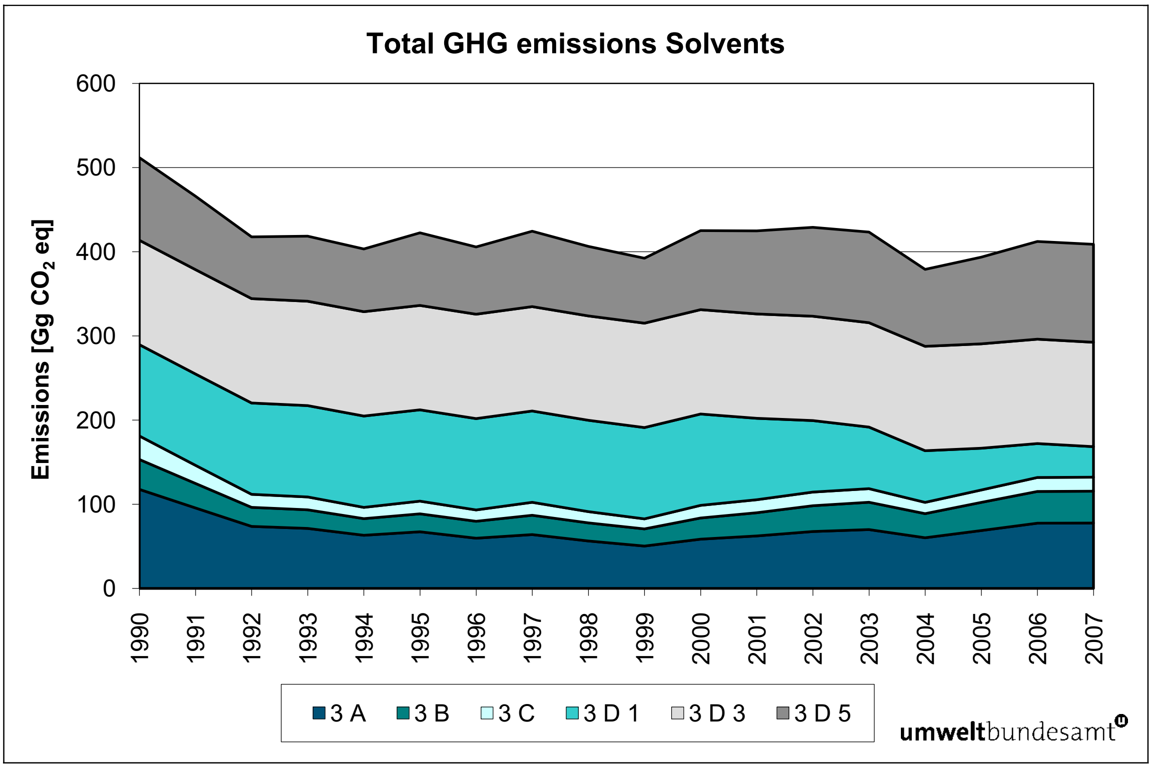


*Figure 20: Total greenhouse gas emissions and trend from 1990–2006 by subcategories of Category 3 Solvent and Other Product Use.*

*Table 116: Total greenhouse gas emissions and trend from 1990–2007 by subcategories of Category 3 Solvent and Other Product Use.*

| GHG | Total 3 | 3.A | 3.B | 3.C | 3.D | 3.D.1 | 3.D.3 | 3.D.5 |
|---|---|---|---|---|---|---|---|---|
| | | *Solvent* | *Solvent* | *Solvent* | | *Use of $N_2O$* | | *Solvent* |
| | [Gg $CO_2$ equivalent] | | | | | | | |
| 1990 | 511.80 | 117.70 | 35.51 | 27.94 | 330.65 | 108.50 | 124.00 | 98.15 |
| 1991 | 465.98 | 95.63 | 29.10 | 21.55 | 319.71 | 108.50 | 124.00 | 87.21 |
| 1992 | 417.65 | 73.70 | 22.63 | 15.48 | 305.84 | 108.50 | 124.00 | 73.34 |
| 1993 | 418.48 | 71.30 | 22.11 | 15.27 | 309.80 | 108.50 | 124.00 | 77.30 |
| 1994 | 403.26 | 63.13 | 19.79 | 13.37 | 306.97 | 108.50 | 124.00 | 74.47 |
| 1995 | 422.45 | 67.29 | 21.33 | 15.08 | 318.76 | 108.50 | 124.00 | 86.26 |
| 1996 | 405.66 | 59.65 | 20.12 | 13.48 | 312.41 | 108.50 | 124.00 | 79.91 |
| 1997 | 424.37 | 63.96 | 22.94 | 15.41 | 322.07 | 108.50 | 124.00 | 89.57 |
| 1998 | 406.32 | 56.38 | 21.49 | 13.38 | 315.08 | 108.50 | 124.00 | 82.58 |
| 1999 | 392.26 | 50.33 | 20.38 | 11.91 | 309.63 | 108.50 | 124.00 | 77.13 |
| 2000 | 425.06 | 58.50 | 25.17 | 15.02 | 326.37 | 108.50 | 124.00 | 93.87 |
| 2001 | 424.79 | 62.36 | 27.54 | 15.47 | 319.41 | 96.72 | 124.00 | 98.69 |
| 2002 | 428.96 | 67.62 | 30.64 | 16.20 | 314.50 | 84.94 | 124.00 | 105.56 |
| 2003 | 423.34 | 69.91 | 32.47 | 16.16 | 304.80 | 73.16 | 124.00 | 107.64 |
| 2004 | 379.04 | 60.20 | 28.63 | 13.41 | 276.80 | 61.38 | 124.00 | 91.42 |
| 2005 | 393.53 | 68.76 | 33.45 | 14.74 | 276.57 | 49.60 | 124.00 | 102.97 |
| 2006 | 412.16 | 77.49 | 37.70 | 16.62 | 280.35 | 40.30 | 124.00 | 116.05 |
| 2007 | 408.80 | 77.70 | 37.80 | 16.66 | 276.64 | 36.27 | 124.00 | 116.37 |
| *Trend 2006–2007* | *-0.8%* | *0.3%* | *0.3%* | *0.3%* | *-1.3%* | *-10.0%* | *0.0%* | *0.3%* |
| *Trend 1990-2007* | *-20.1%* | *-34.0%* | *6.5%* | *-40.4%* | *-16.3%* | *-66.6%* | *0.0%* | *18.6%* |

Greenhouse gas emissions in this sector decreased by 20% between 1990 and 2007, due to decreasing solvent and $N_2O$ use as well as due to the positive impact of the enforced laws and regulations in Austria:

- Solvent Ordinance: limitation of emission of volatile organic compounds due to the use of organic solvents in certain paints and varnishes and vehicle refinishing products in order to combat acidification and ground-level ozone

  *Federal Law Gazette II No. 398/2005[32], amendment of Federal Law Gazette 872/1995[33]; amendment of Federal Law Gazette 492/1991[34] (implementation of Council Directive 2004/42/CE)*

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[32] Verordnung des Bundesministers für Land- und Forstwirtschaft, Umwelt und Wasserwirtschaft über die Begrenzung der Emissionen flüchtiger organischer Verbindungen durch Beschränkung des Inverkehrsetzens und der Verwendung organischer Lösungsmittel in bestimmten Farben und Lacken (Lösungsmittelverordnung 2005 – LMV 2005), BGBl. II Nr. 398/2005; Umsetzung der Richtlinie 2004/42/EG

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

- Ordinance for paint finishing system (surface technology systems): limitation of emission of volatile organic compounds due to the use of organic solvents by activities such as surface coating, painting or varnishing of different materials and products along the entire chain in the painting process in order to combat acidification and ground-level ozone

  *Federal Law Gazette 873/1995*[35]*, amendment of Federal Law Gazette 27/1990*[36]

- 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*[37]

- 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*[38]

- Convention on Long-range Transboundary Air Pollution (LRTAP)[39], extended by eight protocols from which the following have relevance
  - The 1988 Protocol concerning the Control of Nitrogen Oxides or their Transboundary Fluxes[40]
  - The 1991 Protocol concerning the Control of Emissions of Volatile Organic Compounds or their Transboundary Fluxes[41]
  - The 1998 Protocol on Persistent Organic Pollutants (POPs)[42]
  - The 1999 Protocol to Abate Acidification, Eutrophication and Ground-level Ozone; 21 Parties.[43]

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

[35] Verordnung des Bundesministers für wirtschaftliche Angelegenheiten über die Begrenzung der Emission von luftverunreinigenden Stoffen aus Lackieranlagen in gewerblichen Betriebsanlagen (Lackieranlagen-Verordnung), BGBl. Nr. 873/1995

[36] Verordnung des Bundesministers für wirtschaftliche Angelegenheiten vom 26. April 1989 über die Begrenzung der Emission von chlorierten organischen Lösemitteln aus CKW-Anlagen in gewerblichen Betriebsanlagen (CKW-Anlagen-Verordnung), BGBl. Nr. 27/1990

[37] 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)

[38] Verordnung des Bundesministers für wirtschaftliche Angelegenheiten über die Begrenzung der Emission von chlorierten organischen Lösemitteln aus CKW-Anlagen in gewerblichen Betriebsanlagen (CKW-Anlagen-Verordnung 1994), BGBl. Nr. 865/1994

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

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

[41] Entered into force 29 September 1997; ratified by Austria 23 August 1994; Bekämpfung von Emissionen flüchtiger organischer Verbindungen oder ihres grenzüberschreitenden Flusses samt Anhängen und Erklärung, BGBl. III Nr. 164/1997

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

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

- Ordinance for volatile organic compounds (VOC) due to the use of organic solvents in certain activities and installations;

  *Federal Law Gazette II No. 301/2002*[44]*, amended by Federal Law Gazette*[45]
- Council Directive 1999/13/EC[46] of March 1999 on the limitation of emissions of volatile organic compounds due to the use of organic solvents in certain activities and installations
- Council Directive 2004/42/CE[47] of the European Parliament and of the Council of 21 April 2004 on the limitation of emissions of volatile organic compounds due to the use of organic solvents in certain paints and varnishes and vehicle refinishing products and amending Directive 1999/13/EC
- Ordinance on the limitation of emission during the use of solvents containing lightly volatile halogenated hydrocarbons in industrial facilities and installations

  *Federal Law Gazette II No. 411/2005*[48]

In emission intensive activity areas such as coating, painting, and printing as well as in the pharmaceutical industry several measures were implemented:

- Primary measures
  - complete substitution of certain solvents
  - Reduction of the solvent content by changing the composition of solvent containing products
  - technological change from solvent emitting processes to low or non-solvent emitting processes
  - implementation of resources saving procedures and techniques
  - installation of new equipments and facilities and shutdown of old equipments and facilities
  - avoidance of fugitive emissions
- Secondary measures
  - Waste gas collection and waste gas purification, whereas the solvents in the exhaust air are precipitated and either recycled if applicable or destructed.
  - raising of environmental awareness
  - compliance with emission limit values for exhaust gas
  - compilation of solvent balance
  - compilation of solvent reduction plan

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[44] Verordnung des Bundesministers für Wirtschaft und Arbeit zur Umsetzung der Richtlinie 1999/13/EG über die Begrenzung der Emissionen bei der Verwendung organischer Lösungsmittel in gewerblichen Betriebsanlagen (VOC-Anlagen-Verordnung – VAV) BGBL II Nr. 301/2002

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

[46] 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

[47] 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

[48] Verordnung des Bundesministers für Wirtschaft und Arbeit über die Begrenzung der Emissionen bei der Verwendung halogenierter organischer Lösungsmittel in gewerblichen Betriebsanlagen (HKW-Anlagen-Verordnung – HAV) BGBl. II Nr. 411/2005

But also the $N_2O$ use has significantly decreased due to shorter duration of anaesthesia during operations and more regional anaesthetics than general anaesthesia.

Table 117 presents the trend in total greenhouse gas emissions by gas.

*Table 117:Trend in greenhouse gas emissions of solvent and other product use 1990–2007.*

| GHG | $CO_2$ emission [Gg $CO_2$ equivalent] | $N_2O$ emission [Gg $CO_2$ equivalent] | Total [Gg $CO_2$ equivalent] |
|---|---|---|---|
| 1990 | 279.30 | 232.50 | 511.80 |
| 1991 | 233.48 | 232.50 | 465.98 |
| 1992 | 185.15 | 232.50 | 417.65 |
| 1993 | 185.98 | 232.50 | 418.48 |
| 1994 | 170.76 | 232.50 | 403.26 |
| 1995 | 189.95 | 232.50 | 422.45 |
| 1996 | 173.16 | 232.50 | 405.66 |
| 1997 | 191.87 | 232.50 | 424.37 |
| 1998 | 173.82 | 232.50 | 406.32 |
| 1999 | 159.76 | 232.50 | 392.26 |
| 2000 | 192.56 | 232.50 | 425.06 |
| 2001 | 204.07 | 220.72 | 424.79 |
| 2002 | 220.02 | 208.94 | 428.96 |
| 2003 | 226.18 | 197.16 | 423.34 |
| 2004 | 193.66 | 185.38 | 379.04 |
| 2005 | 219.93 | 173.60 | 393.53 |
| 2006 | 247.86 | 164.30 | 412.16 |
| 2007 | 248.53 | 160.27 | 408.80 |
| *Trend 2006–2007* | *-11.0%* | *-31.1%* | *0.7%* |
| *Trend 1990-2007* | *0.3%* | *-2.5%* | *0.5%* |

### 5.1.2 Key Sources

The key category analysis is presented in Chapter 1.5. This chapter includes information about the key sources in the solvents sector. $CO_2$ emissions of this source have been identified as key category.

*Table 118:Key sources of solvent and other product use.*

| IPCC Category | Source Categories | Key Sources* | |
|---|---|---|---|
| | | GHG | KS-Assessment |
| 3 | Solvent and other product use | $CO_2$ | LA 90 |

*LA90 = Level Assessment 1990*

### 5.1.3 Completeness

Table 119 gives an overview of the IPCC 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 subcategories. A “✓” indicates that emissions from this sub-category have been estimated.

*Table 119: Overview of subcategories of solvents and other product use: transformation into SNAP Codes and status of estimation.*

| IPCC Category | | SNAP | | $CO_2$ | $N_2O$ |
|---|---|---|---|---|---|
| 3.A | Paint application | 0601 | Paint application | ✓ | NA |
| 3.B | Degreasing and Dry Cleaning | 0602 | Degreasing, dry cleaning and electronics | ✓ | NA |
| 3.C | Chemical Products, Manufacture and Processing | 0603 | Chemical products manufacturing and processing | ✓ | NA |
| 3.D | Other | 0604 | Other use of solvents and related activities | ✓ | NA |
| | | 0605 | Use of HFC, N2O, NH3, PFC and SF6 | NA | ✓ |

## 5.2 $CO_2$ Emissions from Solvent and other product use (Category 3.A, 3.B, 3.C and 3.D.5)

### 5.2.1 Methodology Overview

$CO_2$ emissions from solvent use were calculated from NMVOC emissions of this sector. 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 21 to Figure 23 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.

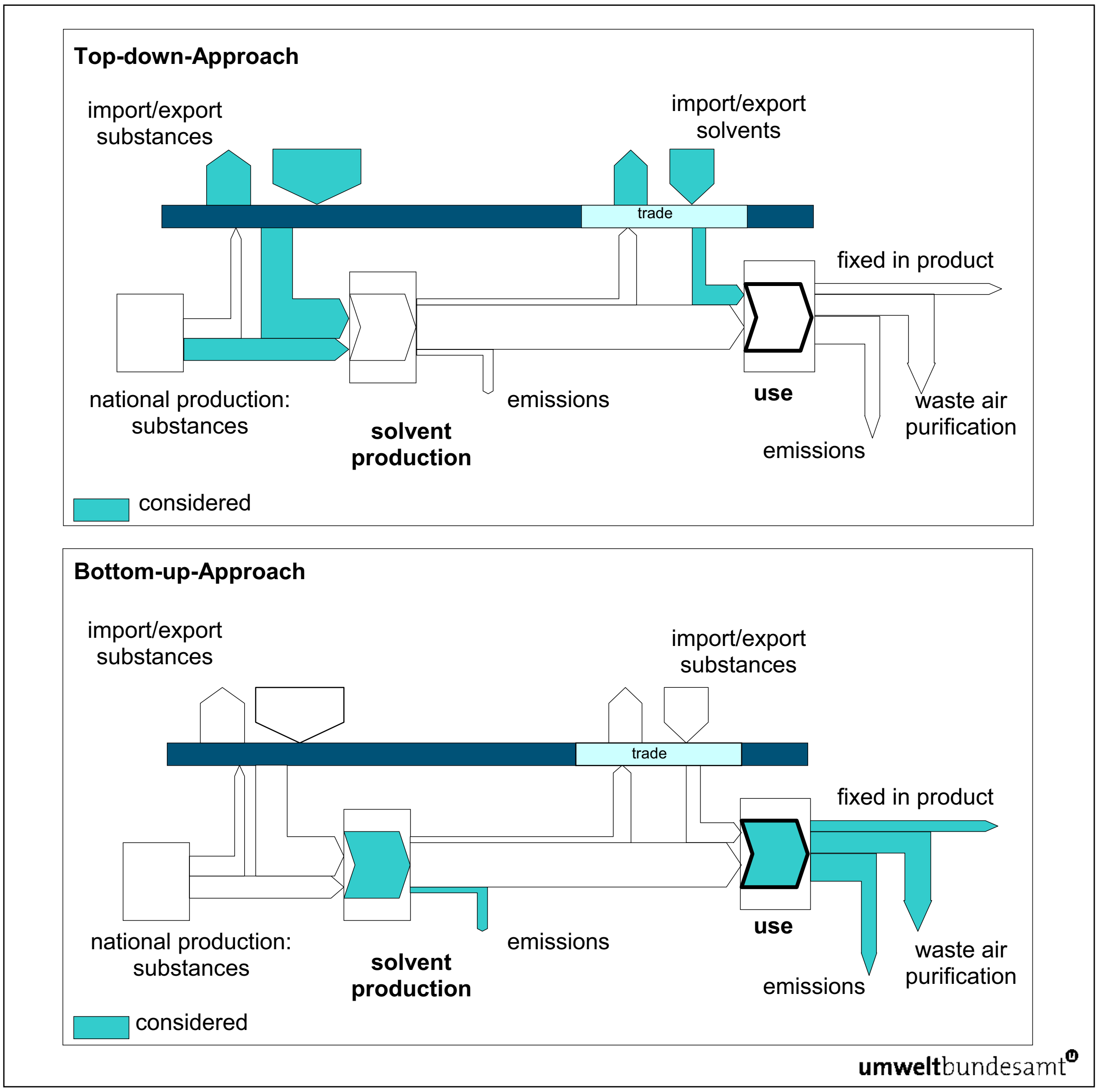


*Figure 21: Top-down-Approach compared to Bottom-up-Approach.*

**Top-down** (CRF Sector 3)

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

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

*Figure 22: Combination of Top-down-Approach compared to Bottom-up-Approach for 2007.*

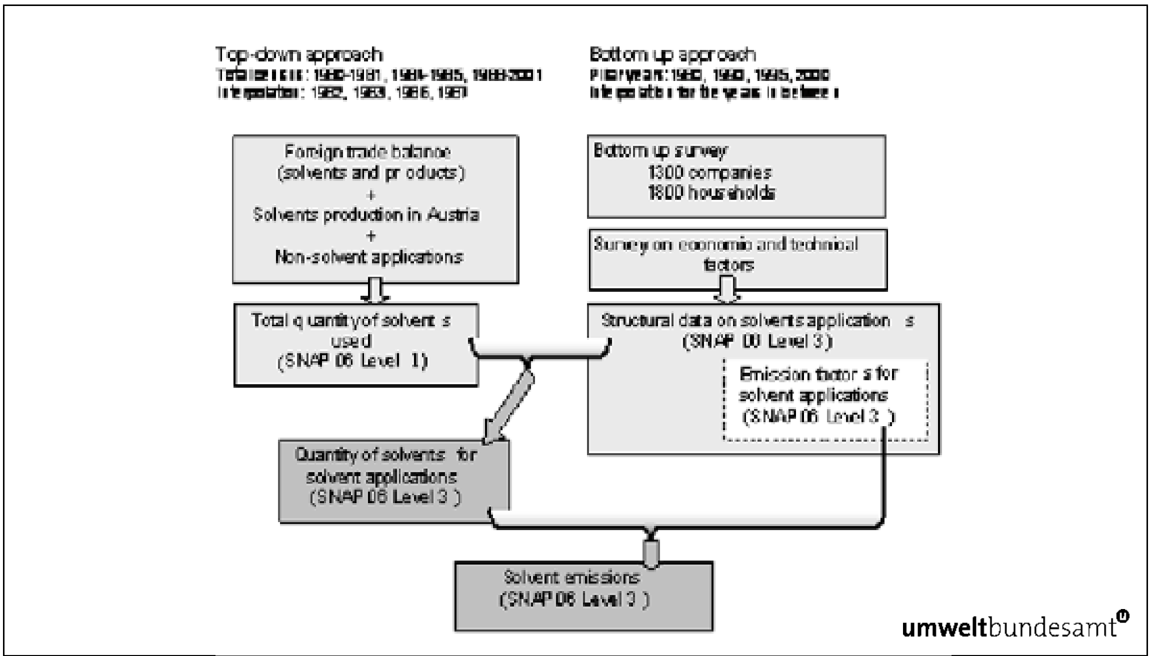


*Figure 23: Overview of the methodology for solvent emissions.*

A study (WINDSPERGER et al. 2002a) showed that emission estimates only based on the top down approach overestimate emissions because a large amount of solvent substances is used for "non-solvent-applications". "Non-solvent application" are applications where substances usually are used as feed stock in chemical, pharmaceutical or petrochemical industry (e.g. production of MTBE[49], ETBE[50], formaldehyde, polyester, biodiesel, pharmaceuticals etc.) and where therefore no emissions from "solvent use" arise. However, there might be emissions from the use of the produced products, such as MTBE and ETBE which is used as fuel additive and finally combusted, these emissions for example are considered in the transport sector.

Additionally the comparison of the top-down and the bottom-up approach helped to identify several quantitatively important applications like windscreens wiper fluids, antifreeze, moonlighting, hospitals, deicing agents of aeroplanes, tourism, cement- respectively pulp industry, which were not considered in the top-down approach.

### 5.2.2 Top-down Approach

The top-down approach is based on

1. import-export statistics (foreign trade balance)
2. production statistics on solvents in Austria
3. a survey on non-solvent-applications in companies (WINDSPERGER et al. 2004a, WINDSPERGER et al. 2008)
4. survey on the solvent content in products and preparations at producers and retailers (WINDSPERGER et al. 2002a, WINDSPERGER et al. 2008)

**ad (1) and (2):** Total quantity of solvents used in Austria were obtained from import-export statistics and production statistics provided by STATISTIK AUSTRIA.

Nearly a full top down investigation of substances of the import-export statistics from 1980 to 2007 was carried out (data in the years 1982, 1983, 1986 and 1987 were linearly interpolated). A main problem was that the methodology of the import-export statistics changed over the years. In earlier years products and substances had been pooled to groups and whereas the current foreign trade balance is more detailed with regard to products and substances. It was necessary to harmonise the time series in case of deviations.

There are only a few facilities producing solvents in Austria. Therefore due to confidentiality the Statistic Austria provided the data in an aggregated form. The solvents production fluctuated especially in the last years considerably.

**ad (3):** In the study on the comparison of top down and bottom up approach (WINDSPERGER et al. 2002a) the amount of solvent substances used in "non-solvent-applications" was identified. The 20 most important companies in this context were identified and asked to report the quantities of solvents they used over the considered time period in „non-solvent-applications"." In 2008 these companies were requested to report the quantities of used solvents for the time period 2002-2007 in „non-solvent-applications".

**ad (4):** Relevant producers and retailers provided data on solvent content in products and preparations. As the most important substance groups alcohols and esters were identified.

[49] Methyl-tertiär-butylether

[50] Ethyl-*tert*-butylether

### 5.2.3 Bottom-up Approach

In a first step an extensive survey on the use of solvents in the year 2000 was carried out in 1 300 Austrian companies (WINDSPERGER et al. 2002b). In this survey data about the solvent content of paints, cleaning agents etc. and on solvents used (both substances and substance categories) like acetone or alcohols were collected.

Furthermore information were gathered about

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

For every category of application and waste gas treatment an emission factor was estimated to calculate solvent emissions in the year 2000 (see Table 120).

*Table 120:Emission factors for NMVOC emissions from Solvent Use.*

| Category | Factor |
|---|---|
| final application | 1.00 |
| cleaner | 0.85 |
| product preparation | 0.05 |
| open application | 1.00 |
| waste gas collection | 0.50 |
| waste gas treatment | 0.20 |

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

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

In a second step a survey in 1 800 households was made (WINDSPERGER et al. 2002a) for estimating the domestic solvent use (37 categories in 5 main groups: cosmetic, do-it-yourself, household cleaning, car, fauna and flora). Also, solvent use in the context of moonlighting besides commercial work and do-it-yourself was calculated.

The comparison of top down and bottom up approach helped to identify several additional applications, that make an important contribution to the total amount of solvents used. Thus in a third step the quantities of solvents used in these applications such as windscreens wiper fluids, antifreeze, hospitals, de-icing agents of aeroplanes, tourism, cement- respectively pulp industry, were estimated in surveys.

The outcome of these three steps was the total stock of solvents used for each application in the year 2000 (at SNAP level 3) (WINDSPERGER et al. 2002a).

To achieve a time series the development of the economic and technical situation in relation to the year 2000 was considered. It was distinguished between "general aspects" and "specific aspects" (see tables below). The information about these defined aspects were collected for three pillar years (1980, 1990, 1995) and were taken from several studies (SCHMIDT et al. 1998, BARNERT 1998) and expert judgements from associations of industries (chemical industry, printing industry, paper industry) and other stakeholders. On the basis of this information calculation factors were estimated. With these factors and the data for solvent use and emission of 2000 data for the three pillar years was estimated. For the years in between data was linearly interpolated. The 2000 data was also used for the subsequent years as no new survey has been conducted.

*Table 121: General aspects and their development.*

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

*Table 122: Specific aspects and their development: distribution of the used paints (water based-paints – solvent-based paints) and part of waste gas purification (application – purification).*

| SNAP category | description | year | Distribution of used paints | | Part of waste gas treatment | |
|---|---|---|---|---|---|---|
| | | | Solvent based paints | Water based paints | application | purification |
| 060101 | manufacture of automobiles | 2005 | 73% | 27% | 10% | 0% |
| | | 2000 | | | | |
| | | 1995 | 80% | 20% | 8% | 0% |
| | | 1990 | 90% | 10% | 5% | 0% |
| | | 1980 | 100% | 0% | 0% | 0% |
| 060102 | car repairing | 2005 | 51% | 49% | 62% | 1% |
| | | 2000 | | | | |
| | | 1995 | 55% | 45% | 60% | 0% |
| | | 1990 | 75% | 25% | 10% | 0% |
| | | 1980 | 85% | 15% | 5% | 0% |
| 060107 | wood coating | 2005 | 46% | 54% | 46% | 3% |
| | | 2000 | | | | |
| | | 1995 | 60% | 40% | 45% | 2% |
| | | 1990 | 85% | 15% | 10% | 0% |
| | | 1980 | 100% | 0% | 0% | 0% |

| SNAP category | description | year | Distribution of used paints | | Part of waste gas treatment | |
|---|---|---|---|---|---|---|
| | | | Solvent based paints | Water based paints | application | purification |
| 060108 | Other industrial paint application | 2005 | 97% | 3% | 90% | 46% |
| | | 2000 | | | | |
| | | 1995 | 99% | 1% | 87% | 45% |
| | | 1990 | 100% | 0% | 26% | 20% |
| | | 1980 | 100% | 0% | 0% | 0% |
| 060201 | Metal degreasing | 2005 | 92% | 8% | 75% | 0% |
| | | 2000 | | | | |
| | | 1995 | 95% | 5% | 65% | 0% |
| | | 1990 | 100% | 0% | 10% | 0% |
| | | 1980 | 100% | 0% | 0% | 0% |
| 060403 | Printing industry | 2005 | | | 44% | 17% |
| | | 2000 | | | | |
| | | 1995 | | | 29% | 10% |
| | | 1990 | | | 10% | 5% |
| | | 1980 | | | 0% | 0% |
| 060405 | Application of glues and adhesives | 2005 | | | 58% | 0% |
| | | 2000 | | | | |
| | | 1995 | | | 53% | 0% |
| | | 1990 | | | 15% | 0% |
| | | 1980 | | | 0% | 0% |
| 060103 | Paint application: construction and buildings | 2005 | 91% | 9% | 19% | 4% |
| | | 2000 | | | | |
| | | 1995 | 93% | 7% | 15% | 2% |
| | | 1990 | 100% | 0% | 5% | 0% |
| | | 1980 | 100% | 0% | 0% | 0% |
| 060105 | Paint application : coil coating | 2005 | 100% | 0% | 63% | 0% |
| | | 2000 | | | | |
| | | 1995 | 100% | 0% | 60% | 0% |
| | | 1990 | 100% | 0% | 25% | 0% |
| | | 1980 | 100% | 0% | 0% | 0% |
| 060406 | Preservation of wood | 2005 | 83% | 17% | 0% | 0% |
| | | 2000 | | | | |
| | | 1995 | 85% | 15% | 0% | 0% |
| | | 1990 | 95% | 5% | 0% | 0% |
| | | 1980 | 100% | 0% | 0% | 0% |
| 060412 | Other (preservation of seeds,…) | 2005 | 100% | 0% | 90% | 0% |
| | | 2000 | | | | |
| | | 1995 | 100% | 0% | 80% | 0% |
| | | 1990 | 100% | 0% | 10% | 0% |
| | | 1980 | 100% | 0% | 0% | 0% |

*Table 123: Specific aspects and their development: changes in the number of employees compared to the year 2000.*

| SNAP | | Changes in the number of employees compared to the year 2000 | | | | |
|---|---|---|---|---|---|---|
| | | 1980 | 1990 | 1995 | 2000 | 2005 |
| **0601** | **Paint application** | | | | | |
| 060101 | manufacture of automobiles | 88% | 82% | 72% | 100% | 131% |
| 060102 | car repairing | 94% | 98% | 96% | 100% | 107% |
| 060103 | construction and buildings | 96% | 90% | 102% | 100% | 106% |
| 060104 | domestic use | separate analysed | | | | |
| 060105 | coil coating | 99% | 113% | 107% | 100% | 96% |
| 060107 | wood coating | 107% | 109% | 112% | 100% | 90% |
| 060108 | industrial paint application | 122% | 112% | 106% | 100% | 101% |
| **0602** | **Degreasing, dry cleaning and electronics** | | | | | |
| 060201 | Metal degreasing | 151% | 113% | 83% | 100% | 104% |
| 060202 | Dry cleaning | 63% | 75% | 88% | 100% | 103% |
| 060203 | Electronic components manufacturing | 143% | 122% | 104% | 100% | 84% |
| 060204 | Other industrial cleaning | 33% | 77% | 56% | 100% | 130% |
| **0603** | **Chemical products manufacturing and processing** | | | | | |
| 060305 | Rubber processing | 110% | 101% | 102% | 100% | 75% |
| 060306 | Pharmaceutical products manufacturing | 118% | 112% | 97% | 100% | 90% |
| 060307 | Paints manufacturing | 118% | 112% | 97% | 100% | 101% |
| 060308 | Inks manufacturing | 118% | 112% | 97% | 100% | 100% |
| 060309 | Glues manufacturing | 118% | 112% | 98% | 100% | 62% |
| 060310 | Asphalt blowing | 124% | 120% | 120% | 100% | 94% |
| 060311 | Adhesive, magnetic tapes, films and photographs | 33% | 57% | 76% | 100% | 97% |
| 060312 | Textile finishing | 241% | 171% | 132% | 100% | 71% |
| 060314 | Other | 117% | 112% | 98% | 100% | 88% |
| **0604** | **Other use of solvents and related activities** | | | | | |
| 060403 | Printing industry | 129% | 125% | 111% | 100% | 85% |
| 060404 | Fat, edible and non edible oil extraction | 129% | 116% | 112% | 100% | 52% |
| 060405 | Application of glues and adhesives | 239% | 156% | 104% | 100% | 56% |
| 060406 | Preservation of wood | 108% | 105% | 100% | 100% | 110% |
| 060407 | Under seal treatment and conservation of vehicles | 97% | 102% | 103% | 100% | 101% |
| 060408 | Domestic solvent use (other than paint application | separate analysed | | | | |
| 060411 | Domestic use of pharmaceutical products (k) | | | | | |
| 060412 | Other (preservation of seeds, …) | 108% | 105% | 101% | 100% | 107% |

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

### 5.2.4 Combination Top down – Bottom up approach and updating

To verify and adjust the data the solvents given in the top down approach and the results of the bottom up approach were differentiated in the pillar years (1980, 1990, 1995, 2000) by 15 defined categories of solvent groups. For the updated pillar year 2005 only the total difference is shown because no complete bottom up survey was carried out (see below Table 124). The differences between the quantities of solvents from the top down approach and bottom up approach between 1980 and 2000 respectively are lower than 15%. Since 2000 no new bottom up survey has been conducted, therefore the difference has been increased up to 25%. Table 124 shows the range of the differences in the considered pillar years broken down to the 15 substance categories.

*Table 124:Differences between the results of the bottom up and the top down approach.*

| | Acetone | Methanol | Propanol | Solvent naphta | Paraffins | Alcohols | Glycols | Ester | Aromates | Ether | org. acids | Ketones | Aldehydes | Amines | cycl. Hydrocarb. | Others | Sum of Differences [kt/a] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2005 | | | | | | | | | | | | | | | | | -44 |
| 2000 | | | | | | | | | | | | | | | | | - |
| 1995 | | | | | | | | | | | | | | | | | -7 |
| 1990 | | | | | | | | | | | | | | | | | 8 |
| 1980 | | | | | | | | | | | | | | | | | -26 |

| | |
|---|---|
| | *difference less than 2 kt/a* |
| | *difference 2–10 kt/a* |
| | *difference greater than 10 kt/a* |

As the data of the top down approach were obtained from national statistics, they are assumed to be more reliable than the data of the bottom up approach. That's why the annual quantities of solvents used were taken from the top down approach while the share of the solvents for the different applications (on SNAP level 3) and the solvent emission factors have been calculated on the basis of the bottom up approach. Table 125 presents activity data and implied emission factors.

The inventory has been updated with data from (WINDSPERGER et al. 2008).

*Table 125: Activity data for solvent and other product use [Mg].*

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

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

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

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

### 5.2.5 Calculation of $CO_2$ emissions from Solvent Emissions

The basis for the calculation of the carbon dioxide emissions were the quantities of solvent emissions differentiated by the 15 groups of substances (acetone, methanol, propanol, solvent naphtha, paraffins, alcohols, glycols, ester, aromates, ketones, aldehydes, amines, organic acids, cyclic hydrocarbons, and others). Substance specific carbon dioxide factors for these 15 substance groups have been created (see Table 126) on the basis of the carbon content and the stoichiometrically formed $CO_2$.

*Table 126: Substance specific carbon dioxide emission factors.*

| Substances | $CO_2$ factor [kg $CO_2$/kg substance] | Substances | $CO_2$ factor [kg $CO_2$/kg substance] |
|---|---|---|---|
| Acetone | 2.28 | Glycols | 1.82 |
| Aldehydes | 2.44 | Ketones | 2.45 |
| Alcohols | 1.91 | Methanol | 1.38 |
| Alcohols/Propanols | 2.20 | Paraffins | 3.14 |
| Aromates | 3.33 | Residuals | 0.92 |
| Cydic Hydrocarbons | 3.14 | Solvent naphta | 3.14 |
| Ester | 2.16 | Glycols | 1.82 |

The amount of carbon dioxide emissions was disaggregated to SNAP level 3 according to the share of solvents used and solvent emissions that were calculated in the context of the bottom up approach. In Table 127 the carbon dioxide emissions of Category 3 Solvent and Other Product Use for the years 1990 to 2007 are shown.

*Table 127: $CO_2$ emission of Category 3 Solvent and Other Product Use 1990–2007.*

| IPCC | 3.A | 3.A | 3.A | 3.A | 3.A | 3.A | 3.A | 3.A |
|---|---|---|---|---|---|---|---|---|
| SNAP | Total | 060101 | 060102 | 060103 | 060104 | 060105 | 060107 | 060108 |
| Unit | | | | Gg | | | | |
| 1990 | 117.70 | 4.67 | 2.56 | 9.98 | 10.68 | 13.43 | 17.50 | 58.90 |
| 1991 | 95.63 | 3.67 | 2.30 | 9.15 | 8.15 | 11.19 | 14.50 | 46.68 |
| 1992 | 73.70 | 2.73 | 1.95 | 7.91 | 5.85 | 8.85 | 11.40 | 35.00 |
| 1993 | 71.30 | 2.53 | 2.07 | 8.54 | 5.23 | 8.80 | 11.27 | 32.85 |
| 1994 | 63.13 | 2.15 | 2.01 | 8.40 | 4.22 | 8.02 | 10.21 | 28.12 |
| 1995 | 67.29 | 2.18 | 2.35 | 9.92 | 4.03 | 8.81 | 11.15 | 28.85 |
| 1996 | 59.65 | 2.07 | 2.11 | 9.09 | 3.77 | 7.74 | 9.65 | 25.23 |
| 1997 | 63.96 | 2.38 | 2.29 | 10.07 | 4.26 | 8.23 | 10.07 | 26.66 |
| 1998 | 56.38 | 2.25 | 2.05 | 9.19 | 3.95 | 7.18 | 8.63 | 23.13 |
| 1999 | 50.33 | 2.15 | 1.85 | 8.49 | 3.72 | 6.34 | 7.47 | 20.30 |
| 2000 | 58.50 | 2.68 | 2.19 | 10.23 | 4.56 | 7.29 | 8.39 | 23.16 |
| 2001 | 62.36 | 3.02 | 2.35 | 10.97 | 4.86 | 7.67 | 8.72 | 24.77 |
| 2002 | 67.62 | 3.45 | 2.57 | 11.97 | 5.27 | 8.20 | 9.21 | 26.95 |
| 2003 | 69.91 | 3.74 | 2.68 | 12.45 | 5.44 | 8.37 | 9.27 | 27.96 |
| 2004 | 60.20 | 3.38 | 2.33 | 10.79 | 4.68 | 7.11 | 7.77 | 24.15 |
| 2005 | 68.76 | 4.03 | 2.68 | 12.39 | 5.35 | 8.00 | 8.64 | 27.67 |
| 2006 | 77.49 | 4.54 | 3.02 | 13.97 | 6.02 | 9.02 | 9.74 | 31.19 |
| 2007 | 77.70 | 4.55 | 3.02 | 14.00 | 6.04 | 9.05 | 9.76 | 31.27 |

| IPCC | 3.B | 3.B | 3.B | 3.B | 3.B |
|---|---|---|---|---|---|
| SNAP | Total | 060201 | 060202 | 060203 | 060204 |
| Unit | | | Gg | | |
| 1990 | 35.51 | 22.89 | 0.50 | 4.25 | 7.86 |
| 1991 | 29.10 | 17.72 | 0.48 | 3.33 | 7.56 |
| 1992 | 22.63 | 12.94 | 0.43 | 2.47 | 6.79 |
| 1993 | 22.11 | 11.78 | 0.48 | 2.28 | 7.57 |
| 1994 | 19.79 | 9.73 | 0.49 | 1.92 | 7.65 |
| 1995 | 21.33 | 9.57 | 0.59 | 1.93 | 9.24 |
| 1996 | 20.12 | 8.70 | 0.56 | 1.70 | 9.16 |
| 1997 | 22.94 | 9.57 | 0.64 | 1.81 | 10.91 |
| 1998 | 21.49 | 8.66 | 0.61 | 1.59 | 10.64 |
| 1999 | 20.38 | 7.94 | 0.58 | 1.41 | 10.45 |
| 2000 | 25.17 | 9.49 | 0.72 | 1.62 | 13.33 |
| 2001 | 27.54 | 10.12 | 0.77 | 1.66 | 14.99 |
| 2002 | 30.64 | 10.98 | 0.84 | 1.73 | 17.09 |
| 2003 | 32.47 | 11.36 | 0.86 | 1.72 | 18.53 |
| 2004 | 28.63 | 9.78 | 0.74 | 1.42 | 16.68 |
| 2005 | 33.45 | 11.18 | 0.85 | 1.55 | 19.88 |
| 2006 | 37.70 | 12.60 | 0.96 | 1.74 | 22.40 |
| 2007 | 37.80 | 12.63 | 0.96 | 1.75 | 22.46 |

| IPCC | 3.C | 3.C | 3.C | 3.C | 3.C | 3.C | 3.C | 3.C | 3.C | 3.C |
|---|---|---|---|---|---|---|---|---|---|---|
| SNAP | Total | 060305 | 060306 | 060307 | 060308 | 060309 | 060310 | 060311 | 060312 | 060314 |
| Unit | | | | | | Gg | | | | |
| 1990 | 27.94 | 0.00 | 2.82 | 8.21 | 8.80 | 0.64 | 2.22 | 0.04 | 0.01 | 0.33 |
| 1991 | 21.55 | 0.00 | 2.46 | 6.20 | 6.36 | 0.50 | 1.82 | 0.04 | 0.01 | 0.28 |
| 1992 | 15.48 | 0.00 | 2.04 | 4.39 | 4.17 | 0.36 | 1.35 | 0.03 | 0.01 | 0.22 |
| 1993 | 15.27 | 0.00 | 2.11 | 3.85 | 4.31 | 0.41 | 1.57 | 0.03 | 0.01 | 0.22 |
| 1994 | 13.37 | 0.00 | 2.01 | 3.03 | 3.78 | 0.39 | 1.55 | 0.03 | 0.01 | 0.20 |
| 1995 | 15.08 | 0.00 | 2.30 | 2.80 | 4.61 | 0.53 | 2.13 | 0.04 | 0.01 | 0.22 |
| 1996 | 13.48 | 0.00 | 1.99 | 2.92 | 3.80 | 0.46 | 1.93 | 0.03 | 0.01 | 0.18 |
| 1997 | 15.41 | 0.00 | 2.07 | 3.62 | 4.27 | 0.53 | 2.39 | 0.03 | 0.01 | 0.18 |
| 1998 | 13.38 | 0.00 | 1.77 | 3.65 | 3.28 | 0.43 | 2.05 | 0.03 | 0.01 | 0.15 |
| 1999 | 11.91 | 0.00 | 1.53 | 3.69 | 2.59 | 0.36 | 1.80 | 0.02 | 0.01 | 0.12 |
| 2000 | 15.02 | 0.00 | 1.71 | 4.81 | 3.23 | 0.49 | 2.55 | 0.02 | 0.01 | 0.13 |
| 2001 | 15.47 | 0.00 | 1.72 | 5.01 | 3.38 | 0.51 | 2.49 | 0.02 | 0.01 | 0.13 |
| 2002 | 16.20 | 0.00 | 1.76 | 5.29 | 3.60 | 0.55 | 2.46 | 0.03 | 0.01 | 0.13 |
| 2003 | 16.16 | 0.00 | 1.71 | 5.33 | 3.65 | 0.57 | 2.30 | 0.03 | 0.01 | 0.12 |
| 2004 | 13.41 | 0.00 | 1.38 | 4.47 | 3.09 | 0.49 | 1.77 | 0.02 | 0.01 | 0.10 |
| 2005 | 14.74 | 0.00 | 1.47 | 4.98 | 3.46 | 0.55 | 1.79 | 0.03 | 0.01 | 0.10 |
| 2006 | 16.62 | 0.00 | 1.65 | 5.61 | 3.90 | 0.63 | 2.02 | 0.03 | 0.01 | 0.11 |
| 2007 | 16.66 | 0.00 | 1.66 | 5.62 | 3.91 | 0.63 | 2.02 | 0.03 | 0.01 | 0.11 |

| IPCC | 3.D.5 | 3.D.5 | 3.D.5 | 3.D.5 | 3.D.5 | 3.D.5 | 3.D.5 | 3.D.5 | 3.D.5 |
|---|---|---|---|---|---|---|---|---|---|
| SNAP | Total | 060403 | 060404 | 060405 | 060406 | 060407 | 060408 | 060411 | 060412 |
| Unit | | | | | Gg | | | | |
| 1990 | 98.15 | 29.19 | 0.34 | 2.13 | 1.83 | 0.41 | 25.93 | 10.71 | 27.62 |
| 1991 | 87.21 | 24.56 | 0.29 | 1.74 | 1.63 | 0.38 | 25.57 | 10.03 | 23.00 |
| 1992 | 73.34 | 19.62 | 0.24 | 1.35 | 1.38 | 0.33 | 23.41 | 8.82 | 18.19 |
| 1993 | 77.30 | 19.70 | 0.25 | 1.31 | 1.46 | 0.37 | 26.47 | 9.67 | 18.07 |
| 1994 | 74.47 | 18.13 | 0.24 | 1.17 | 1.41 | 0.36 | 27.07 | 9.64 | 16.45 |
| 1995 | 86.26 | 20.11 | 0.27 | 1.25 | 1.64 | 0.43 | 33.00 | 11.50 | 18.05 |
| 1996 | 79.91 | 17.69 | 0.23 | 1.12 | 1.49 | 0.38 | 31.80 | 10.74 | 16.47 |
| 1997 | 89.57 | 18.81 | 0.24 | 1.20 | 1.64 | 0.41 | 36.96 | 12.13 | 18.18 |
| 1998 | 82.58 | 16.44 | 0.20 | 1.06 | 1.49 | 0.36 | 35.26 | 11.27 | 16.51 |
| 1999 | 77.13 | 14.54 | 0.17 | 0.95 | 1.36 | 0.32 | 34.00 | 10.60 | 15.19 |
| 2000 | 93.87 | 16.73 | 0.19 | 1.11 | 1.63 | 0.37 | 42.62 | 12.98 | 18.22 |
| 2001 | 98.69 | 17.21 | 0.18 | 1.08 | 1.77 | 0.40 | 44.74 | 13.83 | 19.49 |
| 2002 | 105.56 | 17.99 | 0.17 | 1.05 | 1.94 | 0.43 | 47.78 | 14.99 | 21.21 |
| 2003 | 107.64 | 17.92 | 0.16 | 0.97 | 2.04 | 0.44 | 48.64 | 15.49 | 21.99 |
| 2004 | 91.42 | 14.85 | 0.11 | 0.73 | 1.78 | 0.38 | 41.24 | 13.33 | 19.00 |
| 2005 | 102.97 | 16.30 | 0.11 | 0.72 | 2.06 | 0.43 | 46.38 | 15.22 | 21.77 |
| 2006 | 116.05 | 18.37 | 0.12 | 0.81 | 2.32 | 0.48 | 52.27 | 17.15 | 24.53 |
| 2007 | 116.37 | 18.42 | 0.12 | 0.81 | 2.33 | 0.48 | 52.41 | 17.19 | 24.60 |

*Table 128: Implied $CO_2$ Emission factors for Category 3 Solvent and Other Product Use 1990–2007.*

| IPCC | 3.A | 3.A | 3.A | 3.A | 3.A | 3.A | 3.A |
|---|---|---|---|---|---|---|---|
| SNAP | 060101 | 060102 | 060103 | 060104 | 060105 | 060107 | 060108 |
| Unit | | | | [$tCO_2/t$] | | | |
| 1990 | 2.61 | 2.57 | 2.61 | 2.36 | 2.39 | 2.50 | 1.91 |
| 1991 | 2.42 | 2.58 | 2.58 | 2.29 | 2.21 | 2.36 | 1.66 |
| 1992 | 2.22 | 2.56 | 2.52 | 2.23 | 2.03 | 2.21 | 1.43 |
| 1993 | 2.02 | 2.52 | 2.44 | 2.19 | 1.86 | 2.06 | 1.22 |
| 1994 | 1.82 | 2.45 | 2.33 | 2.19 | 1.68 | 1.91 | 1.03 |
| 1995 | 1.70 | 2.47 | 2.30 | 2.35 | 1.59 | 1.84 | 0.90 |
| 1996 | 1.59 | 2.33 | 2.23 | 2.26 | 1.50 | 1.74 | 0.82 |
| 1997 | 1.60 | 2.37 | 2.31 | 2.32 | 1.51 | 1.77 | 0.81 |
| 1998 | 1.57 | 2.35 | 2.35 | 2.34 | 1.49 | 1.76 | 0.78 |
| 1999 | 1.54 | 2.33 | 2.39 | 2.35 | 1.47 | 1.74 | 0.75 |
| 2000 | 1.53 | 2.34 | 2.45 | 2.39 | 1.47 | 1.75 | 0.73 |
| 2001 | 1.53 | 2.34 | 2.45 | 2.39 | 1.47 | 1.75 | 0.73 |
| 2002 | 1.53 | 2.34 | 2.45 | 2.39 | 1.47 | 1.75 | 0.73 |
| 2003 | 1.53 | 2.34 | 2.45 | 2.39 | 1.47 | 1.75 | 0.73 |
| 2004 | 1.53 | 2.34 | 2.45 | 2.39 | 1.47 | 1.75 | 0.73 |
| 2005 | 1.53 | 2.34 | 2.45 | 2.39 | 1.47 | 1.75 | 0.73 |
| 2006 | 1.53 | 2.34 | 2.45 | 2.39 | 1.47 | 1.75 | 0.73 |
| 2007 | 1.53 | 2.34 | 2.45 | 2.39 | 1.47 | 1.75 | 0.73 |

| IPCC | 3.B | 3.B | 3.B | 3.B |
|---|---|---|---|---|
| SNAP | 060201 | 060202 | 060203 | 060204 |
| Unit | | [$tCO_2/t$] | | |
| 1990 | 2.47 | 1.10 | 1.94 | 1.96 |
| 1991 | 2.25 | 1.18 | 1.75 | 1.98 |
| 1992 | 2.02 | 1.25 | 1.56 | 1.95 |
| 1993 | 1.80 | 1.29 | 1.38 | 1.91 |
| 1994 | 1.58 | 1.31 | 1.20 | 1.83 |
| 1995 | 1.43 | 1.38 | 1.08 | 1.82 |
| 1996 | 1.31 | 1.34 | 1.01 | 1.74 |
| 1997 | 1.29 | 1.39 | 1.00 | 1.79 |
| 1998 | 1.24 | 1.42 | 0.98 | 1.79 |
| 1999 | 1.20 | 1.44 | 0.96 | 1.79 |
| 2000 | 1.16 | 1.47 | 0.94 | 1.80 |
| 2001 | 1.16 | 1.47 | 0.94 | 1.80 |
| 2002 | 1.16 | 1.47 | 0.94 | 1.80 |
| 2003 | 1.16 | 1.47 | 0.94 | 1.80 |
| 2004 | 1.16 | 1.47 | 0.94 | 1.80 |
| 2005 | 1.16 | 1.47 | 0.94 | 1.80 |
| 2006 | 1.16 | 1.47 | 0.94 | 1.80 |
| 2007 | 1.16 | 1.47 | 0.94 | 1.80 |

| IPCC | 3.C | 3.C | 3.C | 3.C | 3.C | 3.C | 3.C | 3.C | 3.C |
|---|---|---|---|---|---|---|---|---|---|
| SNAP | 060305 | 060306 | 060307 | 060308 | 060309 | 060310 | 060311 | 060312 | 060314 |
| Unit | | | | | [$tCO_2/t$] | | | | |
| 1990 | 2.88 | 0.99 | 2.77 | 1.78 | 2.68 | 0.03 | 2.18 | 2.11 | 1.40 |
| 1991 | 2.88 | 0.90 | 2.46 | 1.61 | 2.45 | 0.03 | 2.23 | 2.11 | 1.32 |
| 1992 | 2.85 | 0.80 | 2.09 | 1.38 | 2.11 | 0.03 | 2.22 | 2.09 | 1.23 |
| 1993 | 2.81 | 0.71 | 2.24 | 1.49 | 2.27 | 0.03 | 2.19 | 2.07 | 1.15 |
| 1994 | 2.75 | 0.61 | 2.23 | 1.47 | 2.24 | 0.03 | 2.12 | 2.05 | 1.06 |
| 1995 | 2.79 | 0.54 | 2.71 | 1.76 | 2.65 | 0.03 | 2.13 | 2.14 | 1.02 |
| 1996 | 2.66 | 0.52 | 2.49 | 1.62 | 2.45 | 0.03 | 2.05 | 2.04 | 0.95 |
| 1997 | 2.71 | 0.54 | 2.77 | 1.80 | 2.72 | 0.03 | 2.12 | 2.09 | 0.95 |
| 1998 | 2.72 | 0.54 | 2.53 | 1.65 | 2.50 | 0.03 | 2.14 | 2.11 | 0.93 |
| 1999 | 2.73 | 0.54 | 2.34 | 1.53 | 2.32 | 0.03 | 2.15 | 2.13 | 0.91 |
| 2000 | 2.77 | 0.55 | 2.69 | 1.78 | 2.68 | 0.03 | 2.18 | 2.19 | 0.89 |
| 2001 | 2.77 | 0.55 | 2.69 | 1.78 | 2.68 | 0.03 | 2.18 | 2.19 | 0.89 |
| 2002 | 2.77 | 0.55 | 2.69 | 1.78 | 2.68 | 0.03 | 2.18 | 2.19 | 0.89 |
| 2003 | 2.77 | 0.55 | 2.69 | 1.78 | 2.68 | 0.03 | 2.18 | 2.19 | 0.89 |
| 2004 | 2.77 | 0.55 | 2.69 | 1.78 | 2.68 | 0.03 | 2.18 | 2.19 | 0.89 |
| 2005 | 2.77 | 0.55 | 2.69 | 1.78 | 2.68 | 0.03 | 2.18 | 2.19 | 0.89 |
| 2006 | 2.77 | 0.55 | 2.69 | 1.78 | 2.68 | 0.03 | 2.18 | 2.19 | 0.89 |
| 2007 | 2.77 | 0.55 | 2.69 | 1.78 | 2.68 | 0.03 | 2.18 | 2.19 | 0.89 |

| IPCC | 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** | | | | **[$tCO_2/t$]** | | | | |
| 1990 | 2.88 | 0.99 | 2.77 | 1.78 | 2.68 | 0.03 | 2.18 | 2.11 |
| 1991 | 2.88 | 0.90 | 2.46 | 1.61 | 2.45 | 0.03 | 2.23 | 2.11 |
| 1992 | 2.85 | 0.80 | 2.09 | 1.38 | 2.11 | 0.03 | 2.22 | 2.09 |
| 1993 | 2.81 | 0.71 | 2.24 | 1.49 | 2.27 | 0.03 | 2.19 | 2.07 |
| 1994 | 2.75 | 0.61 | 2.23 | 1.47 | 2.24 | 0.03 | 2.12 | 2.05 |
| 1995 | 2.79 | 0.54 | 2.71 | 1.76 | 2.65 | 0.03 | 2.13 | 2.14 |
| 1996 | 2.66 | 0.52 | 2.49 | 1.62 | 2.45 | 0.03 | 2.05 | 2.04 |
| 1997 | 2.71 | 0.54 | 2.77 | 1.80 | 2.72 | 0.03 | 2.12 | 2.09 |
| 1998 | 2.72 | 0.54 | 2.53 | 1.65 | 2.50 | 0.03 | 2.14 | 2.11 |
| 1999 | 2.73 | 0.54 | 2.34 | 1.53 | 2.32 | 0.03 | 2.15 | 2.13 |
| 2000 | 2.77 | 0.55 | 2.69 | 1.78 | 2.68 | 0.03 | 2.18 | 2.19 |
| 2001 | 2.77 | 0.55 | 2.69 | 1.78 | 2.68 | 0.03 | 2.18 | 2.19 |
| 2002 | 2.77 | 0.55 | 2.69 | 1.78 | 2.68 | 0.03 | 2.18 | 2.19 |
| 2003 | 2.77 | 0.55 | 2.69 | 1.78 | 2.68 | 0.03 | 2.18 | 2.19 |
| 2004 | 2.77 | 0.55 | 2.69 | 1.78 | 2.68 | 0.03 | 2.18 | 2.19 |
| 2005 | 2.77 | 0.55 | 2.69 | 1.78 | 2.68 | 0.03 | 2.18 | 2.19 |
| 2006 | 2.77 | 0.55 | 2.69 | 1.78 | 2.68 | 0.03 | 2.18 | 2.19 |
| 2007 | 2.77 | 0.55 | 2.69 | 1.78 | 2.68 | 0.03 | 2.18 | 2.19 |

### 5.2.6 Uncertainty Assessment

In the latest study on uncertainties of the Austrian inventory (WINIWARTER 2008) (see Chapter 1.7) the uncertainties of solvent emissions in Austria were determined, and were compared with the results of the detailed analysis of solvent emissions in Austria (WINDSPERGER et al. 2004) (see also NIR 2006). Differences between bottom-up and top-down methodology to estimate emissions were calculated at less than 10%, which is compatible with expert estimates on the uncertainties presented for national statistics. Additional uncertainty has been attributed to the released fraction of solvents employed, reflecting an emission factor (solvents are released as volatile organic compounds, which eventually are converted into $CO_2$ in the atmosphere).

Using the WINDSPERGER et al. (2004) data, an uncertainty of 5% is attributed to the activity data, and 10% to the emission factor of solvents. According to WINDSPERGER et al. (2004), the uncertainty should decrease and the overall quality improve between 1990 and current data. But according to WINIWARTER (2008) a general decrease in the quality of the import-export statistics, and a decrease in the released fraction of solvents (reflecting the emission factor) over the years results in a constant uncertainty.

In Table 129 and Table 130 the results of the studies are presented whereas the results of WINIWARTER (2008) are used for calculating the total uncertainty of the Austrian GHG inventory.

*Table 129: Uncertainties of Sector 3 Solvent and other product use (WINDSPERGER et al. 2004).*

| | 1990 | 1995 | 2000 |
|---|---|---|---|
| Uncertainty solvent emissions | -21 to +24% | -18 to +21% | -13 to +14% |

*Table 130: Uncertainties of Sector 3 Solvent and other product use (WINIWARTER 2008).*

| IPCC Source category | Gas | AD | EF | Combined |
|---|---|---|---|---|
| | | | Uncertainty [%] | |
| 3: Solvent and other product use | $CO_2$ | 5.0 | 10.0 | 11.2 |

## 5.3 $N_2O$ Emissions from Solvent and Other Product Use (IPCC Sector 3.D.1, 3.D.2 and 3.D.3)

| | **3.D.1**<br>**Use of $N_2O$ for anaesthesia** | **3.D.3**<br>**Use of $N_2O$ in aerosol cans** | **3.D.2**<br>**Use of $N_2O$ in fire extinguishers** |
|---|---|---|---|
| **GHG key category** | no | no | not ocurring |
| **gas** | $N_2O$ emission from the use of anaesthesia | $N_2O$ emission from the use of aerosol cans | – |
| **activity** | $N_2O$ consumption of anaesthesia | $N_2O$ consumption in aerosol cans | $N_2O$ is not flammable, but has oxidising properties. There is no evidence of this gas being used in fire extinguishers in Austria. |
| | Due to new industry inquiries (ÖIGV 2008) the amount of $N_2O$ used for anaesthesia was updated for the years 2001–2007. | It is assumed that the use of $N_2O$ for aerosol cans is constant at 400 tons per year. This estimate is based on expert judgement and industry inquiries (ÖIGV 2008). | |
| **method** | A specific methodology for these activities has not been prepared yet.[51] | | – |
| | 100% of $N_2O$ used for anaesthesia is released into atmosphere | 100% of $N_2O$ used for aerosol cans is released into atmosphere | |
| **emission factor** | activity data = emission<br>1.00 Mg $N_2O$/Mg product use | | – |

[51] CORINAIR Guidebook 3rd edition

*Table 131: $N_2O$-consumption of anaesthesia and $N_2O$-consumption in aerosol cans.*

| | 3.D.1 | 3.D.3 |
|---|---|---|
| | use of $N_2O$ for anaesthesia | use of $N_2O$ in aerosol cans |
| Unit | Mg | |
| 1990 | 350 | 400 |
| 1991 | 350 | 400 |
| 1992 | 350 | 400 |
| 1993 | 350 | 400 |
| 1994 | 350 | 400 |
| 1995 | 350 | 400 |
| 1996 | 350 | 400 |
| 1997 | 350 | 400 |
| 1998 | 350 | 400 |
| 1999 | 350 | 400 |
| 2000 | 350 | 400 |
| 2001 | 312 | 400 |
| 2002 | 274 | 400 |
| 2003 | 236 | 400 |
| 2004 | 198 | 400 |
| 2005 | 160 | 400 |
| 2006 | 130 | 400 |
| 2007 | 117 | 400 |

### 5.3.1 Uncertainty Assessment for $N_2O$ Emissions from Solvent and Other Product Use

Direct use of $N_2O$ has been specifically collected from industry experts in Austria. According to (WINIWARTER 2008) pursuant to (RAMIREZ et al. 2006) an uncertainty of 20% for the amount of $N_2O$ is used. In contrast to Ramirez, it is assumed that virtually all of the $N_2O$ actually used is also fully released thus no additional uncertainty is applied.

*Table 132: Uncertainties of Sector 3.D Solvent and other product use.*

| IPCC Source category | Gas | AD | EF | Combined |
|---|---|---|---|---|
| | | | Uncertainty [%] | |
| 3: Solvent and other product use | $N_2O$ | 20.0 | 0 | 20.0 |

## 5.4 Recalculation for emissions from solvent and other product use

To improve and update the solvent model a study (WINDSPERGER, 2008 (unpublished) was made, the results of which will be presented in the IIR 2009.

**Update of activity data:**

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

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

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

**Improvements of methodologies and emission factors:**

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

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

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

The table below shows the recalculation difference of $CO_2$ emissions from solvent and other product use and its subcategories with respect to the previous submission (the complete time series is presented in Annex 5). There were no recalculations for $N_2O$ emissions.

*Table 133: Recalculation difference with respect to submission 2008.*

| **$CO_2$ Emission** | | **Absolute difference [Gg]** | | | | **Relative difference [∆%]** | |
|---|---|---|---|---|---|---|---|
| | | **1990** | **2000** | **2005** | **2006** | **1990** | **2006** |
| 3 | Solvent and Other Product Use | -3.37 | 11.54 | 29.79 | 26.87 | -1% | 12% |
| 3 A | Paint application | -1.99 | 2.78 | 9.05 | 7.38 | -2% | 11% |
| 3 B | Degreasing and dry cleaning | -0.60 | 1.19 | 7.77 | 7.54 | -2% | 25% |
| 3 C | Chemical products, manufacture and processing | -14.31 | -9.14 | -7.34 | -7.04 | -34% | -30% |
| 3 D 5 | Other solvent use | 13.52 | 16.71 | 20.31 | 18.99 | 16% | 20% |

# 6 AGRICULTURE (CRF SECTOR 4)

## 6.1 Sector Overview

This chapter gives information about the estimation of greenhouse gas emissions from Sector *Agriculture* in correspondence to the data reported under the Sector 4 in the Common Reporting Format.

The following sources exist in Austria: domestic livestock activities with enteric fermentation and manure management, agricultural soils and agricultural residue burning.

Applied methods are in line with the 1996 Revised IPCC Guidelines and are based on following studies commissioned by the Umweltbundesamt: (GEBETSROITHER et al. 2002, AMON et al. 2002, and STREBL et al. 2002).

These studies are not published. A detailed description of the applied methods is given in this report.

To give an overview of Austria's agricultural sector some information is provided below (according to the 2005 Farm Structure Survey – full survey) (BMLFUW 2000-2008):

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

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

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

### 6.1.1 Emission Trends

In the year 2007 the sector agriculture contributed 9.0% to the total of Austria's greenhouse gas emissions (without LULUCF). The trend of GHG emissions from 1990 to 2007 shows a decrease of 13.3% for this sector (see Figure 24 and Table 135) due to a decrease in activity data.

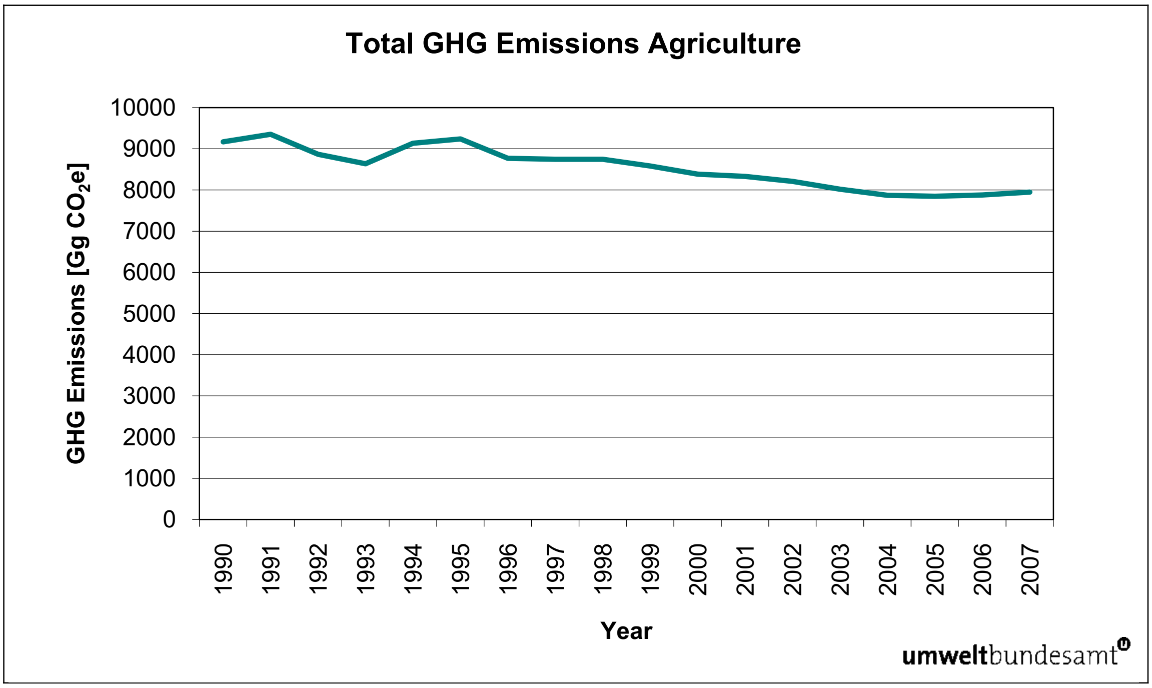


*Figure 24: Trend of total GHG emissions from agriculture.*

The fluctuations in the time series shown in Figure 24 are mainly due to fluctuations of $N_2O$ emissions from agricultural soils.

### Emission trends per gas

$CH_4$ emissions from agriculture decreased by 14.9% since the base year mainly due to lower emissions from enteric fermentation and manure management. $N_2O$ emissions decreased by 11.5% mainly due to lower emissions from agricultural soils (direct and indirect emissions). The trend is presented in Table 134.

*Table 134: Emissions of greenhouse gases from 1990–2007 from agriculture.*

| Year | GHG emissions [Gg] | |
|---|---|---|
| | $CH_4$ | $N_2O$ |
| 1990 | 230.11 | 13.99 |
| 1991 | 226.89 | 14.80 |
| 1992 | 218.42 | 13.81 |
| 1993 | 218.90 | 13.03 |
| 1994 | 219.21 | 14.62 |
| 1995 | 220.24 | 14.89 |
| 1996 | 216.89 | 13.60 |
| 1997 | 213.88 | 13.72 |
| 1998 | 213.02 | 13.79 |
| 1999 | 208.92 | 13.54 |
| 2000 | 206.69 | 13.05 |
| 2001 | 204.53 | 13.02 |
| 2002 | 200.17 | 12.93 |
| 2003 | 198.49 | 12.43 |
| 2004 | 196.72 | 12.07 |
| 2005 | 195.40 | 12.08 |
| 2006 | 194.57 | 12.24 |
| 2007 | 195.73 | 12.38 |
| *Trend 90-07* | *-14.9%* | *-11.5%* |

### Emission trends per sub category

Table 135 presents total GHG emissions and trend 1990–2007 from agriculture by sub-categories as well as the contribution to the overall inventory emissions. Important categories are 4.A enteric fermentation (3.7%) and 4.D agricultural soils (3.4%) followed by 4.B manure management (2.0%).

*Table 135: GHG emissions 1990–2007 of agriculture by categories.*

| Year | GHG emissions [Gg $CO_2$ equivalent] by categories | | | | |
|---|---|---|---|---|---|
| | 4 | 4.A | 4.B | 4.D | 4.F |
| 1990 | 9 170.66 | 3 763.50 | 2 065.40 | 3 339.95 | 1.81 |
| 1991 | 9 353.59 | 3 711.04 | 2 038.44 | 3 602.33 | 1.78 |
| 1992 | 8 868.31 | 3 549.50 | 1 985.45 | 3 331.64 | 1.71 |
| 1993 | 8 636.40 | 3 548.51 | 1 995.68 | 3 090.52 | 1.69 |
| 1994 | 9 136.46 | 3 567.53 | 1 983.77 | 3 583.41 | 1.76 |
| 1995 | 9 242.05 | 3 596.20 | 1 996.91 | 3 647.18 | 1.77 |
| 1996 | 8 771.75 | 3 545.46 | 1 960.11 | 3 264.44 | 1.74 |
| 1997 | 8 745.25 | 3 483.63 | 1 947.38 | 3 312.40 | 1.84 |
| 1998 | 8 748.54 | 3 455.71 | 1 955.31 | 3 335.73 | 1.78 |
| 1999 | 8 585.15 | 3 421.48 | 1 891.11 | 3 270.73 | 1.83 |
| 2000 | 8 386.35 | 3 400.86 | 1 852.83 | 3 130.95 | 1.71 |

| Year | GHG emissions [Gg $CO_2$ equivalent] by categories | | | | |
|---|---|---|---|---|---|
| | 4 | 4.A | 4.B | 4.D | 4.F |
| 2001 | 8 331.73 | 3 350.84 | 1 849.44 | 3 129.64 | 1.81 |
| 2002 | 8 211.12 | 3 290.15 | 1 800.89 | 3 118.28 | 1.81 |
| 2003 | 8 020.07 | 3 252.30 | 1 795.52 | 2 970.61 | 1.64 |
| 2004 | 7 872.85 | 3 243.46 | 1 764.02 | 2 862.90 | 2.48 |
| 2005 | 7 848.10 | 3 214.28 | 1 756.45 | 2 875.75 | 1.62 |
| 2006 | 7 880.47 | 3 201.41 | 1 749.44 | 2 928.16 | 1.46 |
| 2007 | 7 949.49 | 3 214.83 | 1 763.16 | 2 969.96 | 1.55 |
| *Share in Austrian Total 2007* | *9.0%* | *3.7%* | *2.0%* | *3.4%* | *0.0%* |
| *Trend 1990-2007* | -13.3% | -14.6% | -14.6% | -11.1% | -14.5% |

As can be seen in Figure 25 and Table 135 the overall trend concerning emissions from all categories is decreasing. The reason for the continuous decrease of emissions from enteric fermentation and manure management is the decrease in livestock numbers (cattle and swine). Fluctuations of emissions from agricultural soils are mainly due to varying underlying activity data (sales figures of mineral fertilizers).

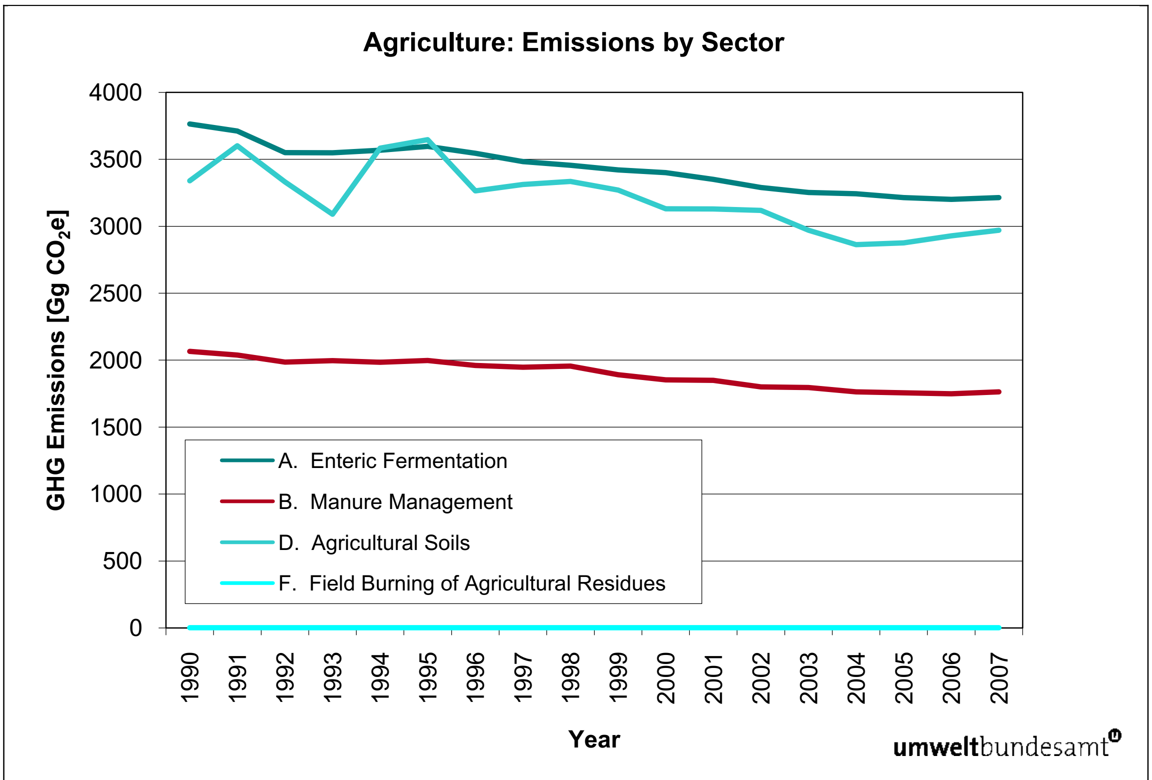


*Figure 25: Emission trends of agriculture by categories.*

As can be seen in Table 136, in 2007 about 40% of emissions from agriculture originate from enteric fermentation. Agricultural soils contributes around 37%, manure management contributes another 22%. Field burning of agricultural wastes contributes only a negligible part (0.02% in 2007).

*Table 136: Share of categories of agriculture, 1990 and 2007.*

| | GHG emissions [%] by sub categories | | | | |
|---|---|---|---|---|---|
| **Year** | **4** | **4.A** | **4.B** | **4.D** | **4.F** |
| 1990 | 100.0% | 41.0% | 22.5% | 36.4% | 0.0% |
| 2007 | 100.0% | 40.4% | 22.2% | 37.4% | 0.0% |

### 6.1.2 Key Categories

The key category analysis is presented in Chapter 1.5. This chapter includes information about the key sources of the agriculture sector. Key sources within this category are presented in Table 137.

*Table 137: Key sources of agriculture.*

| IPCC Category | Source Categories | Key Sources | |
|---|---|---|---|
| | | **GHG** | **KS-Assessment*** |
| 4.A.1 | Cattle | $CH_4$ | LA90, LA07, TA |
| 4.B.1 | Cattle | $N_2O$ | LA90, LA07, TA |
| 4.B.1 | Cattle | $CH_4$ | LA90, LA07, TA |
| 4.B.8 | Swine | $CH_4$ | LA90, LA07 |
| 4.D.1 | Direct Soil Emissions | $N_2O$ | LA90, LA07, TA |
| 4.D.2 | Pasture, Range and Paddock Manure | $N_2O$ | Q |
| 4.D.3 | Indirect Emissions | $N_2O$ | LA90, LA07, TA |

### 6.1.3 Methodology

For enteric fermentation, manure management and agricultural soils IPCC Tier 1 methods and IPCC default emission factors were used, except for key sources of these categories (these are the categories cattle for enteric fermentation and cattle and swine for manure management) where the more detailed Tier 2 method and country specific emission factors were used.

For the calculation of emissions from enteric fermentation - poultry the IPCC Tier 2 method with Swiss emission factors (Gross Energy Intake, Methane Conversion Rate) was used. It is assumed that Swiss conditions are very similar to Austrian conditions.

As recommended in the Centralized Review 2003 for the estimation of emissions from category field burning of agricultural wastes the IPCC methodology using default values was applied.

### 6.1.4 Quality Assurance and Quality Control (QA/QC)

Data were checked for transcription errors between input data and calculation sheets. Calculations were examined focusing on units/scale and formulas. Quality Control following the GPG is described in the chapters of the sub-categories. A description of the QMS (Quality Management System) is presented in Chapter 1.6.

### 6.1.5 Uncertainty Assessment

Animal numbers, in accordance to WINIWARTER & ORTHOFER (2000) were estimated at 10% uncertainty and considered statistically independent. Uncertainties of emission factors for $CH_4$ emissions of enteric fermentation, according to AMON et al. (2002) were considered 20% for cattle and sheep (representing ruminants) and 30% for all other animals. This is consistent with more detailed knowledge for those animals that contribute more to the emissions. The respective uncertainty factors are considered correlated. Based on the identical animal numbers, uncertainties of emission factors for $CH_4$ from manure were assessed at 70% (AMON et al. 2002), and for $N_2O$ emissions a lognormal distribution with a low at 50% and a high of 200% of the best estimate was chosen derived from IPCC, 2000 (note: "low" stands for the 2.5-percentile and "high" for the 97.5-percentile of the distribution).

RYPDAL & WINIWARTER (2001) noted that the largest contributor to uncertainty for several existing GHG inventories is $N_2O$ emissions from soils. Thus it is worthwhile to consider this source in some more detail – even if no real improvement of the situation should be expected at this time. While IPCC (2000) assumes two orders of magnitude as the uncertainty margin, re-evaluation of basically the same data leads to a considerable improvement of the situation to estimated 30%-300% of the best estimate, lognormal distribution (IPCC 2006). This range is closer but still higher compared to the one estimated by WINIWARTER & RYPDAL (2001), who assumed uncertainty in a triangular distribution between 50 and 200%. In the latest Austrian study (WINIWARTER 2008) for the emission factor of $N_2O$ from soils an uncertainty of 150% was applied. Uncertainty contributions of the activity (combined from agricultural area and average N-fertilizer input) at about 5% is almost negligible in this context.

The IPCC methodology (IPCC 2006) recommends separate treatment of direct and indirect emissions. Indirect emissions in this context are again soil emissions, which occur after evaporation/leaching of N from the soil to which fertilizer originally has been applied to. Uncertainties of emission factors of indirect emissions are not significantly different from those of direct emissions, and the underlying processes (microbial nitrification/denitrification) are identical. Thus it was decided to treat the uncertainties of direct and indirect emissions as being correlated.

Table 138 presents uncertainties for emissions as well as for activity data and the EFs of the key categories of agriculture according to the error propagation method (Tier 1).

*Table 138: Uncertainties of emissions and emission factors (key categories agriculture).*

| **Categories** | | **$CH_4$ Emissions** | **$N_2O$ Emissions** | **EF $CH_4$** | **EF $N_2O$** |
|---|---|---|---|---|---|
| 4.A.1 | Cattle | +/- 22.4% | – | +/- 20% | – |
| 4.B.1 | Cattle | +/- 70.7% | +/- 100,5% | +/- 70% | +/- 100% |
| 4.B.8 | Swine | +/- 70.7% | – | +/- 70% | – |
| 4.D.1 | Direct Soil Emissions | – | +/- 150.1% | – | +/- 150% |
| 4.D.2 | Indirect Soil Emissions | – | +/- 150.1% | – | +/- 150% |
| 4.D.3 | Pasture, Range & Paddock | – | +/- 150.1% | – | +/- 150% |
| **Activity Data** | | | | | |
| Animal Population | | +/- 10% | | | |
| Area Data & Fertilizer Input (combined) | | +/- 5% | | | |

### 6.1.6 Recalculations

#### 4.A.9 Enteric Fermentation – Poultry

The gross energy intake data (GE) and the methane conversion rate (Ym) of poultry were revised. The new values were obtained from the National Inventory Report of Switzerland 2008. Following the Swiss NIR, data on energy intake are taken from (SBV 2007). The Ym value is based on an in vivo trial with broilers (HADORN & WENK 1996). The revision results in 50 % higher $CH_4$ emissions from 1990-2007.

### 6.1.7 Completeness

Table 139 gives an overview of the IPCC 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 subcategories. A "✓" indicates that emissions from this sub-category have been estimated.

*Table 139: Overview of sub-categories of agriculture: transformation into SNAP Codes and status of estimation.*

| IPCC Category | | SNAP | | $CH_4$ | $N_2O$ |
|---|---|---|---|---|---|
| **4.A** | **ENTERIC FERMENTATION** | **1004** | **ENTERIC FERMENTATION** | ✓ | **NA** |
| 4.A.1 | Cattle | – | – | ✓ | NA |
| 4.A.1.a | Dairy Cattle | 100401 | Dairy cows | ✓ | NA |
| 4.A.1.b | Non-Dairy Cattle | 100402 | Other cattle | ✓ | NA |
| 4.A.2 | Buffalo | 100414 | Buffalos | NO | NO |
| 4.A.3 | Sheep | 100403 | Ovines | ✓ | NA |
| 4.A.4 | Goats | 100407 | Goats | ✓ | NA |
| 4.A.5 | Camels and Lamas | 100413 | Camels | NO | NO |
| 4.A.6 | Horses | 100405 | Horses | ✓ | NA |
| 4.A.7 | Mules and Asses | 100406 | Mules and asses | IE[1)] | NA |
| 4.A.8 | Swine | 100404 | Fattening pigs | ✓ | NA |
| 4.A.9 | Poultry | 100408 /09/10 | Laying hens, broilers, other poultry | ✓ | NA |
| 4.A.10 | Other | 100415 | Deer | ✓ | NA |
| **4.B.** | **MANURE MANAGEMENT** | **1005**<br><br><br>**1009** | **MANURE MANAGEMENT REGARDING ORGANIC COMPOUNDS**<br>**MANURE MANAGEMENT REGARDING NITROGEN COMPOUNDS** | ✓<br><br><br>**NO** | **NO**<br><br><br>✓ |
| 4.B.1 | Cattle | – | – | ✓ | ✓ |
| 4.B.1.a | Dairy Cattle | 100501 | Dairy cows | ✓ | ✓ |
| 4.B.1.b | Non-Dairy Cattle | 100502 | Other cattle | ✓ | ✓ |
| 4.B.2 | Buffalo | 100514 | Buffalos | NO | NO |
| 4.B.3 | Sheep | 100505 | Ovines | ✓ | ✓ |
| 4.B.4 | Goats | 100511 | Goats | ✓ | ✓ |
| 4.B.5 | Camels and Lamas | 100513 | Camels | NO | NO |

| IPCC Category | | SNAP | | $CH_4$ | $N_2O$ |
|---|---|---|---|---|---|
| 4.B.6 | Horses | 100506 | Horses | ✓ | ✓ |
| 4.B.7 | Mules and Asses | 100506 | Mules and asses | IE[2)] | IE[2)] |
| 4.B.8 | Swine | 100503 | Fattening pigs | ✓ | ✓ |
| 4.B.9 | Poultry | 100507 /08/09 | Laying hens, broilers, Other poultry (ducks, gooses,…) | ✓ | ✓ |
| 4.B.10 | Other Livestock | 100515 | Deer | ✓ | ✓ |
| 4.B.11 | Anaerobic | | Anaerobic | NO | NO |
| 4.B.12 | Liquid Systems | | Liquid Systems | IE[3)] | ✓ |
| 4.B.13 | Solid Storage | | Solid Storage and Dry Lot | IE[3)] | ✓ |
| 4.B.14 | Other | | Other management/ manure without bedding | IE[3)] | ✓ |
| **4.C** | **RICE CULTIVATION** | **100103 100103** | **Rice Field (with fertilizers) Rice Field (without fertilizers)** | **NO** | **NO** |
| **4.D** | **AGRICULTURAL SOILS** | **1001 1002** | **CULTURES WITH FERTILIZERS CULTURES WITHOUT FERTILIZERS** | **NO** | ✓ |
| 4.D.1 | Direct Soil Emissions | 1001/ 1002 | Cultures with and without fertilizers | NO | ✓ |
| 4.D.2 | Pasture, Range and Paddock Manure | 1002 | Cultures without fertilizers | NO | ✓ |
| 4.D.3 | Indirect Emissions | 1001/ 1002 | Cultures with and without fertilizers | NO | ✓ |
| **4.E** | **PRESCRIBED BURNING OF SAVANNAS** | **–** | **–** | **NO** | **NO** |
| **4.F** | **FIELD BURNING OF AGRICULTURAL RESIDUES** | **1003** | **ON-FIELD BURNING OF STUBBLE, STRAW, …** | ✓ | ✓ |
| 4.F.1 | Cereals | 100301 | Cereals | ✓ | ✓ |
| 4.F.2 | Pulses | 100302 | Pulse | NO | NO |
| 4.F.3 | Tubers and Roots | 100303 | Tuber and Root | NO | NO |
| 4.F.4 | Sugar Cane | 100304 | Sugar Cane | NO | NO |
| 4.F.5 | Other: Vine | 100305 [0907] | Other: Open burning of agricultural wastes (except 1003) | ✓ | ✓ |

1) *included in 4.A.6 Horses, SNAP 100406*

2) *included in 4.B.6 Horses, SNAP 100506*

3) *$CH_4$ emissions included in 4.B.1 to 4.B.10*

### 6.1.8 Planned Improvements

Planned Improvements are presented in the respective sub-chapters.

## 6.2 Enteric fermentation (CRF category 4.A)

This chapter describes the estimation of $CH_4$ emissions from enteric fermentation. In 2007 78.2% of agricultural $CH_4$ emissions arose from this category.

### 6.2.1 Source Category Description

$CH_4$ emissions amounted to 179.2 Gg in the 'Kyoto' base year and have decreased by 14.6% to 153.1 Gg in 2007. Almost all emissions of category 4.A (93.3% in 2007) are caused by cattle farming, thus $CH_4$ emissions from *Cattle (4.A.1)* are a key source. The contribution of *Dairy Cattle (4.A.1.a)* decreased from 49.3% in 1990 to 39.4% in 2007.

*Table 140: Greenhouse gas emissions from enteric fermentation by sub-categories 1990–2007.*

| **Year** | **$CH_4$ emissions [Gg] per Livestock Category** | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | **4.A** | **4.A.1.a** | **4.A.1.b** | **4.A.3** | **4.A.4** | **4.A.6** | **4.A.8** | **4.A.9** | **4.A.10** |
| | **Total** | **Dairy** | **Non-Diary** | **Sheep** | **Goats** | **Horses** | **Swine** | **Poultry** | **Other** |
| 1990 | 179.21 | 88.32 | 81.24 | 2.48 | 0.19 | 0.89 | 5.53 | 0.27 | 0.30 |
| 1991 | 176.72 | 85.72 | 81.11 | 2.61 | 0.20 | 1.04 | 5.46 | 0.28 | 0.30 |
| 1992 | 169.02 | 82.55 | 76.54 | 2.50 | 0.20 | 1.11 | 5.58 | 0.26 | 0.30 |
| 1993 | 168.98 | 81.40 | 77.19 | 2.67 | 0.24 | 1.17 | 5.73 | 0.28 | 0.30 |
| 1994 | 169.88 | 81.12 | 78.40 | 2.74 | 0.25 | 1.20 | 5.59 | 0.27 | 0.30 |
| 1995 | 171.25 | 72.07 | 88.53 | 2.92 | 0.27 | 1.30 | 5.56 | 0.27 | 0.32 |
| 1996 | 168.83 | 71.81 | 86.31 | 3.05 | 0.27 | 1.32 | 5.50 | 0.25 | 0.33 |
| 1997 | 165.89 | 74.83 | 80.11 | 3.07 | 0.29 | 1.34 | 5.52 | 0.28 | 0.45 |
| 1998 | 164.56 | 76.37 | 77.28 | 2.89 | 0.27 | 1.36 | 5.72 | 0.28 | 0.40 |
| 1999 | 162.93 | 73.79 | 78.82 | 2.82 | 0.29 | 1.47 | 5.15 | 0.28 | 0.31 |
| 2000 | 161.95 | 66.64 | 85.28 | 2.71 | 0.28 | 1.47 | 5.02 | 0.23 | 0.31 |
| 2001 | 159.56 | 65.12 | 84.41 | 2.56 | 0.30 | 1.47 | 5.16 | 0.24 | 0.31 |
| 2002 | 156.67 | 65.06 | 81.91 | 2.43 | 0.29 | 1.47 | 4.96 | 0.24 | 0.31 |
| 2003 | 154.87 | 62.14 | 82.84 | 2.60 | 0.27 | 1.57 | 4.87 | 0.25 | 0.33 |
| 2004 | 154.45 | 60.41 | 84.31 | 2.62 | 0.28 | 1.57 | 4.69 | 0.25 | 0.33 |
| 2005 | 153.06 | 60.50 | 82.78 | 2.61 | 0.28 | 1.57 | 4.75 | 0.25 | 0.33 |
| 2006 | 152.45 | 60.19 | 82.64 | 2.50 | 0.27 | 1.57 | 4.71 | 0.25 | 0.33 |
| 2007 | 153.09 | 60.34 | 82.56 | 2.81 | 0.30 | 1.57 | 4.93 | 0.25 | 0.33 |
| Share 2007 | 100% | 39.4% | 53.9% | 1.8% | 0.2% | 1.0% | 3.2% | 0.2% | 0.2% |
| *Trend 1990-2007* | -14.6% | -31.7% | 1.6% | 13.4% | 62.0% | 77.0% | -10.9% | -5.7% | 11.0% |

The overall reduction is caused by a decrease in total numbers of animals. However, in the case of dairy cows the reduction of animals is partly counterbalanced by an increase in emissions per animal (because of the increasing milk yield of milk cattle and the connected gross energy intake since 1990).

Following a recommendation of the centralized review 2008, in the NIR 2009 $CH_4$ emissions from *Non-Dairy Cattle* are reported separately:

*Table 141: Greenhouse gas emissions from non-dairy cattle (4.A.1.b) by sub-categories 1990–2007.*

| | $CH_4$ emissions [Gg] of Non-Dairy Cattle (4.A.1.b) sub-categories | | | | |
|---|---|---|---|---|---|
| **Year** | **4.A.1.b Total** | **Suckling Cows > 2 yr** | **Young Cattle < 1 yr** | **Young Cattle 1-2 yr** | **Other Cattle > 2 yr** |
| 1990 | 81.24 | 4.35 | 30.67 | 36.81 | 9.41 |
| 1991 | 81.11 | 5.31 | 29.62 | 36.45 | 9.72 |
| 1992 | 76.54 | 5.60 | 27.44 | 34.12 | 9.37 |
| 1993 | 77.19 | 6.42 | 23.20 | 37.44 | 10.14 |
| 1994 | 78.40 | 8.33 | 23.15 | 37.38 | 9.54 |
| 1995 | 88.53 | 19.49 | 22.54 | 36.69 | 9.81 |
| 1996 | 86.31 | 19.70 | 21.83 | 34.92 | 9.86 |
| 1997 | 80.11 | 15.79 | 20.53 | 33.43 | 10.36 |
| 1998 | 77.28 | 14.29 | 20.67 | 32.24 | 10.08 |
| 1999 | 78.82 | 16.36 | 20.52 | 31.72 | 10.21 |
| 2000 | 85.28 | 23.41 | 21.33 | 30.31 | 10.24 |
| 2001 | 84.41 | 23.87 | 21.45 | 29.61 | 9.49 |
| 2002 | 81.91 | 22.68 | 20.83 | 29.23 | 9.16 |
| 2003 | 82.84 | 22.51 | 20.88 | 28.98 | 10.46 |
| 2004 | 84.31 | 24.22 | 21.02 | 28.60 | 10.46 |
| 2005 | 82.78 | 25.05 | 20.42 | 28.27 | 9.05 |
| 2006 | 82.64 | 25.13 | 20.51 | 28.18 | 8.83 |
| 2007 | 82.56 | 25.13 | 20.59 | 28.31 | 8.54 |
| *Share 2007* | *100.0%* | *30.4%* | *24.9%* | *34.3%* | *10.3%* |
| *Trend 1990-2007* | *1.6%* | *477.0%* | *-32.9%* | *-23.1%* | *-9.2%* |

The steady rise in suckling cow numbers (see Table 142) is responsible for the increasing emission trend of non-dairy cattle *(4.A.1.b)*. In contrast, all the other cattle sub-categories show a considerable decrease in emissions from 1990-2007. These sub-categories include both female cattle and bulls.

## 6.2.2 Methodological Issues

The IPCC Tier 1 Method was applied for swine, sheep, goats, horses and 'other animals'.

For *Cattle* the more detailed Tier 2 method was applied. The IPCC Tier 2 method is based on the Tier 1 method, but it uses specific emission factors for different livestock sub-categories.

The IPCC Guidelines don't provide methodologies for the categories poultry and other.

In Austria, the animal category 'other' corresponds to deer. For the estimation of $CH_4$ emissions from category 4.A.10 the IPCC default emission factor of sheep was used, as sheep is the most similar livestock category to deer.

For the calculation of emissions from poultry the IPCC Tier 2 method with Swiss emission factors (gross energy intake, methane conversion rate) was used. It is assumed that Swiss conditions are very similar to Austrian conditions.

### Activity data

The Austrian official statistics (STATISTIK AUSTRIA 2007) provides national data of annual livestock numbers on a very detailed level. These data are based on livestock counts held in December each year[52].

In Table 142 and Table 143 applied animal data are presented. Background information to the data is listed below:

From 1990 onwards: The continuous decline of dairy cattle numbers is connected with the increasing milk yield per cow: For the production of milk according to Austria's milk quota every year a smaller number of cows is needed.

1991: A minimum counting threshold for poultry was introduced. Farms with less than 11 poultry were not considered any more. However, the contribution of these small farms is negligible, both with respect to the total poultry number and to the trend.

The increase of the soliped population between 1990 and 1991 is caused by a better data collection from riding clubs and horse breeding farms.

1993: New characteristics for swine and cattle categories were introduced in accordance with Austria's entry into the European Economic Area and the EU guidelines for farm animal population categories. In 1993 part of the "Young cattle < 1 yr" category was included in the "Young cattle 1–2 yr" category. This shift is considered to be insignificant: no inconsistency in the emission trend of "Non-Dairy Cattle" category was recorded.

In the same year "Young swine < 50 kg" were shifted to "Fattening pigs > 50 kg" (before 1993 the limits were 6 months and not 50 kg which led to the shift) causing distinct inconsistencies in time series. Following a recommendation of the Centralized Review 2003, the age class split for swine categories of the years 1990–1992 was adjusted using the split from 1993.

1993: For the first time other animals e.g. deer (but not wild living animals) were counted. Following the recommendations of the Centralized Review 2004, to ensure consistency and completeness animal number of 1993 was used for the years 1990 to 1992.

1995: The financial support of suckling cow husbandry increased significantly in 1995 when Austria became a Member State of the European Union. The husbandry of suckling cows is used for the production of veal and beef; the milk yield of the cow is only provided for the suckling calves. Especially in mountainous regions with unfavourable farming conditions, suckling cow husbandry allows an extensive and economic reasonable utilisation of the pastures. Suckling cow husbandry contributes to the conservation of the traditional Austrian alpine landscape.

1996–1998: The market situation affected a decrease in veal and beef production, resulting in a declining suckling cow husbandry. Farmers partly used their former suckling cows for milk production. Thus, dairy cow numbers slightly increased at this time. Reasons are manifold: Changing market prices, BSE epidemic in Europe and change of consumer behaviour, milk quota, etc.

[52] 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).

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 142: Domestic livestock population and its trend 1990–2007 (I).*

| Year | Population size [heads] * | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Livestock category | | | | | | | |
| | **Dairy** | **Non-Dairy** | **Suckling Cows > 2 yr** | **Young Cattle < 1 yr** | **Young Cattle 1–2 yr** | **Other Cattle > 2 yr** | **Sheep** | **Goats** |
| 1990 | 904 617 | 1 679 297 | 47 020 | 925 162 | 560 803 | 146 312 | 309 912 | 37 343 |
| 1991 | 876 000 | 1 658 088 | 57 333 | 894 111 | 555 432 | 151 212 | 326 100 | 40 923 |
| 1992 | 841 716 | 1 559 009 | 60 481 | 831 612 | 521 078 | 145 838 | 312 000 | 39 400 |
| 1993 | 828 147 | 1 505 740 | 69 316 | 705 547 | 572 921 | 157 956 | 333 835 | 47 276 |
| 1994 | 809 977 | 1 518 541 | 89 999 | 706 579 | 573 177 | 148 786 | 342 144 | 49 749 |
| 1995 | 706 494 | 1 619 331 | 210 479 | 691 454 | 564 352 | 153 046 | 365 250 | 54 228 |
| 1996 | 697 521 | 1 574 428 | 212 700 | 670 423 | 537 382 | 153 923 | 380 861 | 54 471 |
| 1997 | 720 377 | 1 477 563 | 170 540 | 630 853 | 514 480 | 161 690 | 383 655 | 58 340 |
| 1998 | 728 718 | 1 442 963 | 154 276 | 635 113 | 496 159 | 157 415 | 360 812 | 54 244 |
| 1999 | 697 903 | 1 454 908 | 176 680 | 630 586 | 488 283 | 159 359 | 352 277 | 57 993 |
| 2000 | 621 002 | 1 534 445 | 252 792 | 655 368 | 466 484 | 159 801 | 339 238 | 56 105 |
| 2001 | 597 981 | 1 520 473 | 257 734 | 658 930 | 455 712 | 148 097 | 320 467 | 59 452 |
| 2002 | 588 971 | 1 477 971 | 244 954 | 640 060 | 449 932 | 143 025 | 304 364 | 57 842 |
| 2003 | 557 877 | 1 494 156 | 243 103 | 641 640 | 446 121 | 163 292 | 325 495 | 54 607 |
| 2004 | 537 953 | 1 513 038 | 261 528 | 646 946 | 441 397 | 163 167 | 327 163 | 55 523 |
| 2005 | 534 417 | 1 476 263 | 270 465 | 628 426 | 436 303 | 141 069 | 325 728 | 55 100 |
| 2006 | 527 421 | 1 475 498 | 271 314 | 631 529 | 434 991 | 137 664 | 312 375 | 53 108 |
| 2007 | 524 500 | 1 475 696 | 271 327 | 634 089 | 437 058 | 133 222 | 351 329 | 60 487 |
| *Trend 1990–2007* | *-42.0%* | *-12.1%* | *477.0%* | *-31.5%* | *-22.1%* | *-8.9%* | *13.4%* | *62.0%* |

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

The FAO agricultural data base (FAOSTAT) provides worldwide harmonized data (FAO AGR. STATISTICAL SYSTEM 2001). In the case of Austria, these data come from the national statistical system (Statistik Austria). However, there are inconsistencies between these two data sets. Analysis shows that there is often a time gap of one year between the two data sets. FAOSTAT data are seemingly based on the official Statistik Austria data but there is an annual attribution error. In the Austrian inventory Statistik Austria data is used, they are the best available.

*Table 143: Domestic livestock population and its trend 1990–2007 (II).*

| Year | Population size [heads] * | | | | |
|---|---|---|---|---|---|
| | Livestock category | | | | |
| | Horses | Swine | Fattening Pig > 50 kg | Swine for breeding > 50 kg | Young Swine < 50 kg |
| 1990 | 49 200 | 3 687 981 | 1 308 525 | 382 335 | 1 997 120 |
| 1991 | 57 803 | 3 637 980 | 1 290 785 | 377 152 | 1 970 044 |
| 1992 | 61 400 | 3 719 653 | 1 319 744 | 385 613 | 2 014 296 |
| 1993 | 64 924 | 3 819 798 | 1 355 295 | 396 001 | 2 068 502 |
| 1994 | 66 748 | 3 728 991 | 1 323 145 | 394 938 | 2 010 908 |
| 1995 | 72 491 | 3 706 185 | 1 312 334 | 401 490 | 1 992 361 |
| 1996 | 73 234 | 3 663 747 | 1 262 391 | 398 633 | 2 002 723 |
| 1997 | 74 170 | 3 679 876 | 1 268 856 | 397 742 | 2 013 278 |
| 1998 | 75 347 | 3 810 310 | 1 375 037 | 386 281 | 2 048 992 |
| 1999 | 81 566 | 3 433 029 | 1 250 775 | 343 812 | 1 838 442 |
| 2000 | 81 566 | 3 347 931 | 1 211 988 | 334 278 | 1 801 665 |
| 2001 | 81 566 | 3 440 405 | 1 264 253 | 350 197 | 1 825 955 |
| 2002 | 81 566 | 3 304 650 | 1 187 908 | 341 042 | 1 775 700 |
| 2003 | 87 072 | 3 244 866 | 1 243 807 | 334 329 | 1 666 730 |
| 2004 | 87 072 | 3 125 361 | 1 159 501 | 317 033 | 1 648 827 |
| 2005 | 87 072 | 3 169 541 | 1 224 053 | 315 731 | 1 629 757 |
| 2006 | 87 072 | 3 139 438 | 1 197 124 | 321 828 | 1 620 486 |
| 2007 | 87 072 | 3 286 292 | 1 272 889 | 318 349 | 1 695 054 |
| *Trend 1990–2007* | *77.0%* | *-10.9%* | *-2.7%* | *-16.7%* | *-15.1%* |

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

*Table 144: Domestic livestock population and its trend 1990–2007 (III).*

| Year | Population size [heads] * | | | |
|---|---|---|---|---|
| | Livestock category | | | |
| | Poultry | Chicken | Other Poultry | Other |
| 1990 | 13 820 961 | 13 139 151 | 681 810 | 37 100 |
| 1991 | 14 397 143 | 13 478 820 | 918 323 | 37 100 |
| 1992 | 13 683 900 | 12 872 100 | 811 800 | 37 100 |
| 1993 | 14 508 473 | 13 588 850 | 919 623 | 37 100 |
| 1994 | 14 178 834 | 13 265 572 | 913 262 | 37 736 |
| 1995 | 13 959 316 | 13 157 078 | 802 238 | 40 323 |
| 1996 | 12 979 954 | 12 215 194 | 764 760 | 41 526 |
| 1997 | 14 760 355 | 13 949 648 | 810 707 | 56 244 |
| 1998 | 14 306 846 | 13 539 693 | 767 153 | 50 365 |
| 1999 | 14 498 170 | 13 797 829 | 700 341 | 39 086 |
| 2000 | 11 786 670 | 11 077 343 | 709 327 | 38 475 |

| Year | Population size [heads] * | | | |
|---|---|---|---|---|
| | Livestock category | | | |
| | Poultry | Chicken | Other Poultry | Other |
| 2001 | 12 571 528 | 11 905 111 | 666 417 | 38 475 |
| 2002 | 12 571 528 | 11 905 111 | 666 417 | 38 475 |
| 2003 | 13 027 145 | 12 354 358 | 672 787 | 41 190 |
| 2004 | 13 027 145 | 12 354 358 | 672 787 | 41 190 |
| 2005 | 13 027 145 | 12 354 358 | 672 787 | 41 190 |
| 2006 | 13 027 145 | 12 354 358 | 672 787 | 41 190 |
| 2007 | 13 027 145 | 12 354 358 | 672 787 | 41 190 |
| *Trend 1990–2007* | *-5.7%* | *-6.0%* | *-1.3%* | *11.0%* |

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

Information about the extent of organic farming in Austria was provided in the Austrian INVEKOS[53] database (KIRNER & SCHNEEBERGER 1999), which was established to account for the financial support for sustainable agriculture including organic farming. INVEKOS data were used to calculate the share of animals that are subject to organic farming practices. However, INVEKOS data were available only for the years 1997 to 2000, and these data referred only to aggregated livestock categories. Furthermore, the INVEKOS data are not fully compatible with the Statistik Austria data because they rely on different data reporting periods.

The data gaps in the INVEKOS data sets (insufficiently detailed animal categories, lack of data for 1990–1996) were filled through expert judgments and trend extrapolations using surrogate data (e.g. the development of organic farming).

For all major animal categories the average share of organic farming in the 1997–2000 period was calculated from the INVEKOS data. This average share was then allocated to all animal sub-categories, assuming a default ratio between all sub-categories (e.g. assuming that the cattle in organic and conventional farming have the same ratios of dairy cattle, suckling cows, calves etc.).

Table 145 shows the results of the shares of organic farming in the relevant livestock categories for 1990, 1997–2000 and 2007:

[53] INVEKOS (Integriertes Verwaltungs- und Kontrollsystem, Integrated Administration and Control System) contains data about the regional distribution, land use, and the number of animals per farm. The INVEKOS is managed by the Federal Ministry of Agriculture, Forestry, Environment and Water Management.

*Table 145: Share of cattle population under organic farming systems (calculations based on INVEKOS data).*

| IPCC Category | % organic | % organic | % organic |
|---|---|---|---|
| | 1990 | 1997–2000 | 2007 |
| CATTLE | 1% | 15% | 17% |
| Dairy Cattle > 2 yr | 1% | 15% | 16% |
| Suckling Cows > 2 yr | 2% | 25% | 29% |
| Cattle > 2 yr | 1.5% | 20% | 15% |
| Young Cattle < 1 yr | 1% | 13% | 15% |
| Young Cattle 1–2 yr | 1% | 12% | 15% |

For the years 1990–1996, a trend extrapolation using surrogate data was made, namely the number of farms that apply organic farming practices (BMLFUW 2001). These data for expansion development of organic farming in Austria were applied to derive a trend of the animal population numbers in organic farming for the years 1990–1996 where no other relevant data were available. For the years 2001 to 2003 the data for 2000 was used. From 2004 onwards INVEKOS data of organic cattle population as reported in the so called 'Green Reports' of the ministery of agriculture (BMLFUW 2000-2008) was used.

#### 6.2.2.1 Cattle (4.A.1)

*Key Source: Yes ($CH_4$)*

$CH_4$ emissions from enteric fermentation – cattle (sum of dairy and non-dairy cattle) is a key source due to the contribution to total greenhouse gas emissions in Austria and also due to its contribution to the total inventory's trend. In the year 2007, emissions from enteric fermentation – cattle contributed 3.4% to total greenhouse gas emissions in Austria.

$CH_4$ emissions were calculated using the IPCC Tier 2 methodology. Activity data were obtained from national statistics and are presented in Table 142 and Table 143.

**Emission Factors**

Country specific emission factors were used. They were calculated from the specific gross energy intake and the methane conversion rate (GPG, Equation 4.14).

$EF = (GE * Y_m * 365 \text{ days/yr})/55.65$ MJ/kg

*$Y_m$ Methane conversion rate*

The methane conversion rate ($Y_m$) was taken from the IPCC recommended value for "all other cattle" (0.06 +/- 8.3%) because there are few if any feedlot cattle with a high-energy diet (i.e. with 90% or more of the diet in form of concentrates) in Austria.

Country specific values for the Gross Energy Intake were applied. The estimation was done separately for dairy and non-dairy cows.

*GE Gross energy intake of dairy cows (4.A.1.a):*

Austrian specific values for dairy cows were derived from feed intake data and energy content of feed (forage and concentrate) in dependency of annual milk yields (GRUBER & STEINWIDDER 1996). Following a recommendation of the Centralized Review 2004 in the year 2005 Austrian N excretion values and energy intake data were recalculated by Dr. Erich M. Pötsch from the Agricultural Research and Education Centre (AREC) Raumberg-Gumpenstein (PÖTSCH 2005), (GRUBER & PÖTSCH 2006).

*Table 146: Revised energy intake data for diary cattle in Austria (PÖTSCH 2005).*

| Annual milk yield | kg/cow/yr | 3 000 | 3 500 | 4 000 | 4 500 | 5 000 | 5 500 | 6 000 |
|---|---|---|---|---|---|---|---|---|
| energy intake | MJ NEL* $day^{-1}$ | 5.6 | 5.7 | 5.7 | 5.8 | 5.9 | 6.0 | 6.0 |
| forage intake | kg dry matter $day^{-1}$ | 13.9 | 14.0 | 14.0 | 13.9 | 13.8 | 13.8 | 13.8 |
| concentrate intake | kg dry matter $day^{-1}$ | 0.4 | 0.7 | 0.9 | 1.3 | 1.8 | 2.3 | 2.8 |
| net energy intake | MJ NEL* $day^{-1}$ | 80.3 | 82.8 | 85.3 | 88.5 | 91.7 | 95.8 | 99.8 |
| Gross Energy Intake | MJ GE $day^{-1}$ | 235.3 | 242.6 | 249.8 | 259.2 | 268.7 | 280.7 | 292.3 |

* *net energy lactation*

Austrian dairy cattle show average milk yields from 3 791 kg/cow (1990) to 5 997 kg/cow (2007). The time series of average milk yields per dairy cow was taken from national statistics and are presented in Table 147. For dairy cattle there was a 17.8% increase of GE intake between 1990 and 2007 due to the increase of the milk yield per dairy cow in this time. The resulting emission factor is presented in the following table:

*Table 147: Annual milk yield, gross energy intake and emission factors of dairy cattle 1990–2007.*

| Year | Milk Yield | Gross Energy Intake | Emission Factor |
|---|---|---|---|
| | [kg/cow*yr] | [MJ/head*day] | [kg $CH_4$/head*yr] |
| 1990 | 3 791 | 248.10 | 97.64 |
| 1991 | 3 862 | 248.66 | 97.86 |
| 1992 | 3 934 | 249.22 | 98.07 |
| 1993 | 4 005 | 249.77 | 98.29 |
| 1994 | 4 076 | 254.50 | 100.15 |
| 1995 | 4 619[1)] | 259.23 | 102.01 |
| 1996 | 4 670 | 261.59 | 102.94 |
| 1997 | 4 787 | 263.95 | 103.87 |
| 1998 | 4 924 | 266.32 | 104.80 |
| 1999 | 5 062 | 268.68 | 105.73 |
| 2000 | 5 210 | 272.69 | 107.31 |
| 2001 | 5 394 | 276.71 | 108.89 |
| 2002 | 5 487 | 280.72 | 110.47 |
| 2003 | 5 638 | 283.04 | 111.38 |
| 2004 | 5 802 | 285.36 | 112.30 |
| 2005 | 5 783 | 287.68 | 113.21 |
| 2006 | 5 903 | 290.00 | 114.12 |
| 2007 | 5 997 | 292.32 | 115.04 |

1) *From 1995 onwards data have been revised by Statistik Austria.*

Up to the early 1990ies Austrian dairy husbandry was determined by traditional Austrian green feeding and traditional Austrian races. From the mid 1990ies onwards milk production has been intensified: diets with higher energy concentration were fed and the share of high yield breeds (e.g. Holstein Friesian) in dairy farming was increased.

*GE Gross energy intake of non-dairy cattle (4.A.1.b):*

*Suckling cows:*

The husbandry of suckling cows is used for the production of veal and beef. The milk yield of the cow is only provided for the suckling calves. As a rule of thumb under the national circumstances in Austria 10 kg milk are needed for 1 kg gain in weight for a calve. A new born calve has around 40 kg and suckles until it weighs about 350 kg.

The study "Mutterkuh und Ochsenhaltung 2003" in which 56 holdings in Styria, Lower Austria, Carinthia and Salzburg were investigated, reports daily rates of weight increases of 1 020 g (2002) and 1 060 g (2003). Calves were suckled about 300 days (GRABNER et al. 2004). An experiment based on measurements made from 1978 to 1987 (STEINWENDER & GOLD 1989) shows similar results: The daily increase of weight of young bulls was 1 225 g and of young cows 1 044 g.

In an study (STEINWIDDER et al. 2006) with Austrian suckling cows (Simmental) the influence of duration of suckling period (6 months and 9 months) on milk yield and body weight of cows and weight gain of calves was determined. Cows were fed with forage of low quality. Anyhow, the milk yield of the 1$^{st}$ lactating suckling cows was on a high level: For the period of 6 month suckling a milk yield of 2 040 kg, for the period of 9 month suckling a milk yield of 3 329 kg per cow has been measured. The daily gains of the beef cattle (Simental x Limousin steers and heifers) were 1.22 and 1.26 kg for the 180 or 270 days of suckling period, respectively. The experiment was running from 2004 to the end of 2008. We expect the final report by the end of 2009.

According to an article in the Swiss agricultural journal UFA-Revue 2005 (HEIM, P. 2005), measurements show that in mother cow husbandry a milk yield of 3 000kg is needed to achieve a daily gain in weight of one kg.

Thus, in the Austrian Greenhouse Gas Emission Inventory for the period from 1990 to 2007 a constant average milk yield of 3 000 kg was applied, resulting in a Gross Energy Intake of 235.3 MJ per suckling cow and day (see Table 146).

*Other non dairy cattle categories:*

Gross energy intake for all other cattle categories were calculated from typical Austrian diets. Animal nutrition expert Andreas Steinwidder worked out animal diets as shown in Table 148 and Table 149 (AMON et al. 2002).

These livestock categories show distinct differences in organic and conventional diets. Thus, in this section a differentiation between both production systems was worked out. Gross Energy Intake was calculated using the methodology as described in (GRUBER & STEINWIDDER 1996).

*Table 148: Typical Austrian diets and gross energy intake of Non-Dairy Cattle, conventional production system.*

| CONVENTIONAL | cattle < 1 year | cattle 1–2 years | non-dairy cattle > 2 years |
|---|---|---|---|
| live weight | 210 kg | 530 kg | 600 kg |
| animal diet | 15% green feeding | 20% green feeding | 40% green feeding |
| | 20% hay | 15% hay | 20% hay |
| | 30% grass silage | 30% grass silage | 30% grass silage |
| | 35% maize silage | 35% maize silage | 10% maize silage |
| forage intake [kg dry matter $day^{-1}$] | 2.5 | 7.4 | 8.2 |
| concentrate intake [kg dry matter $day^{-1}$] | 2 | 2 | 1 |
| Gross Energy Intake [(MJ GE (kg dry matter)$^{-1}$] | 84.4 | 167.0 | 163.4 |

*Table 149:Typical Austrian diets and gross energy intake of Non-Dairy Cattle, organic production system.*

| ORGANIC | cattle < 1 year | cattle 1–2 years | non-dairy cattle > 2 years |
|---|---|---|---|
| live weight | 190 kg | 480 kg | 580 kg |
| animal diet | 35% green feeding | 40% green feeding | 40% green feeding |
| | 20% hay | 15% hay | 15% hay |
| | 45% grass silage | 45% grass silage | 45% grass silage |
| forage intake [kg dry matter $day^{-1}$] | 2.9 | 7.5 | 8 |
| concentrate intake [kg dry matter $day^{-1}$] | 1 | 1 | 1 |
| Gross Energy Intake [(MJ GE (kg dry matter)$^{-1}$] | 72.1 | 151.1 | 159.9 |

As no major changes in diets of *Non-Dairy Cattle* occurred in the period from 1990–2007, methane emissions from enteric fermentation of *Non-Dairy Cattle* are calculated with a constant gross energy intake for the whole time series. The resulting emission factor is presented in the following table:

*Table 150:Emission factors and gross energy intake of non-dairy cattle 1990–2007.*

| IPCC Category | Farming type | Gross Energy Intake [MJ/head*day] | Calculated Emission Factor [kg $CH_4$/head.yr] |
|---|---|---|---|
| Suckling Cows > 2 yr | con/org | 235 | 93 |
| Cattle > 2 yr | conventional | 163 | 64 |
| Cattle > 2 yr | organic | 160 | 63 |
| Young Cattle < 1 yr | conventional | 84 | 33 |
| Young Cattle < 1 yr | organic | 72 | 28 |
| Young Cattle 1–2 yr | conventional | 167 | 66 |
| Young Cattle 1–2 yr | organic | 151 | 59 |

#### 6.2.2.2 Sheep (4.A.3), Goats (4.A.4), Horses (4.A.6) Swine (4.A.8), Poultry (4.A.9) and Other (4.A.10)

*Key Source: No*

As presented in Table 140, $CH_4$ emissions from sheep, goats, horses, swine, poultry and 'Other' (deer) are only minor emission sources of enteric fermentation. Together they contributed 6.7% to total emissions from this category in 2007. The most important sub- category is swine, with a contribution of 3.2%, followed by sheep (1.8%), horses (1.0%) and 'Other' (deer), goats, poultry with each about 0.2% (figures are also presented in Table 140).

Emissions (except poultry) were estimated using the IPCC Tier 1 methodology.

As sheep is the most similar animal category to deer, emissions from deer were estimated applying the default emission factor of sheep. For all swine categories an emission factor of 1.5 kg/head*yr was used. Default emission factors were taken from the IPCC Guidelines and are presented in the following table:

*Table 151: IPCC Default Emission Factors for Categories estimated by Tier 1.*

| IPCC Category | Emission Factor* (Developed Countries) [kg $CH_4$/head*yr] | IPCC Category | Emission Factor* (Developed Countries) [kg $CH_4$/head*yr] |
|---|---|---|---|
| 4.A.3 Sheep (+ Deer) | 8.0 | 4.A.6 Horses | 18.0 |
| 4.A.4 Goats | 5.0 | 4.A.8 Swine | 1.5 |

** Source: IPCC Reference Manual p.4.10*

The IPCC Guidelines don't provide specific methodologies for the estimation of emissions from poultry.

For the calculation of emissions from poultry the IPCC Tier 2 method with Swiss values (Gross Energy Intake (GE), Methane Conversion Rate ($Y_m$)) was used. It is assumed that Swiss conditions are very similar to Austrian conditions.

$Y_m$: 0.16%

*GE*: 1.80 MJ/head/yr

Swiss data on energy intake (see Swiss NIR 2008) are taken from (SBV 2007). The Ym value is based on an in vivo trial with broilers (HADORN & WENK 1996).

Activity data were obtained from national statistics and are presented in Table 142 and Table 143.

### 6.2.3 Uncertainties

Uncertainties are presented in Table 138.

### 6.2.4 Recalculations

In the submission 2009 revised Swiss values on gross energy intake (GE) and methane conversion rate (Ym) were applied. The new values were obtained from the National Inventory Report of Switzerland 2008. Following the Swiss NIR, data on energy intake are taken from (SBV 2007). The Ym value is based on an in vivo trial with broilers (HADORN & WENK 1996).

The revision results in 50% higher $CH_4$ emissions from 1990-2007.

### 6.2.5 Planned Improvements

From 2005 to 2007 a comprehensive investigation of Austria's agricultural practice was carried out (AMON et al 2007). It is planned to use the updated figures to prepare the Austrian Greenhouse Gas Emission Inventory, submission 2010.

## 6.3 Manure management (CRF category 4.B)

This chapter describes the estimation of $CH_4$ and $N_2O$ emissions from animal manure. In 2007 21.5% of the agricultural $CH_4$ emissions and 22.9% of the agricultural $N_2O$ emissions were caused by this category.

### 6.3.1 Source Category Description

From 1990 to 2007 $CH_4$ emissions from manure management decreased by 16.5% to 42.2 Gg. This is mainly due a decrease of the livestock categories cattle and swine.

*Table 152: $CH_4$ emissions from manure management 1990–2007.*

| | $CH_4$ emissions from manure management [Gg] | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Livestock categories | | | | | | | | |
| | **4.B Total** | **4.B.1.a Dairy** | **4.B.1.b Non Dairy** | **4.B.3 Sheep** | **4.B.4 Goats** | **4.B.6 Horses** | **4.B.8 Swine** | **4.B.9 Poultry** | **4.B.10 Other/ Deer** |
| 1990 | 50.49 | 17.60 | 10.36 | 0.06 | 0.00 | 0.07 | 21.32 | 1.08 | 0.01 |
| 1991 | 49.78 | 17.07 | 10.40 | 0.06 | 0.00 | 0.08 | 21.03 | 1.12 | 0.01 |
| 1992 | 49.02 | 16.42 | 9.86 | 0.06 | 0.00 | 0.09 | 21.50 | 1.07 | 0.01 |
| 1993 | 49.39 | 16.19 | 9.83 | 0.06 | 0.01 | 0.09 | 22.08 | 1.13 | 0.01 |
| 1994 | 48.86 | 15.89 | 9.93 | 0.07 | 0.01 | 0.09 | 21.77 | 1.11 | 0.01 |
| 1995 | 48.48 | 13.91 | 11.47 | 0.07 | 0.01 | 0.10 | 21.83 | 1.09 | 0.01 |
| 1996 | 47.55 | 13.76 | 11.28 | 0.07 | 0.01 | 0.10 | 21.31 | 1.01 | 0.01 |
| 1997 | 47.48 | 14.23 | 10.55 | 0.07 | 0.01 | 0.10 | 21.35 | 1.15 | 0.01 |
| 1998 | 47.94 | 14.43 | 10.19 | 0.07 | 0.01 | 0.10 | 22.02 | 1.12 | 0.01 |
| 1999 | 45.47 | 13.85 | 10.46 | 0.07 | 0.01 | 0.11 | 19.84 | 1.13 | 0.01 |
| 2000 | 44.23 | 12.38 | 11.49 | 0.06 | 0.01 | 0.11 | 19.25 | 0.92 | 0.01 |
| 2001 | 44.46 | 11.98 | 11.19 | 0.06 | 0.01 | 0.11 | 20.12 | 0.98 | 0.01 |
| 2002 | 43.05 | 11.86 | 10.82 | 0.06 | 0.01 | 0.11 | 19.20 | 0.98 | 0.01 |
| 2003 | 43.15 | 11.26 | 11.13 | 0.06 | 0.01 | 0.12 | 19.54 | 1.02 | 0.01 |
| 2004 | 41.81 | 10.88 | 11.37 | 0.06 | 0.01 | 0.12 | 18.35 | 1.02 | 0.01 |
| 2005 | 41.91 | 10.83 | 10.97 | 0.06 | 0.01 | 0.12 | 18.90 | 1.02 | 0.01 |
| 2006 | 41.66 | 10.72 | 10.92 | 0.06 | 0.01 | 0.12 | 18.81 | 1.02 | 0.01 |
| 2007 | 42.17 | 10.68 | 10.87 | 0.07 | 0.01 | 0.12 | 19.40 | 1.02 | 0.01 |
| *Share 2007* | *100%* | 25.7% | 26.2% | 0.1% | 0.0% | 0.3% | 45.1% | 2.4% | 0.0% |
| *Trend 1990–2007* | *-16.5%* | -39.3% | 4.9% | 13.4% | 62.0% | 77.0% | -9.0% | -5.7% | 11.0% |

From 1990 to 2007 the $N_2O$ emissions from manure management decreased by 12.7% to 2.8 Gg. Emissions of cattle dominate the trend. The reduction of diary cows is partly counterbalanced by an increase in emissions per animal (because of the increasing gross energy intake, milk production and N excretion of diary cattle since 1990).

*Table 153: $N_2O$ Emissions from manure management 1990–2007.*

| | **$N_2O$ emissions from manure management [Gg]** | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | **Livestock categories** | | | | | | | | |
| | **4.B** | **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.10** |
| | **Total** | **Dairy** | **Non Dairy** | **Sheep** | **Goats** | **Horses** | **Swine** | **Poultry** | **Other/ Deer** |
| 1990 | 3.24 | 1.55 | 1.38 | 0.01 | 0.00 | 0.00 | 0.25 | 0.05 | 0.00 |
| 1991 | 3.20 | 1.52 | 1.37 | 0.01 | 0.00 | 0.00 | 0.25 | 0.06 | 0.00 |
| 1992 | 3.08 | 1.47 | 1.30 | 0.01 | 0.00 | 0.00 | 0.25 | 0.05 | 0.00 |
| 1993 | 3.09 | 1.46 | 1.31 | 0.01 | 0.00 | 0.00 | 0.26 | 0.06 | 0.00 |
| 1994 | 3.09 | 1.44 | 1.33 | 0.01 | 0.00 | 0.00 | 0.26 | 0.06 | 0.00 |
| 1995 | 3.16 | 1.33 | 1.50 | 0.01 | 0.00 | 0.00 | 0.26 | 0.05 | 0.00 |
| 1996 | 3.10 | 1.32 | 1.47 | 0.01 | 0.00 | 0.00 | 0.25 | 0.05 | 0.00 |
| 1997 | 3.07 | 1.38 | 1.36 | 0.01 | 0.00 | 0.00 | 0.25 | 0.06 | 0.00 |
| 1998 | 3.06 | 1.42 | 1.32 | 0.01 | 0.00 | 0.00 | 0.26 | 0.06 | 0.00 |
| 1999 | 3.02 | 1.38 | 1.34 | 0.01 | 0.00 | 0.00 | 0.23 | 0.06 | 0.00 |
| 2000 | 2.98 | 1.24 | 1.45 | 0.01 | 0.00 | 0.00 | 0.23 | 0.05 | 0.00 |
| 2001 | 2.95 | 1.22 | 1.44 | 0.01 | 0.00 | 0.00 | 0.24 | 0.05 | 0.00 |
| 2002 | 2.89 | 1.21 | 1.40 | 0.01 | 0.00 | 0.00 | 0.23 | 0.05 | 0.00 |
| 2003 | 2.87 | 1.17 | 1.41 | 0.01 | 0.00 | 0.00 | 0.23 | 0.05 | 0.00 |
| 2004 | 2.86 | 1.14 | 1.44 | 0.01 | 0.00 | 0.00 | 0.22 | 0.05 | 0.00 |
| 2005 | 2.83 | 1.13 | 1.41 | 0.01 | 0.00 | 0.00 | 0.22 | 0.05 | 0.00 |
| 2006 | 2.82 | 1.13 | 1.41 | 0.01 | 0.00 | 0.00 | 0.22 | 0.05 | 0.00 |
| 2007 | 2.83 | 1.13 | 1.41 | 0.01 | 0.00 | 0.00 | 0.23 | 0.05 | 0.00 |
| *Share 2007* | *100%* | 40.1% | 49.8% | 0.2% | 0.0% | 0.0% | 8.1% | 1.8% | 0.0% |
| *Trend 90–07* | *-12.7%* | -13.2% | -27.0% | 2.4% | 13.4% | 62.0% | 77.0% | -9.3% | -5.5% |

## 6.3.2 Methodological Issues

The IPPC-Tier 2 methodology is applied to estimate $CH_4$ emissions from manure management of cattle and swine as these are key sources. This method requires detailed information on animal characteristics and the manner in which manure is managed. sheep, goats, horses and other soliped, chicken, other poultry and other animals are of minor importance in Austria, therefore the $CH_4$ emissions of these livestock categories are estimated with the Tier 1 approach.

For the estimation of $N_2O$ emissions a Tier 1 methodology is used. $N_2O$ emissions are calculated on the basis of N excretion per animal and waste management system.

Data on the distribution of Austria's manure management system were taken from (KONRAD 1995). In this study data on existing Austrian conditions were derived from a research survey carried out on 720 randomly-chosen agricultural enterprises in the years 1989–1992.

**Activity data**

(STATISTIK AUSTRIA 2007) provides national data of annual livestock numbers on a very detailed level (see Table 142 and Table 143).These data are basis for the estimation.

The animal numbers of *Young Swine* were not taken into account because the emission factors for breeding sows already includes nursery and growing pigs (SCHECHTNER 1991).

### 6.3.2.1 Estimation of $CH_4$ Emissions

$CH_4$ emissions of cattle and swine are estimated with the Tier 2 approach. This method requires detailed information on animal characteristics and the manner in which manure is managed. The following formula has been used (GPG, Equation 4.17):

$$EF_i = VS_i * 365 [days\ yr^{-1}] * B_{0i} * 0.67 [kg\ m^{-3}] * \Sigma_{jK}\ MCF_{jK} * MS\%_{ijK}$$

$EF_i$ = annual emission factor (kg) for animal type i (e.g. dairy cows)

$VS_i$ = Average daily volatile solids excreted (kg) for animal type i

$B_{0i}$ = maximum methane producing capacity (m³ per kg of VS) for manure produced by animal type I

$MCF_{jK}$ = methane conversion factors for each manure management system j by climate region K

$MS\%_{ijK}$ = fraction of animal type i`s manure handled using manure systems j in climate region K

**Cattle (4.B.1)**

*Key Source: Yes ($CH_4$, $N_2O$)*

*$B_{0i}$ Values*

IPCC default values were used (Appendix B, IPCC Guidelines, Reference Manual)

*MCF Values*

The default MCF values for 'cool climate regions' presented in the IPCC Guidelines' Reference Manual (table 4-8) were used. For liquid systems the revised GPG default value of 39% was applied.

According the guidelines, cool climates have an average temperature below 15°C. The average temperature in Austria varies from 8.4°C in Klagenfurt to 10.5°C in Vienna (ZAMG, Jahrbuch 2004).

*Manure management systems*

In Austria national statistics on manure management systems are not available. Inventory data is based on a comprehensive survey carried out by (KONRAD 1995). The manure management system distribution is used for the whole period from 1990–2007 (see Table 154).

*Table 154:Manure Management System distribution in Austria: Cattle.*

| 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[2)] | 61.85[2)] | 26.2[2)] |
| cattle < 1 year | 28.75[1)] | 71.25[1)] | – |
| non dairy cattle > 2 years | 48.6[1)] | 51.4[1)] | – |

1) *"Die Rinder-, Schweine- und Legehennenhaltung in Österreich aus ethologischer Sicht" (KONRAD 1995)*

2) *Estimation of Dipl.-Ing. Alfred Pöllinger (Federal Research Institute, Gumpenstein) following (KONRAD 1995)*

MMS are distinguished for dairy cattle, suckling cows and cattle 1–2 years in "summer situation" and "winter situation" (Table 154). 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 (AMON et al. 2002).

*VS Values*

Austrian specific values for dairy cows are calculated in dependency of annual milk yields and corresponding feed intake data (gross energy intake, feed digestibility, ash content, see Table 146 and Table 155). Within the revision of Austrian N excretion values (following a recommondation of the Centralized Review 2005) in the year 2005 energy intake data and VS excretion data of *dairy* and *suckling cows* were recalculated (PÖTSCH 2005 following GRUBER & STEINWIDDER 1996).

*Table 155:VS excretion of Austrian dairy cattle (PÖTSCH 2005 following GRUBER & STEINWIDDER 1996).*

| Milk yield | [kg/yr] | 3 000 | 3 500 | 4 000 | 4 500 | 5 000 | 5 500 | 6 000 |
|---|---|---|---|---|---|---|---|---|
| GE intake | [MJ/day] | 235.32 | 242.55 | 249.77 | 259.23 | 268.68 | 280.72 | 292.32 |
| feed digestibility | [%] | 65.7 | 66.0 | 66.3 | 67.3 | 68.2 | 69.1 | 70.0 |
| ash content | [%] | 11 | 11 | 11 | 11 | 11 | 11 | 11 |
| VS excretion | [kg $cow^{-1}day^{-1}$] | 3.90 | 3.98 | 4.06 | 4.09 | 4.12 | 4.18 | 4.23 |

A time series of VS excretion of dairy cattle was calculated by interpolation of these data (see Table 156).

For the calculation of VS excretion of suckling cows for the years 1990–2007 an average milk yield of 3 000 kg was applied (see Table 155). As already mentioned in Chapter 6.2 data is based on several Austrian and Swiss studies (STEINWENDER & GOLD 1989, GRABNER et al. 2004, STEINWIDDER et al. 2006 and HEIM, P. 2005).

*Table 156:VS excretion of Austrian diary cows for the period 1990–2007.*

| Year | Milk Yield | VS |
|---|---|---|
| | [kg/cow*yr] | [kg/cow*day] |
| 1990 | 3 791 | 4.04 |
| 1991 | 3 862 | 4.05 |
| 1992 | 3 934 | 4.05 |
| 1993 | 4 005 | 4.06 |
| 1994 | 4 076 | 4.07 |
| 1995 | 4 619[1)] | 4.09 |
| 1996 | 4 670 | 4.10 |
| 1997 | 4 787 | 4.11 |
| 1998 | 4 924 | 4.11 |
| 1999 | 5 062 | 4.12 |
| 2000 | 5 210 | 4.14 |
| 2001 | 5 394 | 4.16 |
| 2002 | 5 487 | 4.18 |
| 2003 | 5 638 | 4.19 |
| 2004 | 5 802 | 4.20 |
| 2005 | 5 783 | 4.21 |
| 2006 | 5 903 | 4.22 |
| 2007 | 5 997 | 4.23 |

1) *From 1995 onwards data have been revised by Statistik Austria.*

Austrian specific values on VS excretion for all other cattle categories were calculated from typical Austrian diets under organic and conventional management (according to Andreas Steinwidder, see Table 148).

As no major changes in diets of *Non-Dairy Cattle* occurred in the period from 1990–2007, methane emissions from manure management of *Non-Dairy Cattle* are calculated with a constant gross energy intake and thus constant VS excretion rate for the whole time series.

The VS excretion rate was calculated from feed intake following the formula presented in the IPCC guidelines (Reference Manual, Equation 4.15):

$$VS\ [kg\ dm\ day^{-1}] = Intake\ [MJ\ day^{-1}] * (1kg\ (18.45\ MJ)^{-1}) * (1- DE\%/100) * (1- ASH\%/100)$$

*VS* = *VS excretion per day on a dry weight basis*

*Dm* = *dry matter*

*Intake* = *daily average gross energy feed intake [MJ day$^{-1}$]*

*DE%* = *digestibility of feed in per cent*

*ASH%* = *ash content of manure in per cent*

Table 157 presents data for the calculation of VS excretion of the livestock categories *Non-Dairy Cattle*.

*Table 157:Austrian VS excretion rates of non-dairy cattle, conventional and organic production system.*

| | cattle < 1 year | | cattle 1–2 years | | n.-dairy cattle > 2 years | |
|---|---|---|---|---|---|---|
| | **Conv.** | **Org.** | **Conv.** | **Org.** | **Conv.** | **Org.** |
| feed digestibility [%] | 76 | 75 | 73 | 73 | 73 | 73 |
| ash content [%] | 12.0 | 12.0 | 11.5 | 11.5 | 11.0 | 11.0 |
| Gross energy intake [MJ GE (kg dry matter)$^{-1}$] | 84.36 | 72.06 | 166.96 | 151.14 | 163.44 | 159.93 |
| VS excretion [kg head$^{-1}$ day$^{-1}$] | 0.97 | 0.86 | 2.16 | 1.96 | 2.13 | 2.08 |

The VS values of organic systems are not significantly different from those of the conventional systems. Uncertainty is estimated to be ± 20%.

**Swine (4.B.8)**

*Key Source: Yes ($CH_4$)*

*$B_0$ and MCF Values*

IPCC default values were used.

*Manure management System*

The comprehensive survey carried out by (KONRAD 1995) already mentioned above was used.

*Table 158:Manure management distribution in Austria: Swine.*

| **Livestock category** | **Liquid/Slurry [%]** | **Solid Storage [%]** | **Pasture/ range/paddock [%]** |
|---|---|---|---|
| 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)] *Expert estimation of Dipl.-Ing. Alfred Pöllinger (Federal Research Institute, Gumpenstein)*

*VS excretion*

VS excretion of *Swine* was estimated from country-specific data on VS content in the manure (SCHECHTNER 1991). Changes in animal performance of *Swine* are not reported for Austria. Thus, VS excretion rates of *Swine* were kept constant for the whole time series.

*Table 159:VS excretion from Austrian swine, calculated with (SCHECHTNER 1991).*

| Livestock category | Manure Production given in Schechtner (1991) | Calculated manure production [t head$^{-1}$ yr$^{-1}$] | VS content in manure [kg (t manure)$^{-1}$] | VS excretion [kg head$^{-1}$ day$^{-1}$] |
|---|---|---|---|---|
| breeding sows | 4 t sow$^{-1}$yr$^{-1}$ | 4.00 | 75 | 0.82 |
| fattening pigs | 0.63 t pig$^{-1}$ 120 days$^{-1}$ | 1.92 | 55 | 0.29 |

Animal numbers of *Young Swine* were not taken into account because the emission factors for *Breeding Sows* already include nursery and growing pigs (SCHECHTNER 1991).

**Sheep (4.B.3), goats (4.B.4), horses (4.B.6), poultry (4.B.9) and 'Other' (deer) (4.B.10)**

*Key Source: No*

$CH_4$ emissions from manure management for sheep, goats, horses, poultry and 'Other' (deer) are estimated with the Tier 1 approach.

Default emission factors were taken from the IPCC guidelines (Table 4-5 of the Reference Manual). $CH_4$ emissions were estimated multiplying these emission factors by national animal numbers.

*Table 160:$CH_4$ emissions from manure management systems for sheep, goats, horses and other soliped, chicken,other poultry and 'Other' (deer) in Austria.*

| Livestock category | Emission Factor [kg $CH_4$ per head per yr] | Livestock category | Emission Factor [kg $CH_4$ per head per yr] |
|---|---|---|---|
| Sheep | 0.19 | Chicken | 0.078 |
| Goats | 0.12 | Other Poultry[1)] | 0.078 |
| Horses & other soliped | 1.39 | Other Livestock/Deer | 0.19 |

[1)] *the IPCC guidelines do not differentiate between laying hens and other poultry. The same emission factor was applied to both livestock categories.*

The Austrian inventory does not distinguish between horses and mules and asses. As mules and asses are only of very little importance in Austria, $CH_4$ emissions from manure of horses and other soliped were estimated with the default emission factors for Horses.

In Austria the animal category 'Other' corresponds to deer (held in pastures). As sheep is the most similar animal category to deer, emissions from deer were estimated applying the default emission factor of sheep.

### 6.3.2.2 Estimation of $N_2O$ Emissions

*Key Source: 4.B.1*

Following the guidelines, all emissions of $N_2O$ taking place before the manure is applied to soils are reported under manure management.

For the estimation of $N_2O$ emissions from manure management systems only a Tier 1 approach is available. The IPCC Guidelines method for estimating $N_2O$ emissions from manure management entails multiplying the total amount of N excretion (from all animal species/categories) in each type of manure management system by an emission factor for that type of manure management system. Emissions are then summed over all manure management systems (see formulas below).

N excretion per animal waste management system:

$$Nex_{(AWMS)} = \sum_{(T)}[N_{(T)} \times Nex_{(T)} \times AWMS_{(T)}]$$

| | |
|---|---|
| $Nex_{(AWMS)}$ | = *N excretion per animal waste management system [kg yr$^{-1}$]* |
| $N_{(T)}$ | = *number of animals of type T in the country* |
| $Nex_{(T)}$ | = *N excretion of animals of type T in the country [kg N animal$^{-1}$ yr$^{-1}$]* |
| $AWMS_{(T)}$ | = *fraction of $Nex_{(T)}$ that is managed in one of the different distinguished animal waste management systems for animals of type T in the country* |
| $T$ | = *type of animal category* |

$N_2O$ emission per animal waste management system:

$$N_2O_{(AWMS)} = \sum[Nex_{(AWMS)} \times EF_{3(AWMS)}]$$

*$N_2O_{(AWMS)}$ = $N_2O$ emissions from all animal waste management systems in the country [kg N yr$^{-1}$]*

*$Nex_{(AWMS)}$ = N excretion per animal waste management system [kg yr$^{-1}$]*

*$EF_{3(AWMS)}$ = $N_2O$ emissions factor for an AWMS [kg $N_2O$-N per kg of Nex in AWMS]*

### *AWMS*

The animal waste management system distribution data applied to estimate $N_2O$ emissions from *Manure Management* is the same as used for the estimation of $CH_4$ emissions from *Manure Management* (see Table 154 and Table 158).

### *N excretion*

As recommended in the Centralized Review 2004, in the year 2005 Austrian N excretion values were reviewed and recalculated. The revised values consider the typical agricultural practice in Austria. Especially N excretion rates of dairy and suckling cows are higher now (see Table 161):

*Table 161:Austria specific N excretion values of dairy cows for the period 1990–2007.*

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

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

N excretion values as shown in Table 161 and Table 162 are based on the following literature: (GRUBER & PÖTSCH 2006, PÖTSCH et al. 2005, STEINWIDDER & GUGGENBERGER 2003, UNTERARBEITSGRUPPE N-ADHOC 2004 and ZAR 2004).

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

*Cattle:* Feed rations represent data of 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 162:Austria specific N excretion values of other livestock categories.*

| **Livestock category** | ***Nitrogen excretion* [kg/animal*yr]** |
|---|---|
| suckling cows[1)] | 69.5 |
| cattle 1–2 years | 53.6 |
| cattle < 1 year | 25.7 |
| cattle > 2 years | 68.4 |
| breeding sows | 29.1 |
| fattening pigs | 10.3 |
| sheep | 13.1 |
| goats | 12.3 |
| horses | 47.9 |
| chicken[2)] | 0.52 |
| other poultry[3)] | 1.1 |
| other livestock/ deer[4)] | 13.1 |

1) *annual milk yield: 3 000 kg*

2) *weighted average of hens and broilers*

3) *weighted average of turkeys and other (ducks, gooses)*

4) *N-ex value of sheep applied*

Livestock numbers per category can be found in Table 142 and Table 143, manure management system distribution for cattle and swine can be found in Table 154 and Table 158. For the other livestock categories the IPCC default values for western Europe have been taken (see Table 163).

*Table 163: Distribution of manure management systems following IPCC 1997, Table 4-21 'Western Europe', applied for sheep, goats, horses, poultry and 'Other'.*

| Livestock category | Liquid/Slurry [%] | Solid Storage [%] | Pasture/range/ paddock [%] | Other Management System [%] |
|---|---|---|---|---|
| Sheep | 0 | 2 | 87 | 11 |
| Goats | 0 | 0 | 96 | 4 |
| Horses | 0 | 0 | 96 | 4 |
| Poultry (Chicken and Other Poultry) | 13 | 1 | 2 | 84 |
| Other Animals | 0 | 0 | 96 | 4 |

**Emission factors**

Emission factors for animal waste management systems *Liquid/Slurry*, *Solid Storage*, *Pasture/Range/Paddock* and *Other Systems* were taken from the IPCC guidelines (IPCC GUIDELINES 1997, REFERENCE MANUAL, Table 4-22).

*Table 164:IPCC default values for $N_2O$ emission factors from animal waste per animal waste management system.*

| Animal Waste Management System | Emission factor [kg $N_2O$-N per kg N excreted] |
|---|---|
| Liquid/Slurry | 0.001 |
| Solid Storage | 0.020 |
| Pasture/Range/Paddock | 0.020 |
| Other Systems | 0.005 |

## 6.3.3 Uncertainties

Uncertainties are presented in Table 138.

## 6.3.4 Recalculations

No recalculations have been done.

## 6.3.5 Planned Improvements

From 2005 to 2007 a comprehensive investigation of Austria's agricultural practice was carried out (AMON et al 2007). It is planned to use the updated figures to prepare the Austrian Greenhouse Gas Emission Inventory, submission 2010.

## 6.4 Agricultural soils (CRF category 4.D)

### 6.4.1 Source Category Description

$N_2O$ emissions from the source categories 4.D.1 direct soil emissions, 4.D.2 pasture, range and paddock manure and 4.D.3 indirect soil emissions are a key source.

In 2007 77.1% of total $N_2O$ emissions from agriculture (55.1% of total Austrian $N_2O$ emissions) originated from agricultural soils, the rest originates from manure management and a very small share from field burning of agricultural residues.

Emissions from this category ($N_2O$ and $CH_4$) contributed 3.4% (2 969.96 Gg $CO_2$ equivalents) to Austria's total greenhouse gas emissions in the year 2007. This is 37.4% of total GHG emissions of the sector agriculture.

The trend of $N_2O$ emissions from this category is decreasing: in 2007 emissions were 11.2% below 1990 levels.

Table 165 presents $N_2O$ emissions of agricultural soils by sub-category as well as their trends and their share in total $N_2O$ emissions.

*Table 165: $N_2O$ emissions from agricultural soils, 1990–2007.*

| | $N_2O$ emissions [Gg] | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Year** | **4 D Total** | **4 D 1 Direct Soil Emissions** | **Synthetic Fertilisers** | **Organic Fertiliser** | **Crop Residue** | **N-fixing Crops** | **Sewage Sludge** | **4 D 2 Pasture** | **4 D 3 Indir. Soil Emissions** | **Nitrogen Leaching** | **Athm. Deposition** |
| 1990 | 10.75 | 5.82 | 2.62 | 2.28 | 0.57 | 0.33 | 0.02 | 0.70 | 4.22 | 3.56 | 0.67 |
| 1991 | 11.60 | 6.38 | 3.07 | 2.27 | 0.65 | 0.36 | 0.02 | 0.72 | 4.50 | 3.84 | 0.66 |
| 1992 | 10.73 | 5.91 | 2.60 | 2.20 | 0.63 | 0.46 | 0.02 | 0.70 | 4.12 | 3.48 | 0.64 |
| 1993 | 9.94 | 5.39 | 2.05 | 2.22 | 0.64 | 0.45 | 0.03 | 0.74 | 3.81 | 3.19 | 0.62 |
| 1994 | 11.53 | 6.47 | 2.88 | 2.22 | 0.89 | 0.45 | 0.03 | 0.74 | 4.32 | 3.69 | 0.63 |
| 1995 | 11.74 | 6.56 | 2.92 | 2.26 | 1.04 | 0.32 | 0.03 | 0.77 | 4.40 | 3.76 | 0.64 |
| 1996 | 10.50 | 5.69 | 2.42 | 2.22 | 0.68 | 0.34 | 0.03 | 0.77 | 4.04 | 3.42 | 0.62 |
| 1997 | 10.65 | 5.84 | 2.45 | 2.23 | 0.72 | 0.40 | 0.03 | 0.77 | 4.05 | 3.45 | 0.60 |
| 1998 | 10.73 | 5.92 | 2.47 | 2.22 | 0.77 | 0.43 | 0.03 | 0.75 | 4.06 | 3.45 | 0.62 |
| 1999 | 10.52 | 5.83 | 2.35 | 2.18 | 0.87 | 0.39 | 0.03 | 0.75 | 3.94 | 3.35 | 0.60 |
| 2000 | 10.07 | 5.48 | 2.30 | 2.12 | 0.65 | 0.37 | 0.03 | 0.73 | 3.86 | 3.26 | 0.60 |
| 2001 | 10.07 | 5.52 | 2.28 | 2.11 | 0.74 | 0.36 | 0.03 | 0.72 | 3.83 | 3.24 | 0.59 |
| 2002 | 10.03 | 5.52 | 2.34 | 2.06 | 0.71 | 0.38 | 0.03 | 0.70 | 3.81 | 3.23 | 0.58 |
| 2003 | 9.56 | 5.17 | 2.12 | 2.07 | 0.57 | 0.39 | 0.03 | 0.71 | 3.67 | 3.10 | 0.57 |
| 2004 | 9.21 | 5.01 | 1.86 | 2.05 | 0.67 | 0.40 | 0.03 | 0.71 | 3.49 | 2.93 | 0.56 |
| 2005 | 9.25 | 5.04 | 1.90 | 2.03 | 0.65 | 0.42 | 0.03 | 0.71 | 3.51 | 2.95 | 0.56 |
| 2006 | 9.42 | 5.19 | 1.93 | 2.02 | 0.76 | 0.45 | 0.03 | 0.70 | 3.52 | 2.96 | 0.57 |
| 2007 | 9.55 | 5.27 | 1.96 | 2.05 | 0.79 | 0.44 | 0.03 | 0.72 | 3.56 | 3.00 | 0.56 |
| *Share 2007* | *100%* | *55.2%* | *20.5%* | *21.4%* | *8.3%* | *4.7%* | *0.3%* | *7.5%* | *37.3%* | *31.4%* | *5.9%* |
| *Trend 1990–2007* | *-11.2%* | *-9.5%* | *-25.3%* | *-10.1%* | *37.8%* | *34.5%* | *28.4%* | *2.1%* | *-15.6%* | *-15.6%* | *-15.8%* |

$CH_4$ emissions from agricultural soils originate from sewage sludge spreading on agricultural soils. They contribute only a negligible part of Austria's total methane emissions (0.1% or 0.42 Gg $CH_4$ 2007). This is about 0.2% of total $CH_4$ from the agriculture sector.

*Table 166: $CH_4$ emissions from agricultural soils, 1990–2007.*

| | $CH_4$ emissions [Gg] IPCC Category | |
|---|---|---|
| **Year** | **4.D total** | **Other direct emissions (sewage sludge)** |
| 1990 | 0.33 | 0.33 |
| 1991 | 0.33 | 0.33 |
| 1992 | 0.31 | 0.31 |
| 1993 | 0.47 | 0.47 |
| 1994 | 0.40 | 0.40 |
| 1995 | 0.44 | 0.44 |
| 1996 | 0.45 | 0.45 |
| 1997 | 0.45 | 0.45 |
| 1998 | 0.45 | 0.45 |
| 1999 | 0.45 | 0.45 |
| 2000 | 0.45 | 0.45 |
| 2001 | 0.43 | 0.43 |
| 2002 | 0.38 | 0.38 |
| 2003 | 0.41 | 0.41 |
| 2004 | 0.37 | 0.37 |
| 2005 | 0.37 | 0.37 |
| 2006 | 0.41 | 0.41 |
| 2007 | 0.42 | 0.42 |
| *Share 2007* | *100.0%* | *100.0%* |
| *Trend 1990–2007* | *28.4%* | *28.4%* |

## 6.4.2 Methodological Issues

The IPCC Tier 1a and – where applicable – Tier 1b method was applied and IPCC default emission factors were used.

*Table 167: $N_2O$ emissions factors for agricultural soils.*

| Category | Emission Factor [t $N_2O$-N/t N] | Source |
|---|---|---|
| **4.D.1 Direct Soil Emissions** | | |
| Synthetic fertilizers (mineral fert.) | 0.0125 | IPCC GPG (Table 4.17) |
| Animal waste applied to soils | | |
| N-fixing crops | | |
| Crop residue | | |
| Sewage sludge spreading | | |

| Category | Emission Factor [t $N_2O$-N/t N] | Source |
|---|---|---|
| **4.D.2 Pasture, range and paddock manure** | | |
| Grazing animals | 0.02/ t $N_{exGRAZ}$ | IPCC Guidelines (Table 4.22) |
| **4.D.3 Indirect soil emissions** | | |
| Athmospheric deposition | 0.01/ t of volatized nitrogen | IPCC GPG (Table 4.18) |
| Nitrogen leaching (and run-off) | 0.0025/ t N-loss by leaching | IPCC GPG (Table 4.18) |

For agricultural sewage sludge application on fields also $CH_4$ emissions were estimated (country specific method).

### Activity Data

Data for necessary input parameters (activity data) were taken from the following sources:

*Table 168:Data sources for nitrogen input to agricultural soils.*

| Category | Data Sources |
|---|---|
| **4.D.1 Direct soil emissions** | |
| Synthetic fertilizers (mineral fert.) | Mineral fertilizer consumption: Grüne Berichte (BMLFUW 2000-2008) [1) ]; urea application in Austria: expert judgement based on sales data (RWA 2008) [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 2000-2008) [1)] |
| Crop residue | Harvested amount of agricultural crops: (BMLFUW 2000-2008) [1)] |
| Sewage sludge spreading | Water Quality Report 2000 (PHILIPPITSCH et al. 2001), Report on sewage sludge (UMWELTBUNDESAMT 1997), Austrian report on water pollution control (GEWÄSSERSCHUTZBERICHT 2002), National Austrian Waste Water Database, data query November 2008 (UMWELTBUNDESAMT 2008b) |
| **4.D.2 Pasture, range and paddock manure** | |
| Grazing Animals | Calculations within source category 4.B are based on (AMON et al. 2002) |
| **4.D.3 Indirect soil emissions** | |
| Athmospheric deposition | The amount of manure left for spreading was calculated within source category 4.B following (AMON et al. 2002). Mineral fertilizer data: (BMLFUW 2000-2008) |
| Nitrogen leaching (and Run-off) | see above (synthetic fertilizers, animal waste, sewage sludge) |

*1) http://www.gruenerbericht.at and http://www.awi.bmlf.gv.at*

*2) RWA: Raiffeisen Ware Austria*

*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 S & A report 2004 noticed high inter-annual variations in $N_2O$ emissions of sector 4.D mineral fertilizer use. These variations are caused by the effect of storage: Fertilizers have a high elasticity to prices. Sales data are changing very rapidly due to changing market prices. Not the whole amount purchased is applied in the year of purchase. The fertilizer tax intensivied this effect at the beginning of the 1990ies. Considering this effect, the arithmetic average of each two years is used as fertilizer application data.

In the in-country review 2007 it was recommended to consider revising the time series by determining actual fertilizer use in accordance with the IPCC good practice guidance. However, investigations showed that data on the actual fertilizer use are not available in Austria. Therefore it has been decided to continue to use the official fertilizer sales data as input data for the emission inventory. In the centralized review 2008 the use of fertilizer sales data was considered as an appropriate alternative (ARR 2008, para 50).

The time series for fertilizer consumption is presented in Table 169.

*Table 169:Mineral fertilizer N consumption in Austria 1990–2007 and arithmetic average of each two years.*

| Year | Annual Nutrient Sales Data [t N/yr] | of which Urea | Data Source | Weighted Nutrient Consumption [t N/yr] | Weighted Urea Consumption [t N/yr] |
|---|---|---|---|---|---|
| 1989 | 133 304 | 1 700 | FAO | | |
| 1990 | 140 379 | 3 965 | estimated, GB | 136 842 | 2 833 |
| 1991 | 180 388 | 3 965 | GB | 160 384 | 3 965 |
| 1992 | 91 154 | 3 886 | GB | 135 771 | 3 926 |
| 1993 | 123 634 | 3 478 | GB, RWA | 107 394 | 3 682 |
| 1994 | 177 266 | 4 917 | GB, RWA | 150 450 | 4 198 |
| 1995 | 128 000 | 5 198 | GB, RWA | 152 633 | 5 058 |
| 1996 | 125 300 | 4 600 | GB, RWA | 126 650 | 4 899 |
| 1997 | 131 800 | 6 440 | GB, RWA | 128 550 | 5 520 |
| 1998 | 127 500 | 6 440 | GB, RWA | 129 650 | 6 440 |
| 1999 | 119 500 | 6 808 | GB, RWA | 123 500 | 6 624 |
| 2000 | 121 600 | 3 848 | GB, RWA | 120 550 | 5 328 |
| 2001 | 117 100 | 3 329 | GB, RWA | 119 350 | 3 589 |
| 2002 | 127 600 | 4 470 | GB, RWA | 122 350 | 3 900 |
| 2003 | 94 400 | 6 506 | GB, RWA | 111 000 | 5 488 |
| 2004 | 100 800 | 7 293 | GB, RWA | 97 600 | 6 900 |
| 2005 | 99 700 | 7 673 | GB, RWA | 100 250 | 7 483 |
| 2006 | 103 700 | 11 310 | GB, RWA | 101 700 | 9 491 |
| 2007 | 103 300 | 11 500 | GB, RWA | 103 500 | 11 405 |

*GB: (BMLFUW 2000-2008): www.gruenerbericht.at*

*RWA: Raiffeisen Ware Austria, sales company*

Values of Table 169 differ from the numbers given in CRF table 4.D 'Nitrogen input from application of synthetic fertilizers'. In the CRF table 4.D $NH_3$-N and $NO_x$-N volatilisation losses occurring during fertilizer application are subtracted.

*Legume cropping areas*

The yearly numbers of the legume cropping areas were taken from official statistics (BMLFUW 2000-2008).

*Table 170: Cropped area legume production, 1990–2007.*

| | Areas [ha] | | | |
|---|---|---|---|---|
| **Year** | **peas** | **soja beans** | **horse/field beans** | **clover hey, lucerne, …** |
| 1990 | 40 619 | 9 271 | 13 131 | 57 875 |
| 1991 | 37 880 | 14 733 | 14 377 | 65 467 |
| 1992 | 43 706 | 52 795 | 14 014 | 64 379 |
| 1993 | 44 028 | 54 064 | 1 064 | 68 124 |
| 1994 | 38 839 | 46 632 | 10 081 | 72 388 |
| 1995 | 19 133 | 13 669 | 6 886 | 71 024 |
| 1996 | 30 782 | 13 315 | 4 574 | 72 052 |
| 1997 | 50 913 | 15 217 | 2 783 | 75 976 |
| 1998 | 58 637 | 20 031 | 2 043 | 76 245 |
| 1999 | 46 007 | 18 541 | 2 333 | 75 028 |
| 2000 | 41 114 | 15 537 | 2 952 | 74 266 |
| 2001 | 38 567 | 16 336 | 2 789 | 72 196 |
| 2002 | 41 605 | 13 995 | 3 415 | 75 429 |
| 2003 | 42 097 | 15 463 | 3 465 | 78 813 |
| 2004 | 39 320 | 17 864 | 2 835 | 83 349 |
| 2005 | 36 037 | 21 429 | 3 549 | 88 973 |
| 2006 | 32 652 | 25 013 | 4 555 | 97 549 |
| 2007 | 28 111 | 20 183 | 4 479 | 101 861 |

*Harvest Data*

Harvest data were taken from (BMLFUW 2000-2008) and the datapool of (BUNDESANSTALT FÜR AGRARWIRTSCHAFT 2008) and are presented in Table 171.

*Table 171: Harvest Data I, 1990–2007.*

| | Harvest [1 000 t] | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | **corn** | **wheat** | **rye** | **barley** | **oats** | **maize (corn)** | **potato** | **sugar beet** | **fodder beet** |
| 1990 | 5 290 | 1 404 | 396 | 1 521 | 244 | 1 620 | 794 | 2 494 | 171 |
| 1991 | 5 045 | 1 375 | 350 | 1 427 | 226 | 1 571 | 790 | 2 522 | 173 |
| 1992 | 4 323 | 1 325 | 278 | 1 342 | 185 | 1 118 | 738 | 2 605 | 119 |
| 1993 | 4 206 | 1 018 | 292 | 1 100 | 191 | 1 524 | 886 | 2 994 | 129 |
| 1994 | 4 436 | 1 255 | 319 | 1 184 | 172 | 1 421 | 594 | 2 561 | 103 |
| 1995 | 4 452 | 1 301 | 314 | 1 065 | 162 | 1 474 | 724 | 2 886 | 85 |
| 1996 | 4 493 | 1 240 | 156 | 1 083 | 153 | 1 736 | 769 | 3 131 | 62 |
| 1997 | 5 009 | 1 352 | 207 | 1 258 | 197 | 1 842 | 677 | 3 012 | 59 |
| 1998 | 4 771 | 1 342 | 236 | 1 212 | 164 | 1 646 | 647 | 3 314 | 72 |

| | Harvest [1 000 t] | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | corn | wheat | rye | barley | oats | maize (corn) | potato | sugar beet | fodder beet |
| 1999 | 4 806 | 1 416 | 218 | 1 153 | 152 | 1 700 | 712 | 3 217 | 70 |
| 2000 | 4 490 | 1 313 | 183 | 855 | 118 | 1 852 | 695 | 2 634 | 47 |
| 2001 | 4 827 | 1 508 | 214 | 1 012 | 128 | 1 771 | 695 | 2 773 | 43 |
| 2002 | 4 745 | 1 434 | 171 | 861 | 117 | 1 956 | 684 | 3 043 | 40 |
| 2003 | 4 246 | 1 191 | 133 | 882 | 129 | 1 708 | 560 | 2 485 | 33 |
| 2004 | 5 295 | 1 719 | 213 | 1 007 | 139 | 1 945 | 693 | 2 902 | 33 |
| 2005 | 4 880 | 1 453 | 164 | 880 | 128 | 2 021 | 763 | 3 133 | 17 |
| 2006 | 4 440 | 1 396 | 94 | 914 | 131 | 1 746 | 655 | 2 493 | 22 |
| 2007 | 4 732 | 1 399 | 189 | 811 | 99 | 1 995 | 669 | 2 739 | 15 |

*Table 172: Harvest Data II, 1990–2007.*

| | Harvest [1 000 t] | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Year | silo-green maize | clover-hey | rape | Sun-flower | soja bean | horse-/ fodder bean | peas | vege-tables | oil pumkin |
| 1990 | 4 289 | 717 | 102 | 57 | 18 | 41 | 145 | 273 | 3 |
| 1991 | 4 252 | 797 | 128 | 72 | 37 | 37 | 133 | 277 | 4 |
| 1992 | 3 523 | 587 | 126 | 79 | 81 | 31 | 137 | 227 | 4 |
| 1993 | 4 220 | 628 | 125 | 104 | 103 | 29 | 107 | 230 | 3 |
| 1994 | 4 152 | 743 | 217 | 92 | 105 | 27 | 134 | 246 | 3 |
| 1995 | 3 996 | 823 | 268 | 61 | 31 | 17 | 60 | 302 | 5 |
| 1996 | 3 918 | 858 | 121 | 44 | 27 | 10 | 93 | 297 | 8 |
| 1997 | 3 940 | 962 | 129 | 44 | 34 | 6 | 162 | 349 | 8 |
| 1998 | 3 865 | 1 014 | 128 | 57 | 51 | 5 | 178 | 313 | 11 |
| 1999 | 3 729 | 1 025 | 193 | 64 | 50 | 6 | 140 | 399 | 6 |
| 2000 | 3 531 | 1 440 | 125 | 55 | 33 | 7 | 97 | 361 | 6 |
| 2001 | 3 035 | 1 349 | 147 | 51 | 34 | 7 | 112 | 391 | 7 |
| 2002 | 3 285 | 1 395 | 129 | 58 | 35 | 9 | 96 | 406 | 9 |
| 2003 | 3 026 | 1 425 | 78 | 71 | 39 | 9 | 93 | 376 | 10 |
| 2004 | 3 374 | 1 474 | 121 | 78 | 45 | 8 | 122 | 414 | 5 |
| 2005 | 3 600 | 1 515 | 104 | 81 | 61 | 10 | 90 | 384 | 8 |
| 2006 | 3 546 | 1 635 | 137 | 85 | 65 | 12 | 90 | 392 | 11 |
| 2007 | 3 741 | 1 695 | 145 | 60 | 53 | 11 | 57 | 402 | 12 |

*Sewage sludge application on fields*

Agriculturally applied sewage sludge data were taken from Water Quality Report 2000 (PHILIPPITSCH et al. 2001), Report on sewage sludge (UMWELTBUNDESAMT 1997) and (GEWÄSSERSCHUTZBERICHT 2002). For 2001 to 2007 data from the National Austrian Waste Water Database operated by the Umweltbundesamt was used (data query November 2008, UMWELTBUNDESAMT 2008b).

The federal provinces (Bundesländer) Kärnten, Niederösterreich, Salzburg and Wien did not report 2007 data. For these Bundesländer the values of 2006 have been used for the year 2007. The federal provinces Steiermark and Tirol did not report 2006 data, therefore the 2005 data has been used for the years 2006 and 2007.

*Table 173: Amount of sewage sludge (dry matter) produced in Austria, 1990–2007.*

| Year | Total [t dm] | agriculturally applied [t dm] | agriculturally applied [%] |
|---|---|---|---|
| 1990 | 161 936 | 31 507 | 19.5 |
| 1991 | 161 936 | 31 507 | 19.5 |
| 1992 | 200 000 | 30 000 | 15.0 |
| 1993 | 300 000 | 45 000 | 15.0 |
| 1994 | 350 000 | 38 500 | 11.0 |
| 1995 | 390 500 | 42 400 | 10.9 |
| 1996 | 390 500 | 42 955 | 11.0 |
| 1997 | 390 500 | 42 955 | 11.0 |
| 1998 | 392 909 | 43 220 | 11.0 |
| 1999 | 392 909 | 43 220 | 11.0 |
| 2000 | 392 909 | 43 220 | 11.0 |
| 2001 | 398 800 | 41 600 | 10.4 |
| 2002 | 322 096 | 36 065 | 11.2 |
| 2003 | 315 130 | 39 186 | 12.4 |
| 2004 | 294 942 | 35 357 | 12.0 |
| 2005 | 290 110 | 35 541 | 12.3 |
| 2006 | 235 364 | 39 514 | 16.8 |
| 2007 | 235 633 | 40 546 | 17.2 |

#### 6.4.2.1 Direct soil emissions (4.D.1)

*Key Source: Yes ($N_2O$)*

Direct soil emissions is the most important sub-category of 4.D Agricultural Soils. 55.2% (5.3 Gg in 2007) of $N_2O$ emissions from agricultural soils arise from this sub-category (see Table 165).

$N_2O$ emissions from following sub-sources were estimated:

- *Synthetic fertilizers* (mineral fertilizers and urea)
- *Animal waste* (manure applied to soils)
- Biological *nitrogen fixation* through legumes
- *Incorporation of crop residues* after harvest
- Application of *sewage sludge* on agricultural soils

The nitrogen input is corrected for gaseous losses through volatilization of $NH_3$ and $NO_X$.

Nitrogen input from all sources is calculated using IPCC Tier 1a (GPG, equation 4.20/ 4.21) and the emission factor of 1.25% (IPCC GPG, p.4.54, 4.60). The calculation is described in the following subchapters. The conversion from $N_2O$-N to $N_2O$ emissions is performed by multiplication with (44/28).

This method estimates total direct $N_2O$ emissions, irrespective of type of soils, of land use (e.g. grassland and cropland soils) and of vegetation, irrespective of the nitrogen compounds (e.g. organic, inorganic nitrogen), and irrespective of climatic factors.

### Nitrogen input through application of synthetic (mineral) N fertilizers

The method applied for calculation of the emissions is IPCC Tier 1a (GPG, Equation 4.22):

$$F_{SN} = N_{FERT} * (1- Frac_{GASF})$$

*$F_{SN}$* = *Annual amount of synthetic fertilizer nitrogen applied on soils, corrected for volatile N-losses [t N]*

*$N_{FERT}$* = *Annual amount of nitrogen in synthetic fertilizers (mineral and urea) applied on soils [t N] – (see Table 169)*

*$Frac_{GASF}$* =*Fraction of nitrogen lost through gaseous emissions of $NH_3$ and $NO_x$ [t/t] – 0.023 for mineral fertilizers and 0.153 for urea fertilizers (EEA 1999) p.1 010–15, table 5.1.*

### Nitrogen input through application of animal manure

The method applied is IPCC Tier 1b but with Austria specific consideration of nitrogen losses ($NH_3$-N, $NO_x$-N, $N_2O$-N).

With regard to a comprehensive treatment of the nitrogen budged, Austria established a link between the ammonia and nitrous oxide emissions inventory. This procedure enables the use of country specific data, which is more accurate than the use of the default value for $Frac_{gasm}$.

According to the IPCC method nitrogen from manure that is used as a biofuel should be subtracted, but this is irrelevant for Austria because in Austria manure is not used as a biofuel at all.

*Nitrogen left for spreading*

After storage, manure is applied to agricultural soils. Manure application is connected with $NH_3$ and $N_2O$ losses that depend on the amount of manure N.

From total N excretion by Austrian livestock, the following losses were subtracted:

- N excreted during grazing
- $NH_3$-N losses from housing
- $NH_3$-N losses during manure storage
- $N_2O$-N losses from manure management
- The remaining N is applied to agricultural soils.

$NH_3$-N losses from housig and storage were calculated following the CORINAIR EMEP – methodology (detailed methodology for cattle and swine). This procedure enables the use of country specific data, which is more accurate than the use of the default value for $Frac_{gasm}$.

*Table 174: Animal manure left for spreading on agricultural soils per livestock category 1990–2007 (I).*

| year | Nitrogen left for spreading [Mg N per year] | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | IPCC Livestock Categories | | | | | | | |
| | total | dairy cattle | suckling cows | cattle 1–2 a | cattle < 1 a | cattle > 2 a | sows | fattening pigs |
| 1990 | 141 271 | 55 395 | 2 398 | 18 215 | 19 501 | 8 193 | 8 525 | 10 334 |
| 1991 | 140 940 | 54 007 | 2 924 | 18 041 | 18 846 | 8 468 | 8 409 | 10 194 |
| 1992 | 136 344 | 52 241 | 3 084 | 16 925 | 17 529 | 8 167 | 8 598 | 10 423 |
| 1993 | 137 847 | 51 741 | 3 535 | 18 609 | 14 872 | 8 845 | 8 829 | 10 704 |

| 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 |
| 1994 | 137 429 | 50 938 | 4 589 | 18 617 | 14 893 | 8 332 | 8 806 | 10 450 |
| 1995 | 140 023 | 47 098 | 10 733 | 18 330 | 14 575 | 8 570 | 8 952 | 10 364 |
| 1996 | 137 709 | 46 680 | 10 847 | 17 454 | 14 131 | 8 619 | 8 888 | 9 970 |
| 1997 | 138 091 | 48 733 | 8 697 | 16 711 | 13 297 | 9 054 | 8 868 | 10 021 |
| 1998 | 137 403 | 49 928 | 7 867 | 16 116 | 13 387 | 8 815 | 8 613 | 10 860 |
| 1999 | 134 901 | 48 424 | 9 010 | 15 860 | 13 292 | 8 924 | 7 666 | 9 878 |
| 2000 | 131 389 | 43 670 | 12 891 | 15 152 | 13 814 | 8 949 | 7 453 | 9 572 |
| 2001 | 130 720 | 42 762 | 13 143 | 14 802 | 13 889 | 8 293 | 7 808 | 9 985 |
| 2002 | 127 729 | 42 437 | 12 491 | 14 614 | 13 491 | 8 009 | 7 604 | 9 382 |
| 2003 | 128 189 | 40 726 | 12 397 | 14 490 | 13 525 | 9 144 | 7 454 | 9 823 |
| 2004 | 127 181 | 39 830 | 13 337 | 14 337 | 13 636 | 9 137 | 7 069 | 9 157 |
| 2005 | 125 892 | 39 433 | 13 792 | 14 171 | 13 246 | 7 900 | 7 040 | 9 667 |
| 2006 | 125 265 | 39 300 | 13 836 | 14 129 | 13 312 | 7 709 | 7 176 | 9 455 |
| 2007 | 126 670 | 39 428 | 13 836 | 14 196 | 13 365 | 7 460 | 7 098 | 10 053 |

*Table 175: Animal manure left for spreading on agricultural soils per livestock category 1990–2007 (II).*

| year | Nitrogen left for spreading [Mg N per year] | | | | | | |
|---|---|---|---|---|---|---|---|
| | IPCC Livestock Categories | | | | | | |
| | total | chicken | other poultry | sheep | goats | horses/ solipeds | other animals |
| 1990 | 141 271 | 8 100 | 1 057 | 5 909 | 712 | 2 225 | 708 |
| 1991 | 140 940 | 8 309 | 1 424 | 6 217 | 781 | 2 614 | 708 |
| 1992 | 136 344 | 7 935 | 1 259 | 5 948 | 752 | 2 776 | 708 |
| 1993 | 137 847 | 8 377 | 1 426 | 6 365 | 902 | 2 935 | 708 |
| 1994 | 137 429 | 8 178 | 1 416 | 6 523 | 949 | 3 018 | 720 |
| 1995 | 140 023 | 8 111 | 1 244 | 6 964 | 1 034 | 3 278 | 769 |
| 1996 | 137 709 | 7 530 | 1 186 | 7 261 | 1 039 | 3 311 | 792 |
| 1997 | 138 091 | 8 600 | 1 257 | 7 314 | 1 113 | 3 354 | 1 073 |
| 1998 | 137 403 | 8 347 | 1 189 | 6 879 | 1 035 | 3 407 | 961 |
| 1999 | 134 901 | 8 506 | 1 086 | 6 716 | 1 106 | 3 688 | 746 |
| 2000 | 131 389 | 6 829 | 1 100 | 6 468 | 1 070 | 3 688 | 734 |
| 2001 | 130 720 | 7 339 | 1 033 | 6 110 | 1 134 | 3 688 | 734 |
| 2002 | 127 729 | 7 339 | 1 033 | 5 803 | 1 103 | 3 688 | 734 |
| 2003 | 128 189 | 7 616 | 1 043 | 6 206 | 1 042 | 3 937 | 786 |
| 2004 | 127 181 | 7 616 | 1 043 | 6 237 | 1 059 | 3 937 | 786 |
| 2005 | 125 892 | 7 616 | 1 043 | 6 210 | 1 051 | 3 937 | 786 |
| 2006 | 125 265 | 7 616 | 1 043 | 5 955 | 1 013 | 3 937 | 786 |
| 2007 | 126 670 | 7 616 | 1 043 | 6 698 | 1 154 | 3 937 | 786 |

Values of Table 174 differ from the numbers given in CRF table 4.D 'Nitrogen input from manure applied to soils'. In the CRF table 4.D additionally $NH_3$-N and $NO_x$-N volatilisation losses occurring during manure application are subtracted.

A more detailed description of the method applied is given in the report "Austria's Informative Report 2008 – Submission under the UNECE Convention on Long-range Transboundary Air Pollution". Austria's Informative Report 2009 will be published in May 2009.

Losses of Ammonia ($NH_3$-N) occur during animal housing (1), the storage of manure (2) and the application of organic fertilizers on agricultural soils (3). For the field spreading of manure $NO_x$-N losses were calculated (4).

Following a recommendation of the in-country review 2007, more information on the calculation of volatilization ratios has been included to the NIR (see below).

#### 1) $NH_3$ emissions from housing (cattle and swine)

Table 176 gives $NH_3$ emission factors for emissions from animal housing. As far as possible, Swiss default values as given in the CORINAIR guidelines (EEA 1999) have been chosen. If no CORINAIR emission factors from Switzerland were available, the CORINAIR German default values were used.

*Table 176: Emission factors for $NH_3$ emissions from animal housing.*

| Manure management system | CORINAIR Emission factor [kg $NH_3$-N (kg N excreted)$^{-1}$] |
|---|---|
| Dairy cattle, tied systems, liquid slurry system | 0.040 |
| Dairy cattle, tied systems, solid storage system | 0.039 |
| Diary cattle, loose houses, liquid slurry system | 0.118 |
| Diary cattle, loose houses, solid storage system | 0.118 |
| Other cattle, loose houses, liquid slurry system | 0.118 |
| Other cattle, loose houses, solid storage system | 0.118 |
| Fattening pigs, liquid slurry system | 0.150 |
| Fattening pigs, solid storage system | 15% of total N + 30% of the remaining TAN |
| Sows plus litter, liquid slurry system | 0.167 |
| Sows plus litter, solid storage system | 0.167 |

#### 2) $NH_3$ emissions from manure 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 and the $NH_3$-N losses from housing (see above) are subtracted. The remaining N enters the store.

*Cattle and swine*

TAN content in excreta

The detailed method makes use of the total ammoniacal nitrogen (TAN) when calculating emissions. TAN content for Austrian cattle and swine manure is given in SCHECHTNER 1991.

*Table 177: TAN content for Austrian cattle and swine manure (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 |

$NH_3$ emission factors

During manure storage, $NH_3$ is lost. These losses are estimated with CORINAIR default emission factors given in *Table 178*.

*Table 178: $NH_3$ emission factors for manure storage.*

| Manure storage system | CORINAIR Emission factor [kg $NH_3$-N (kg TAN)$^{-1}$] |
|---|---|
| Cattle, liquid slurry system | 0.15 |
| Cattle, solid storage system | 0.30 |
| Pigs, liquid slurry system | 0.12 |
| Pigs, solid storage system | 0.30 |

*Sheep, goats, horses, poultry and other animals*

The CORINAIR simple methodology uses an average emission factor per animal for each livestock category. Table 179 presents the recommended ammonia emission factors for the different livestock categories given in the CORINAIR guidelines (EEA 1999). Emission factors include emissions from housing and storage.

*Table 179:CORINAIR default ammonia emission factors (simple methodology).(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) | 2.90 | |
| 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.

**3) $NH_3$-N volatilisation losses occuring during manure application**

CORINAIR default $NH_3$ emission factors for spreading of slurry and farmyard manure (expressed as share of TAN) have been applied:

- 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

**4) $NO_X$-N volatilisation losses occuring during manure application**

$NO_x$-N-losses from animal waste spreading were estimated using a conservative emission factor of 1% of manure nitrogen (FREIBAUER & KALTSCHMITT 2001).

**Nitrogen input through biological fixation**

The amount of N-input to soils via N-fixation of legumes ($F_{BN}$) was estimated on the basis of the cropping areas and specific consideration of nitrogen fixation rates of all relevant N-fixing crops:

$$F_{BN} = LCA * B_{Fix}/1\,000$$

*$F_{BN}$ = 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 1990–2007 can be found in Table 170.

Values for biological nitrogen fixation (120 kg N/ ha for peas, soja beans and horse/field beans and 160 kg N/ ha for clover-hey, respectively) were taken from (UMWELTBUNDESAMT 1998a) and ÖPUL 2007 (BMLFUW 2007); the values are constant over the time series.

(UMWELTBUNDESAMT 1998a) represents average data for Austria, which were used for calculating the Austrian Nitrogen Surface balance according to the OECD method. In the study available Austrian data and coefficients were put together, including literature and expert opinions from the Austrian "Fachbeirat für Bodenfruchtbarkeit und Bodenschutz" (advisory board for soil fertility and soil protection of the Federal Ministry for Agriculture and Forestry, Environment and Water Management). This advisory board is a platform of agricultural experts, which publishes regularly the "Richtlinien für die sachgerechte Düngung" (Austrian fertilizer recommendations).

**Nitrogen input from incorporation of crop residues**

The method applied for calculation of the emissions is the IPCC Tier 1b method. During harvest crops and by-products (e.g. like cereal straw) are removed from fields, but stubble, roots or beet leaves are left on the field. Incorporated crop residues release nitrogen during decay. The amount of crop residues is calculated on the basis of the harvest statistics.

Official data for annual yield for different agricultural products were adjusted for dry matter (e.g. cereals have a dry matter content of 86% at harvest) and multiplied by appropriate Austrian empirical factors for average ratios between crops and residues (UMWELTBUNDESAMT 1998a). The residues that are removed from the fields during harvest (such as cereal straw or leaves of fodder beet) are subtracted. Also considered is the loss of nitrogen that is lost if residues are burned on the fields.

The amount of nitrogen was calculated using the following formula:

$$F_{CR} = CY * dm * ExF * Frac_{NCR} * (1 – Frac_{CRR} – Frac_{CRB})$$

$F_{CR}$ = *Annual nitrogen input to soils from crop residues left on fields [t N]*

*CY* = *Annual crop yield [t] (Table 171)*

*dm* = *Dry matter fraction [t/t] (UMWELTBUNDESAMT 1998a)*

*ExF* = *Expansion factor that describes the ratio of crop residues per harvested crop [t/t], (UMWELTBUNDESAMT 1998a)*

$Frac_{NCR}$ =*Fraction of nitrogen in dry matter of crop residues [t N/t] (UMWELTBUNDESAMT 1998a)*

$Frac_{CRR}$ = *Fraction of crop residues removed by harvest [t/t] (LÖHR 1990)*

$Frac_{CRB}$ =*Fraction of crop residue that is burned on field [t/t] (see chapter 6.5)*

Harvest data were taken from (BMLFUW 2000-2008) and the datapool of (BUNDESANSTALT FÜR AGRARWIRTSCHAFT 2008) and are presented in Table 171. The other parameters used are presented in the following table:

*Table 180: Input parameters used to estimate emissions from crop residues.*

| | Dm [t/t] | ExF [t/t] | $Frac_{NCR}$ [t N/t d.m.] | $Frac_{CRR}$ [t/t] | $Frac_{CRB}$ [t/t] |
|---|---|---|---|---|---|
| Wheat | 0.86 | 1.0 | 0.005 | 0.7 | 0.0042 |
| Rye | 0.86 | 1.4 | 0.005 | 0.7 | 0.0042 |
| Barley | 0.86 | 1.1 | 0.005 | 0.7 | 0.0042 |
| Oats | 0.86 | 1.5 | 0.005 | 0.7 | 0.0042 |
| Maize (corn) | 0.50 | 1.4 | 0.005 | 0.0 | 0.0000 |
| Potato | 0.30 | 0.3 | 0.012 | 0.0 | 0.0000 |
| Sugarbeet | 0.45 | 0.8 | 0.007 | 0.0 | 0.0000 |
| Fodderbeet | 0.20 | 3.0 | 0.014 | 1.0 | 0.0000 |
| Maize (silo) | 0.30 | 0.0 | 0.014 | 1.0 | 0.0000 |
| Clover-hay | 0.86 | 0.0 | 0.018 | 1.0 | 0.0000 |
| Rape | 0.86 | 21 | 0.009 | 0.0 | 0.0000 |
| Sunflower | 0.86 | 2.5 | 0.009 | 0.0 | 0.0000 |
| Sojabean | 0.40 | 1.5 | 0.023 | 0.0 | 0.0000 |
| Fodderbean | 0.40 | 1.5 | 0.025 | 0.0 | 0.0000 |
| Peas | 0.40 | 1.0 | 0.038 | 0.0 | 0.0000 |
| Vegetables | 0.20 | 0.8 | 0.015 | 0.0 | 0.0000 |
| Oil pumpkin | 0.80 | 72.0 | 0.015 | 0.0 | 0.0000 |

Values were taken from (UMWELTBUNDESAMT 1998a) and had been worked out by Austrian Experts (Ministery of Agriculture, Fachbeirat für Bodenschutz und Bodenfruchtbarkeit – advisory board for soil fertility and soil protection of the Federal Ministry for Agriculture and Forestry, Environment and Water Management).

In 2007 the figures of the N fractions of agricultural crops have been recalculated. The reason for the recalculation is that up to now the applied N contents of several crops obtained from (UMWELTBUNDESAMT 1998a) were partially not adjusted to dry matter basis. Hence, the recalculation led to higher N values for different crop products (N fixing crops and other). The low average N fractions of Austrian crops have been noted by the S & A Report 2006.

In the submission 2009 in additional table 4.D for the fraction of nitrogen in N-fixing crops ($Frac_{NCRBF}$) the arithmetic mean of 0.026 is reported. For the fraction of nitrogen in non-N-fixing crops ($Frac_{NCRO}$) the arithmetic mean of 0.009 is reported. These values are now closer to the IPCC default values of 0.03 ($Frac_{NCRBF}$) and 0.015 ($Frac_{NCRO}$).

**Nitrogen input through use of sewage sludge**

***$N_2O$ emissions***

The method applied for the calculation of the emissions is IPCC Tier 1b with a default emission factor of 1.25% $N_2O$-N per Mg N input to agricultural soils.

In Austria fertilisation by sewage sludge is very small. In 2007 $N_2O$ emissions from sewage sludge contributed only 0.3% of $N_2O$ emissions from category 4 D Agricultural Soils.

N content data of sewage sludge was obtained from (UMWELTBUNDESAMT 1997). The study contains sewage sludge analyses carried out by the Umweltbundesamt. Digested sludge samples from 17 municipal sewage sludge treatment plants taken in winter 1994/1995 were investigated with regard to more than one hundred inorganic, organic and biological parameters in order to get an idea of the quality of municipal sewage sludge. Following this study a mean value of 3.9% N in dry matter was taken.

In 2007 the N-content value of sewage sludge was re-examined. The comparison with national Studies (ZESSNER, M. 1999) and (ÖWAV-Regelblatt Nr. 17 – Landwirtschaftliche Verwertung von Klärschlamm 2004 – www.oewav.at) approved the value of 3.9% N/dm.

The amount of nitrogen input from agriculturally applied sewage sludge was calculated according following formula:

$$F_{Sslu} = Sslu_N * Sslu_{agric}$$

$F_{Sslu}$ = *Annual nitrogen input to soils by agriculturally applied sewage sludge [t N]*

$Sslu_N$ = *Nitrogen content in dry matter [%] – 3.9%*

$Sslu_{agric}$ = *Annual amount of sewage sludge agriculturally applied [t/t] (see Table 173)*

Annual nitrogen input from sewage sludge applied on agricultural soils is presented in Table 173.

***$CH_4$ emissions***

According to the Institute for Applied Ecology (DETZEL et al. 2003) and (SCHÄFER 2002) the average carbon content of sewage sludge amounts about 300 kg carbon per ton sewage sludge. While 48% of the carbon remains in the soil, 52% are emitted to air. 5% of this emitted carbon is emitted as $CH_4$. Consequential about 10.4 kg methane is emitted per ton sewage sludge.

### 6.4.2.2 Pasture, range and paddock manure (4.D.2)

*Key Source: Yes ($N_2O$)*

Following the IPCC Guidelines, $N_2O$ emissions resulting from nitrogen input through excretions of grazing animals (directly dropped onto the soil) were calculated under *Manure Management* but reported under *Agricultural Soils*.

$F_{GRAZ} = N_{exGRAZ} * EF_{GRAZ}$

*$F_{GRAZ}$ = $N_2O$ emissions induced by nitrogen excreted from grazing animals, expressed as $N_2O$-N [t N].*

*$N_{exGRAZ}$ = Nitrogen excreted during grazing (amount of animal manure nitrogen produced by grazing animals and directly dropped on agricultural soils during grazing) [t N] – see Table 181*

*$EF_{GRAZ}$ = A constant emission factor for $N_2O$ from manure of grazing animals has been used [t $N_2O$-N/t N], – 0.02 (IPCC GUIDELINES 1997), workbook table 4-8*

*Table 181:Nitrogen excreted during grazing ($N_{exGRAZ}$) 1990–2007.*

| Year | N excretion grazing [kg/animal/yr] | Year | N excretion grazing [kg/animal/yr] |
|---|---|---|---|
| 1990 | 22 422 | 1999 | 23 774 |
| 1991 | 22 881 | 2000 | 23 192 |
| 1992 | 22 177 | 2001 | 22 797 |
| 1993 | 23 428 | 2002 | 22 384 |
| 1994 | 23 700 | 2003 | 22 589 |
| 1995 | 24 570 | 2004 | 22 576 |
| 1996 | 24 381 | 2005 | 22 504 |
| 1997 | 24 359 | 2006 | 22 306 |
| 1998 | 23 819 | 2007 | 22 884 |

### 6.4.2.3 Indirect soil emissions (4.D.3)

*Key Source: Yes ($N_2O$)*

According to IPCC definition, indirect $N_2O$ emissions are caused by atmospheric deposition of nitrogen and by nitrogen leaching from soils.

#### $N_2O$ emissions through atmospheric nitrogen deposition

Emissions were calculated following IPCC Tier 1a (GPG, Equation 4.31):

$F_{AD} = [(N_{FERT} * Frac_{GASF}) + (N_{ex} * Frac_{GASM})] * EF_{AD}$

*$F_{AD}$ = $N_2O$ emissions from atmospheric deposition, expressed as $N_2O$-N [t N]*

*$N_{FERT}$ = Nitrogen in mineral fertilizers applied on soils [t N] (see Table 169)*

*$Frac_{GASF}$ = Fraction of nitrogen lost from mineral fertilizer application through gaseous emissions of $NH_3$ and $NO_x$. [t/t] – 0.023 for mineral fertilizers and 0.153 for urea fertilizers (EEA 1999) p.1 010–15, table 5.1.*

*$N_{ex}$ = Total nitrogen annually produced in animal waste management systems [t N] (N excretion values see Table 161, Table 162)*

*$Frac_{GASM}$ = Fraction of animal manure that is volatized as $NH_3$ or $NO_x$ [t/t] (adopted from calculations of $NH_3$ and $NO_x$ emissions following the CORINAIR methodology)*

*$EF_{AD}$ = $N_2O$ emission factor (constant over the time series) for emissions from atmospheric deposition: tons of $N_2O$-nitrogen released per ton of volatized nitrogen – 0.01 [t/t] (IPCC GUIDELINES 1997)*

Total N excretion by livestock that volatizes ($Frac_{GASM}$) includes:

- $NH_3$-N losses from housing, storage, grazing
- $NH_3$-N and $NO_x$-N losses from animal waste application

*Table 182:N-losses and $Frac_{Gasm}$ 1990 to 2007.*

| Year | Total N-losses | $Frac_{Gasm}$ |
|---|---|---|
| | [t N/yr] | ($N_{losses}/Nex_{total}$) |
| 1990 | 39 022 | 0.22 |
| 1991 | 37 935 | 0.22 |
| 1992 | 36 831 | 0.22 |
| 1993 | 36 470 | 0.21 |
| 1994 | 36 133 | 0.21 |
| 1995 | 36 700 | 0.21 |
| 1996 | 35 707 | 0.21 |
| 1997 | 34 796 | 0.20 |
| 1998 | 35 374 | 0.21 |
| 1999 | 34 414 | 0.21 |
| 2000 | 34 447 | 0.21 |
| 2001 | 34 582 | 0.21 |
| 2002 | 33 856 | 0.21 |
| 2003 | 32 961 | 0.21 |
| 2004 | 32 563 | 0.21 |
| 2005 | 32 278 | 0.21 |
| 2006 | 32 453 | 0.21 |
| 2007 | 31 960 | 0.20 |

Calculated N losses are between 20% and 22% of total N excretion, which is consistent with the IPCC default value (20%).

Ammonia emissions for Cattle and Swine were calculated following the CORINAIR detailed methodology (EEA 1999), for the other livestock categories the CORINAIR simple methodology was used.

Following (EEA 1999), the $NO_X$ emissions were estimated according to the assumption from (FREIBAUER & KALTSCHMITT 2001) that 1% of the manure nitrogen left for spreading $N_{LFS}$ (see Table 174) is emitted as $NO_X$-N.

A detailed description of the method applied for $NH_3$ and $NO_x$ is given in the report 'Austria's Informative Report 2009 – Submission under the UNECE Convention on Long-range Transboundary Air Pollution'. Austria's Informative Report 2009 will be published in May 2009.

### $N_2O$ emissions through nitrogen leaching losses

The method applied for emission calculation is IPCC Tier 1b.

Following IPCC recommended values, leaching losses from nitrogen fertilizers are estimated to be about 30% of the nitrogen inputs from synthetic fertilizer use, livestock excretion, and sewage sludge application. $N_2O$ emissions are then estimated as 2.5% of the leaching losses, as suggested by the IPCC.

The calculation follows the following formular:

$$E\text{-}N_2O_{LL} = (F_{FERT} + N_{exLFS} + N_{exGRAZ} + F_{Sslu}) * Frac_{LEACH} * EF\text{-}N_2O_{LL}$$

$E\text{-}N_2O_{LL}$ = *$N_2O$ emissions from leaching losses, expressed as $N_2O$-N [t N]*

$F_{FERT}$ = *Annual amount of nitrogen in synthetic fertilizers (mineral and urea) applied on soils [t N] (see Table 169)*

$N_{exLFS}$ = *Annual amount of nitrogen in animal excreta left for spreading on agricultural soils, corrected for losses during manure management [t N] (see Table 174)*

$N_{exGRAZ}$ = *Annual amount of animal manure nitrogen produced by grazing animals and directly dropped on agricultural soils during grazing [t N] (see Table 181)*

$F_{Sslu}$ = *Annual nitrogen input from sewage sludge applied on agricultural soils [t N] (see Chapter 4 D 1 – Nitrogen input through the use of sewage sludge)*

$Frac_{LEACH}$ = *Fraction of nitrogen applied on soils that leaches (0.3 [t/t] following IPCC GUIDELINES 1997, REFERENCE MANUAL, TABLE 4-24)*

$EF\text{-}N_2O_{LL}$ = *Emission factor for $N_2O$ from leaching, expressed as $N_2O$-N (0.025 [t/t] following IPCC GUIDELINES 1997, WORKBOOK TABLE 4-18)*

### 6.4.3 Uncertainties

Uncertainties are presented in Table 138.

### 6.4.4 Recalculations

No recalculations have been done.

### 6.4.5 Planned Improvements

From 2005 to 2007 a comprehensive investigation of Austria's agricultural practice was carried out (AMON et al 2007). It is planned to use the updated figures to prepare the Austrian Greenhouse Gas Emission Inventory, submission 2010.

## 6.5 Field burning of agricultural residues (CRF Category 4.F)

### 6.5.1 Source Category Description

This category comprises burning straw from cereals and residual wood of vinicultures 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 field burning of agricultural waste to the total emissions is very low.

In the year 2007 total emissions from this category amounted to 1.5 Gg $CO_2$ equivalent, this is a share of 0.02% in total GHG emissions from sector agriculture. $CH_4$ and $N_2O$ emissions for the years from 1990 to 2007 are presented in Table 183.

*Table 183:Emissions from field burning (4.F) 1990–2007.*

| | $CH_4$ | $N_2O$ |
|---|---|---|
| 1990 | 0.07 | 0.001 |
| 1991 | 0.07 | 0.001 |
| 1992 | 0.07 | 0.001 |
| 1993 | 0.06 | 0.001 |
| 1994 | 0.07 | 0.001 |
| 1995 | 0.07 | 0.001 |
| 1996 | 0.07 | 0.001 |
| 1997 | 0.07 | 0.001 |
| 1998 | 0.07 | 0.001 |
| 1999 | 0.07 | 0.001 |
| 2000 | 0.06 | 0.001 |
| 2001 | 0.07 | 0.001 |
| 2002 | 0.07 | 0.001 |
| 2003 | 0.06 | 0.001 |
| 2004 | 0.09 | 0.002 |
| 2005 | 0.06 | 0.001 |
| 2006 | 0.06 | 0.001 |
| 2007 | 0.06 | 0.001 |
| *Trend 1990–2007* | *-14.5%* | *-14.5%* |
| *Share in Agriculture* | *0.03%* | *0.01%* |

## 6.5.2 Methodological issues

### 6.5.2.1 Cereals (4.F.1)

*Key Source: No*

Following a recommendation of the Centralized Review 2003 the IPCC method with default emission factors was applied.

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

Following the guidelines, a default value of 0.90 for fraction oxidised was used. For cereals the default values of wheat were taken (IPCC GPG Table 4-17). For dry matter fraction an Austrian specific value of 0.86 was used (LÖHR 1990).

#### 6.5.2.2 Other (4.F.5)

*Key Source: No*

This category comprises burning residual wood of vinicultures on open fields in Austria.

A simple method (Emission = Activity x Emission Factor) using country specific emission factors was applied.

Activity data (viniculture area) are taken from the Statistical Yearbooks 1992–2002 (Statistik Austria) and the "Green Reports" of (BMLFUW 2000-2008). 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 184: Activity data for field burning of agricultural residues 1990–2007.*

| Year | Viniculture Area [ha] | Burnt Residual Wood [t] |
|---|---|---|
| 1990 | 58 364 | 4 377 |
| 1991 | 58 364 | 4 377 |
| 1992 | 58 364 | 4 377 |
| 1993 | 57 216 | 4 291 |
| 1994 | 57 216 | 4 291 |
| 1995 | 55 628 | 4 172 |
| 1996 | 55 628 | 4 172 |
| 1997 | 52 494 | 3 937 |
| 1998 | 52 494 | 3 937 |
| 1999 | 51 214 | 3 841 |
| 2000 | 51 214 | 3 841 |
| 2001 | 51 214 | 3 841 |
| 2002 | 51 214 | 3 841 |
| 2003 | 47 572 | 3 568 |
| 2004 | 47 572 | 3 568 |
| 2005 | 50 119 | 3 759 |
| 2006 | 50 119 | 3 759 |
| 2007 | 50 119 | 3 759 |

The emission factors (4 828 g $CH_4$ /Mg and 49.7 g $N_2O$/Mg burnt wood) were calculated by multiplying the emission factors of 7 kg $N_2O$/ TJ and 680 g $CH_4$ /TJ (STANZEL et al. 1995) by a calorific value of 7.1 MJ/kg burnt wood which corresponds to burning wood logs in poor operation furnace systems.

# 7 LULUCF (CRF SECTOR 5)

## 7.1 Sector Overview

This category comprises GHG emissions and removals arising from land use, land use change and forestry.

The following table presents emissions and removals from this sector by sub categories.

*Table 185: Emissions and removals from Sector 5 LULUCF by sub-categories[1)] in Gg $CO_2$ equivalents.*

| | Greenhouse gas emissions/removals [Gg $CO_2$ equivalent] | | | | | | |
|---|---|---|---|---|---|---|---|
| | **5 Total** | **A Forest land** | **B Crop land** | **C Grass land** | **D Wet lands[2)]** | **E Settle ments[2)]** | **F Other land[2)]** |
| 1990 | -13 178 | -15 913 | 1 987 | -1 022 | 200 | 760 | 810 |
| 1991 | -19 083 | -21 955 | 1 994 | -1 011 | 216 | 843 | 829 |
| 1992 | -14 042 | -16 891 | 2 008 | -1 002 | 232 | 762 | 849 |
| 1993 | -17 924 | -20 864 | 2 044 | -995 | 248 | 776 | 868 |
| 1994 | -16 571 | -19 545 | 2 054 | -1 012 | 254 | 845 | 833 |
| 1995 | -16 012 | -18 605 | 2 054 | -1 135 | 256 | 674 | 744 |
| 1996 | -10 925 | -13 636 | 2 107 | -1 157 | 282 | 779 | 701 |
| 1997 | -19 855 | -22 488 | 2 124 | -1 179 | 288 | 743 | 657 |
| 1998 | -17 982 | -20 388 | 2 133 | -1 201 | 273 | 588 | 614 |
| 1999 | -22 370 | -24 780 | 2 159 | -1 211 | 283 | 583 | 596 |
| 2000 | -16 975 | -19 340 | 2 169 | -1 221 | 293 | 545 | 578 |
| 2001 | -19 662 | -22 014 | 2 175 | -1 208 | 302 | 522 | 561 |
| 2002 | -15 925 | -18 195 | 2 178 | -1 269 | 310 | 508 | 543 |
| 2003 | -17 305 | -19 647 | 2 239 | -1 259 | 318 | 519 | 525 |
| 2004 | -17 350 | -19 620 | 2 212 | -1 291 | 327 | 511 | 512 |
| 2005 | -17 154 | -19 593 | 2 247 | -1 266 | 319 | 642 | 498 |
| 2006 | -17 166 | -19 566 | 2 248 | -1 288 | 338 | 618 | 484 |
| 2007 | -17 123 | -19 539 | 2 309 | -1 266 | 372 | 531 | 470 |
| *Trend BY- 2007* | *29.9%* | *22.8%* | *16.2%* | *23.9%* | *86.0%* | *-30.1%* | *-42.0%* |

*1) Other GHG are also considered, therefore the totals are different compared to the totals in the CRF tables.*

*2) Only land use conversions are reported*

The table shows that land use, land use change and forestry is a net sink in Austria.

An important sub category is forest land, in particular its sub source forest land remaining forest land. This category, as well as the category grassland are net sinks for $CO_2$, whereas the other sub categories are sources of $CO_2$ emissions. However, total emissions arising from the other sub categories only amount to 15-28% of removals from forest land.

### 7.1.1 Emission Trends

In 2002, which is the last year with measured data of the important sub sector forest land, removals from that category corresponded to 20.9% of total GHG in Austria (without LULUCF), compared to 20.1% in the base year. The removals increased by 29.9% from the base year to 2007, mainly due to an increase of the carbon stock in forest land.

In order to be consistent with the IPCC GPG for LULUCF the area of all LUC categories in the land use transition matrix is followed and reported in the conversion status for 20 years. After these 20 years they are accounted in the remaining categories.

### 7.1.2 Methodology

The methodologies for estimating emissions from LUC from and to these land use categories are described in the sub chapters 7.2 to 7.7. Following the methodology of the actual emission/removal calculations, all land use changes from forest land (which are sub categories of 5 B – 5 F) are included in the methodological description of land converted to forest land.

For a complete time series from 1990 to 2007 on areas remaining in a land use category and areas affected by LUC since 1970 (1960 for perennial cropland) activity data had to be compiled from data of different statistical surveys.

The keypoints of the applied compilation technique are as follows:

- Consistency with respect to the Austrian area (use of sub-category „Other land")
- Consistency within and across years in sub-sectors
- Hierarchical treatment of data sources:
  - 1st hierarchy: Systematically measured statistics are considered to have highest reliability (e.g. NFI forest area)
  - 2nd hierarchy: Land use statistics based on land register and land use surveys for EU-funding are given higher hierarchy than estimates for land use (agricultural areas)
  - 3rd hierarchy: Estimates for land use based on specific information are given higher priority than mere estimates on likelihood basis (e.g. bogs in 5.D)
  - 4th hierarchy: Estimates on likelihood basis are given higher priority than data gaps (e.g. no LUC from wetland to cropland)
  - 5th hierarchy: Data gaps (5.F „Other land")

The forest area as well as land use changes from and to forests are based on data of the National Forest Inventories. For each mean year of an inventory period data on the total forest area are provided, thus the annual data between two consecutive inventories were calculated by linear interpolation. The land use changes from and to forests are based on information from the NFIs. Their split into the subcategories of further or previous land uses was done in the same ratio as for the NFI 2000/02.

Data for the total cropland area are available annually from STATISTIK AUSTRIA (STATISIK AUSTRIA 1990-2007). Based on the Austrian farm structure surveys (e.g. 1993, 1995) STATISTIK AUSTRIA also provides data for the total grassland area. For the years between these surveys data were calculated by linear interpolation. Estimates on the land use changes between cropland and grassland were derived from the data of the IACS (Integrated Administrative Control System, see also 7.3.1).

Bogs are protected areas in most Austrian provinces thus these areas are constant since 1990. The changes in the annual water body area were derived from data of the Real Estate Database. Between 1990 and 2004 a mean average increase was calculated, since then annual data are reported. Based on the regional information of the Real Estate Database, also data for the settlement area are provided annually. As the database is updated by occasion a mean annual increase of the settlement area was calculated for certain time periods (see 7.6). The increases of settlement area derive mainly from grassland and cropland sites. In cases where losses in these two land use categories can not sufficiently complete the increase of settlement area also land use changes from other land are taken into account.

By expert judgment certain land use changes were considered not to occur in Austria:

- wetlands, settlements or other land converted to cropland or grassland
- cropland or settlements converted to wetlands
- wetlands converted to settlements

For other land only land use conversion from forest land are reported.

All these information was merged and based on annually land use changes, a matrix for a transition period over 20 years was established. The remaining area was then calculated as the difference between the total area of a land use category and the land use changes to each category. Further details on the methodologies of area information is given in each land use chapter.

Table 186 presents land use data and data for land use changes for the year 1990 and 2001 for the total area of Austria as used for the calculations. The year 2001 is presented because these data are the latest measured figures on the area that are forested (the last national forest inventory period was 2000/02).

*Table 186:Land use and LUC data for Austria for the year 1990 and 2001.*

| Area in ha | 1990 | 2001 | Diff 1990–2001 |
|---|---|---|---|
| **5.A Forest land – total area** | 3 891 333 | 3 960 000 | 68 667 |
| productive forest | 3 332 667 | 3 371 000 | 38 333 |
| non-productive forest | 558 667 | 589 000 | 30 333 |
| 1. Forest land remaining forest land productive forest | 3 170 671 | 3 310 591 | 139 320 |
| 2. Land converted to forest land | 386 591 | 260 681 | -125 910 |
| 2.1 Cropland converted to forest land | 61 855 | 41 709 | -20 146 |
| 2.2 Grassland converted to forest land | 228 089 | 153 802 | -74 287 |
| 2.3 Wetland converted to forest land | 19 330 | 13 034 | -6 295 |
| 2.4 Settlement converted to forest land | 54 123 | 36 495 | -17 627 |
| 2.5 Other Land converted to forest land | 23 195 | 15 641 | -7 555 |
| **5.B Cropland – total area** | 1 507 533 | 1 460 067 | -47 466 |
| 1. Cropland remaining cropland | 1 000 606 | 931 734 | -68 873 |
| perennial converted to annual | 9 451 | 9 419 | -32 |
| annual converted to perennial | 11 309 | 12 294 | 984 |
| 2. Land converted to cropland | 506 927 | 528 333 | 21 407 |
| 2.1 Forest land converted to cropland | 9 650 | 6 759 | -2 892 |

| Area in ha | 1990 | 2001 | Diff 1990–2001 |
|---|---|---|---|
| 2.2 Grassland land converted to cropland | 495 750 | 519 752 | 24 003 |
| grassland converted to perennial cropland | 1 526 | 1 822 | 296 |
| 2.3 Wetland Land converted to cropland | NO | NO | – |
| 2.4 Settlement converted to cropland | NO | NO | – |
| 2.5 Other Land converted to Cropland | NO | NO | – |
| **5.C. Grassland – total area** | 1 992 765 | 1 929 902 | -62 863 |
| 1. Grassland remaining grassland | 1 391 963 | 1 353 476 | -38 487 |
| 2. Land converted to grassland | 600 802 | 576 426 | -24 376 |
| 2.1 Forest land converted to grassland | 102 294 | 71 641 | -30 653 |
| 2.2 Arable land converted to grassland | 496 412 | 502 069 | 5 657 |
| Perennial cropland converted to grassland | 2 097 | 2 717 | 620 |
| 2.3 Wetland land converted to grassland | NO | NO | – |
| 2.4 Settlement converted to grassland | NO | NO | – |
| 2.5 Other land converted to grassland | NO | NO | – |
| **5 D Wetlands – total area** | 133 068 | 139 874 | 6 806 |
| 1. Wetlands remaining wetlands | 124 579 | 121 923 | -2 656 |
| 2. Land converted to wetlands | 8 489 | 17 952 | 9 463 |
| 2.1 Forest land converted to wetlands | 5 790 | 4 055 | -1 735 |
| 2.2 Arable land converted to wetlands | – | – | – |
| 2.3 Grassland converted to wetlands | 2 699 | 11 764 | 9 065 |
| 2.4 Settlement converted to wetlands | NO | NO | – |
| 2.5 Other land converted to wetlands | – | 2 132 | 2 132 |
| **5 E Settlements – total area** | 384 065 | 461 461 | 77 396 |
| 1. Settlements remaining settlements | 193 482 | 284 246 | 90 764 |
| 2. Land converted to settlements | 190 583 | 177 215 | -13 368 |
| 2.1 Forest land converted to settlements | 28 951 | 20 276 | -8 675 |
| 2.2 Arable land converted to settlements | 38 113 | 51 894 | 13 781 |
| 2.3 Grassland converted to settlements | 106 661 | 60 290 | -46 371 |
| 2.4 Wetlands converted to settlements | NO | NO | – |
| 2.5 Other land converted to settlements | 16 858 | 44 755 | 27 897 |
| **5 F Other land – total area** | 471 292 | 428 751 | -42 540 |
| 2.1 Forest land converted to other land | 46 322 | 32 441 | -13 881 |
| **Total area** | **8 380 056** | **8 380 056** | **–** |

### 7.1.3 Completeness

Table 187 gives an overview of the new IPCC categories included in this chapter and the corresponding sub-divisions for which the actual calculations are made. It also provides information on the status of emission estimates of all subcategories. A "✓" indicates that emissions/removals from this sub-category have been estimated; for LULUCF $CO_2$ emissions/removals are estimated. Only the $N_2O$ emissions resulting from conversion from grassland to cropland have been calculated.

*Table 187:IPCC categories according to the IPCC-Good Practice Guidance for Land-Use, Land-Use Change and Forestry.*

| IPCC categories[54]/ Sub division for calculation | Description | Status for $CO_2$ | Other GHG |
|---|---|---|---|
| 5 A | Forest land | ✓ | |
| 5.A.1 | Forest land remaining forest land | ✓ | |
| Coniferous | Increase, decrease, net change of carbon stock | ✓ | |
| Deciduous | Increase, decrease, net change of carbon stock | ✓ | |
| | Net carbon stock change in dead organic matter | ✓ | |
| | Net carbon stock change in soils | ✓ | |
| 5.A.2 | Land converted to forest land | ✓ | |
| 5.A.2.1 | Cropland converted to forest land | ✓ | |
| | *Carbon stock change in biomass* | ✓ | |
| | *Carbon stock change in soils* | ✓ | |
| 5.A.2.2 | Grassland converted to forest land | ✓ | |
| | *Carbon stock change in biomass* | ✓ | |
| | *Carbon stock change in soils* | ✓ | |
| 5.A.2.3 | Wetlands converted to forest land | ✓ | |
| | *Carbon stock change in biomass* | ✓ | |
| | *Carbon stock change in soils* | ✓ | |
| 5.A.2.4 | Settlements converted to forest land | ✓ | |
| | *Carbon stock change in biomass* | ✓ | |
| | *Carbon stock change in soils* | ✓ | |
| 5.A.2.5 | Other land converted to forest land | ✓ | |
| | *Carbon stock change in biomass* | ✓ | |
| | *Carbon stock change in soils* | ✓ | |
| 5.B | Cropland | ✓ | |
| 5.B.1 | Cropland remaining cropland | ✓ | |
| *Annual remaining annual* | *Carbon stock change in living biomass* | ✓ | |
| *Annual remaining annual* | *Carbon stock change in soils* | ✓ | |
| *Perennial remaining perennial* | *Carbon stock change in living biomass* | ✓ | |
| *Perennial remaining perennial* | *Carbon stock change in soils* | ✓ | |
| *Annual converted to perennial* | *Carbon stock change in living biomass* | ✓ | |
| *Annual converted to perennial* | *Carbon stock change in soils* | ✓ | |
| *Perennial converted to annual* | *Carbon stock change in living biomass* | ✓ | |
| *Perennial converted to annual* | *Carbon stock change in soils* | ✓ | |
| 5.B.2 | Land converted to cropland | ✓ | |
| 5.B.2.1 | Forest land converted to cropland | ✓ | |
| | *Carbon stock change in biomass* | ✓ | |
| | *Carbon stock change in soils* | ✓ | |

[54] IPCC categories – applied according to the "Good Practice Guidance for LULUCF (2003)"

| IPCC categories[54]/ Sub division for calculation | Description | Status for $CO_2$ | Other GHG |
|---|---|---|---|
| 5.B.2.2 | Grassland converted to cropland | ✓ | |
| | *Carbon stock change in living biomass* | ✓ | |
| | *Carbon stock change in soils* | ✓ | ✓ $N_2O$ |
| 5.B.2.3 | Wetland converted to cropland | NO | |
| 5.B.2.4 | Settlements converted to cropland | NO | |
| 5.B.2.5 | Other land converted to cropland | NO | |
| 5.C | Grassland | ✓ | |
| 5.C.1 | Grassland remaining grassland | ✓ | |
| | *Carbon stock change in soils* | ✓ | |
| 5.C.2 | Land converted to grassland | ✓ | |
| 5.C.2.1 | Forest land converted to grassland | ✓ | |
| | *Carbon stock change in biomass* | ✓ | |
| | *Carbon stock change in soils* | ✓ | |
| 5.C.2.2 | Cropland converted to grassland | ✓ | |
| | *Carbon stock change in living biomass* | ✓ | |
| | *Carbon stock change in soil* | ✓ | |
| 5.C.2.3 | Wetland converted to grassland | NO | |
| 5.C.2.4 | Settlements converted to grassland | NO | |
| 5.C.2.5 | Other land converted to grassland | NO | |
| 5.D | Wetlands | ✓ | |
| 5.D.2.1 | Forest land converted to wetlands | ✓ | |
| | *Carbon stock change in living biomass* | ✓ | |
| | *Carbon stock change in soil* | ✓ | |
| 5.D.2.2 | Cropland converted to wetlands | NO | |
| 5.D.2.3 | Grassland converted to wetlands | ✓ | |
| | *Carbon stock change in living biomass* | ✓ | |
| | *Carbon stock change in soil* | ✓ | |
| 5.D.2.4 | Settlements converted to wetlands | NO | |
| 5.D.2.5 | Other land converted to wetlands | ✓ | |
| | *Carbon stock change in living biomass* | ✓ | |
| | *Carbon stock change in soil* | ✓ | |
| 5.E | Settlements | | |
| 5.E.2.1 | Forest land converted to settlements | ✓ | |
| | *Carbon stock change in living biomass* | ✓ | |
| | *Carbon stock change in soil* | ✓ | |
| 5.E.2.2 | Cropland converted to settlements | ✓ | |
| | *Carbon stock change in living biomass* | ✓ | |
| | *Carbon stock change in soil* | ✓ | |
| 5.E.2.3 | Grassland converted to settlements | ✓ | |
| | *Carbon stock change in living biomass* | ✓ | |
| | *Carbon stock change in soil* | ✓ | |

| IPCC categories[54]/ Sub division for calculation | Description | Status for $CO_2$ | Other GHG |
|---|---|---|---|
| 5.E.2.4 | Wetlands converted to settlements | NO | |
| 5.E.2.5 | Other land converted to settlements | ✓ | |
| | *Carbon stock change in living biomass* | ✓ | |
| | *Carbon stock change in soil* | ✓ | |
| 5.F | Other Land | | |
| 5.F.2.1 | Forest land converted to other land | ✓ | |
| | *Carbon stock change in living biomass* | ✓ | |
| | *Carbon stock change in soil* | ✓ | |
| 5.F.2.2 | Cropland converted to other land | NO | |
| 5.F.2.3 | Grassland converted to other land | NO | |
| 5.F.2.4 | Wetlands converted to other land | NO | |
| 5.F.2.5 | Settlements converted to other land | NO | |
| 5(IV) 5 B Limestone $CaCO_3$: Total amount applied | $CO_2$ emissions due to liming of cropland and grassland | ✓ | |
| 5(IV) 5 B Limestone $CaCO_3$: Carbon | $CO_2$ emissions due to liming of cropland and grassland | ✓ | |
| 5(V) 5 A 1 BiomassBurn_contr. | Biomass Burning: Controlled: Forest land remaining forest land | NO | NO |
| 5(V) 5 A 1 BiomassBurn_wildfires | Biomass Burning: Wildfires: Forest land remaining forest land | IE (1) | ✓ $N_2O$ ✓ $CH_4$ |

1) *$CO_2$ emissions caused by wildfires (CRF Table 5(V)) are included in the category 5.A.1.. Data on the area affected by wildfires are available for the years 1990 to 2002.*

## 7.2 Forest land (5.A)

3.96 Mio ha (47.2%) of Austria are forest land (BFW 2004a). The sustaining of the Austrian forests in the past helped to restore an important carbon stock in the Austrian landscape and to avoid net $CO_2$ emissions to the atmosphere from the Sector LULUCF: In 1990 the Austrian forests represented a carbon stock of 339 ± 42 Mt carbon from biomass and 463 ± 185 Mt carbon from soil, i.e. humus layer plus mineral soil to 50 cm depth. This total carbon stock represents approximately 40 times the Austrian $CO_2$ equivalent emissions of the greenhouse gases $CO_2$, $CH_4$ and $N_2O$ in the year 1990 (UMWELTBUNDESAMT 2000).

### Emission/Removal trends of forest land

With regard to forest land the annual net $CO_2$ removals under sector 5 of the reported period 1990–2007[55] range from 13 636 Gg $CO_2$ to 24 780 Gg $CO_2$ (mean: 19 588 Gg $CO_2$). The most important sub-category is forest land remaining forest land (5.A.1), whereas land use changes to forests (5.A.2) and from forests (5.B.2 to 5.F.2) have only minor influence on the net $CO_2$ balance.

[55] For the years 2003 to 2007 the means for the last period (2000 to 2002) of the National Forest Inventory (NFI) have been reported

2001 is the media year of the last national forest inventory period, which was carried out between 2000 and 2002. For the years since 2003 the means for the last period (2000 to 2002) of the National Forest Inventory (NFI) have been reported.

The reported $CO_2$ emissions from forest soils are considered very uncertain (-1.5–1.8 Mt $CO_2$/year) whereas removals of dead wood in general have a minor influence on the totals of Sector 5 (about 600 Gg $CO_2$).

As already reported in previous submissions, changes in the Austrian forest biomass also resulted in a net carbon sink in the years before 1990. In the period 1961 to 1989 the mean annual net carbon sink amounted to 12 031 Gg $CO_2$ (from 5 085 Gg $CO_2$ to 17 755 Gg $CO_2$). Between 1990 and 2002 the net carbon sink of this category ranges between 16% and 31% of the total $CO_2$ equivalent emissions without LULUCF of the GHGs $CO_2$, $CH_4$ and $N_2O$ in this period.

According to the new reporting tables for *Land Use, Land Use Change and Forestry* increments and losses at areas of land use change to and from forests (incl. also non-productive forests) must be taken into account. Details on the methodology, uncertainty assessment, quality assurance, quality control and verification are given in each sub chapter.

For the reported period 1990 to 2007 the total annual net $CO_2$ removals (biomass and soil) from land use changes to forest range from about 2,572 Gg $CO_2$ to 4,813 Gg $CO_2$. The total annual emissions (biomass and soil) from land use changes from forests vary between 1,285 Gg $CO_2$ and 2,326 Gg $CO_2$. These figures are in the order of 7 to 36% of the annual net $CO_2$ removals of IPCC Sector 5.

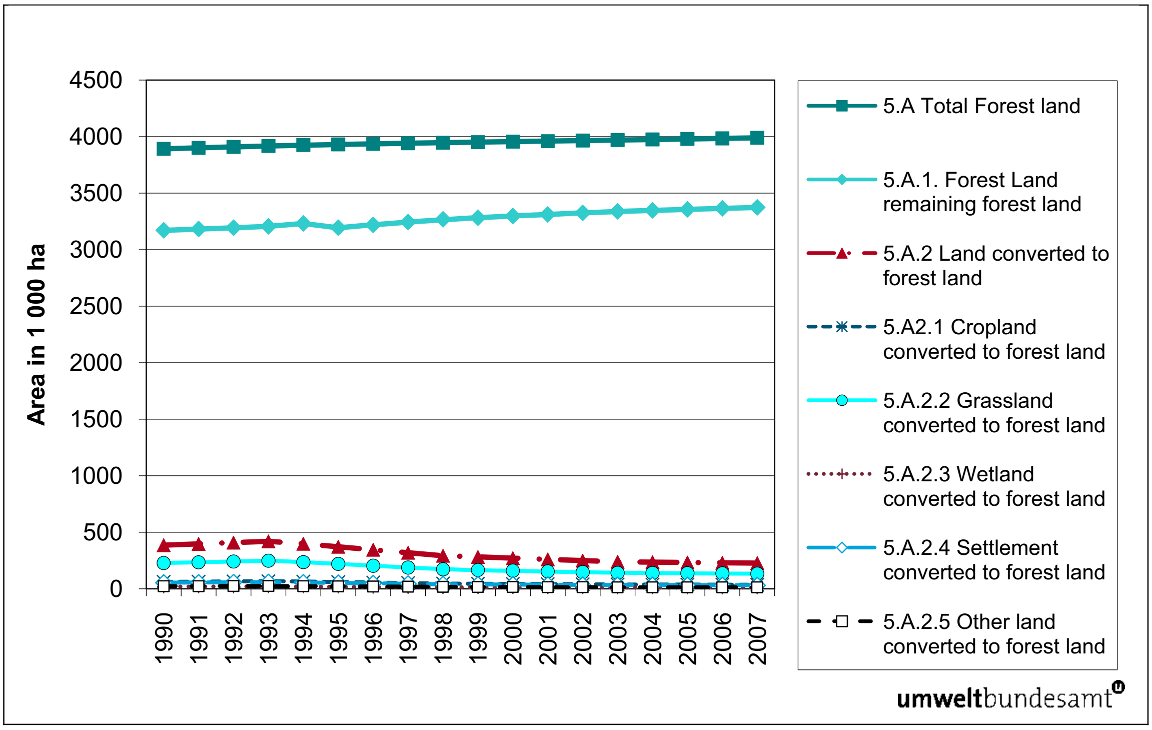


*Figure 26: Trend of forest land and LUC to forest (covering a conversion period of 20 years) from 1990 to 2007 in 1 000 ha (Total forest land includes also unmanaged forest).*

*Table 188: $CO_2$ removals/emissions from IPCC Category 5 A Forest Land and Forest land conversions from 1990–2007 (Gg $CO_2$ resp. Gg $CO_2$ equiv.)*

| | 5 A Total Forest land | 5.A.1. Forest land remaining Forest land | 5.A.2. Land converted to Forest land | 5.A.2.1 Cropland converted to Forest land | 5.A.2.2 Grassland converted to Forest land | 5.A.2.3 Wetlands converted to Forest land | 5.A.2.4 Settlements converted to Forest land | 5.A.2.5 Other Land converted to Forest land | 5.A.1_BiomassBurn_wild_CO2 | 5.A.1_BiomassBurn_wild_CH4 | 5.A.1_BiomassBurn_wild_N2O | 5 Forestland Conv |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1990 | -15 913 | -11 511 | -4 402 | -951 | -1 794 | -406 | -763 | -488 | IE | 0.262 | 0.061 | 2 186 |
| 1991 | -21 955 | -17 416 | -4 539 | -979 | -1 847 | -418 | -793 | -502 | IE | 0.069 | 0.016 | 2 233 |
| 1992 | -16 891 | -12 215 | -4 676 | -1 007 | -1 900 | -430 | -823 | -517 | IE | 0.173 | 0.040 | 2 279 |
| 1993 | -20 864 | -16 051 | -4 813 | -1 035 | -1 953 | -442 | -852 | -531 | IE | 0.147 | 0.034 | 2 326 |
| 1994 | -19 545 | -14 992 | -4 553 | -982 | -1 853 | -419 | -796 | -504 | IE | 0.076 | 0.018 | 2 242 |
| 1995 | -18 605 | -14 288 | -4 317 | -916 | -1 730 | -391 | -809 | -470 | IE | 0.042 | 0.010 | 1 947 |
| 1996 | -13 636 | -9 638 | -3 998 | -851 | -1 606 | -364 | -740 | -437 | IE | 0.038 | 0.009 | 1 842 |
| 1997 | -22 488 | -18 809 | -3 679 | -786 | -1 483 | -336 | -670 | -403 | IE | 0.026 | 0.006 | 1 737 |
| 1998 | -20 388 | -17 028 | -3 360 | -721 | -1 360 | -308 | -601 | -370 | IE | 0.122 | 0.028 | 1 632 |
| 1999 | -24 780 | -21 550 | -3 230 | -694 | -1 310 | -297 | -573 | -356 | IE | 0.010 | 0.002 | 1 589 |
| 2000 | -19 340 | -16 239 | -3 100 | -668 | -1 260 | -285 | -545 | -343 | IE | 0.055 | 0.013 | 1 546 |
| 2001 | -22 014 | -19 043 | -2 971 | -641 | -1 210 | -274 | -517 | -329 | IE | 0.031 | 0.007 | 1 503 |
| 2002 | -18 195 | -15 355 | -2 841 | -614 | -1 160 | -263 | -488 | -315 | IE | 0.251 | 0.058 | 1 461 |
| 2003 | -19 647 | -16 937 | -2 711 | -588 | -1 110 | -251 | -460 | -302 | IE | 0.240 | 0.056 | 1 418 |
| 2004 | -19 620 | -16 944 | -2 676 | -581 | -1 096 | -248 | -453 | -298 | IE | 0.022 | 0.005 | 1 385 |
| 2005 | -19 593 | -16 952 | -2 642 | -574 | -1 083 | -245 | -445 | -295 | IE | 0.041 | 0.009 | 1 352 |
| 2006 | -19 566 | -16 959 | -2 607 | -567 | -1 070 | -242 | -438 | -291 | IE | 0.097 | 0.022 | 1 319 |
| 2007 | -19 539 | -16 967 | -2 572 | -560 | -1 056 | -239 | -430 | -287 | IE | 0.048 | 0.011 | 1 285 |

## 7.2.1 Forest Land remaining Forest Land (5.A.1)

### 7.2.1.1 Methodological Issues

**Activity data**

A national method is applied which follows the IPCC – Good Practice Guidelines for Land Use, Land Use Change and Forestry, Tier 3 (2003). The use of country specific conversion factors and biomass functions for tree branches, needles and below ground biomass provide more accurate and appropriate figures for the Austrian forests. The main basis of the estimates are measured data for the forest area, volume increment and drain (harvest and other losses) of the growing stock (for both stem wood over bark with a diameter at breast height > 5 cm) according to the Austrian National Forest Inventory (NFI – (SCHIELER et al. 1995; BFW 2004a,b; WINKLER 1997)). The NFI was carried out in the periods 1961–70, 1971–80, 1981–85, 1986–90, 1992–96 and 2000–02.

The NFI uses a permanently below ground marked 4 x 4 km grid across all of Austria with four permanent sample plots of 300 $m^2$ size at each grid point. In addition to the NFI harvest data, which are based on measurements in the forests, further harvest statistics exist: the annually reported records of wood felled and the Austrian wood balance (BITTERMANN & GERHOLD 1995), (BMLF 1964–2003). These statistics are not based on measured data. Therefore, it is assumed that the NFI provides more accurate figures on the drain and for this reason the estimates are based on NFI harvest figures. However, the results of the other statistics are used to derive "relative harvest indices for individual years" (see below). In addition, the absolute harvest figures of these statistics are also included in the uncertainty analysis to guarantee an overall consistency of the calculated figures (see below).

***Further comments for a better understanding of the NFI increment and drain data***

The NFI increment and drain data include all possible reasons for biomass increments and losses in the forests. This means that biomass increments due to abandonment of managed land and re-growth by forests or biomass losses due to e.g. traditional (non-commercial) fuel wood consumption, forest land conversion, forest fires (wild-fires) and other damages are already considered in calculations based on the NFI data.

In order to fulfil the requirements of the reporting format and to report on the category *5 A 1 Forest land remaining forest land*, estimates of emissions and removals due to annual land use changes from and to forests are subtracted from the totals based on the total increment and drain. The approaches on calculating $CO_2$ emissions and removals related to land use changes are described in more detail in chapter 7.2.2.

The NFI provides mean values for annual increment and harvest for the individual periods. The measured annual means of increment and harvest provided by the NFI have been attached to the year in the middle of an observation period and not to the year in the middle of an inventory period. This methodological approach reflects the fact that the mean annual increment and harvest which are detected in a certain NFI period are the results of the respective changes in the observation period (which is the time span of the actual NFI period and the NFI period before, and not only the actual NFI period).

In a next step, these NFI means are converted with relative indices[56] to obtain annual data of increment and harvest (instead of using the means or interpolated values for single years). For harvest these relative indices are derived from further national statistics on harvest which are the annually reported records of wood felled (BMLF 1964–2003) and the wood balance (BITTERMANN & GERHOLD 1995). For increment, representative Austrian sets of tree ring cores (HASENAUER et al. 1999a, b; BFW 2005, pers. comm.) are used to calculate the relative indices. These indices are available until 2002. This method allows accurate estimates for individual years for the category 5 A 1. The figures for annual growth and for annual harvest differ year by year for several reasons (e.g. weather conditions; timber demand and prices, wind throws). Such reasons for different growth and different harvest in individual years explain the high annual variations in the $CO_2$ net removals by the Austrian forests.

[56] Values for the relative variation in the individual years of the time series

### Conversion factors, biomass functions

Shrinkage values, wood densities (absolute dry) and C contents for all tree species in Austria are used to convert the increment and harvest of $m^3$ stem wood over bark (o.b.) which is measured by the NFI into t carbon increment and t carbon harvest of the stemwood o.b.

The below given mean conversion factors are based on the species composition of increment and harvest in Austria and on values for the shrinkage and wood densities for all individual tree species (compiled in (KOLLMANN 1982, LOHMANN 1987)) (see Table 189). These conversion factors are calculated for each inventory period and separately for increment and harvest respectively. Between the inventories they show only minor differences (< 1%).

Further details on the approach and methodology are given in (MWELTBUNDESAMT 2000).

*Table 189:Conversion factors for the stemwood o.b. of the Austrian forests; mean of several NFIs (UMWELTBUNDESAMT 2000).*

| Conversion factors | Coniferous | Deciduous |
|---|---|---|
| $m^3$ o.b. to t dm (stemwood) | 0.39 | 0.53 |
| t dm to t C (stemwood) | 0.50 | 0.48 |

### Biomass functions (BF)

The increment and harvest of the other tree compartments (branches, needles, roots) are estimated with the help of biomass functions (BF,*Table 190*) and C contents for these tree compartments (coniferous: 0.47, deciduous: 0.48). The biomass functions were derived with the help of numerous single tree data from Austrian forest sites (see literature given below). These estimates are carried out with all single tree data of the individual NFIs at the Federal Office and Research Centre for Forests. Only the evergreen biomass is estimated (leaves of deciduous trees become part of the soil C pool within one year).

*Table 190:Used biomass functions.*

| Tree species | Tree parts | Input parameter | Literature |
|---|---|---|---|
| Norway spruce (Douglas fir and other coniferous species than listed below) | Branches, needles | Dbh, height, crown ratio | (ECKMÜLLNER 2006) |
| Fir | Branches, needles | Dbh, crown ratio | (LEDERMANN & NEUMANN 2006) |
| Pine | Branches, needles | Dbh, height, crown ratio | (ECKMÜLLNER 2006) |
| Larch | Branches | Dbh, height, crown ratio | (RUBATSCHER et al. 2006) |
| Beech | Branches | Dbh, crown ratio | (LEDERMANN& NEUMANN 2006) |
| Oak | Branches | Dbh, crown ratio | (LEDERMANN& NEUMANN 2006) |
| Oak (coppice) | Branches | Dbh, crown ratio | (HOCHBICHLER et al. 2006) |
| Hornbeam | Branches | Dbh, crown ratio | (LEDERMANN& NEUMANN 2006) |
| Ash | Branches | Dbh, crown ratio | (GSCHWANTNER & SCHADAUER 2006) |
| Other hardwood deciduous species | Branches | Dbh, crown ratio | (GSCHWANTNER & SCHADAUER 2006) |
| Poplar | Branches | Dbh, crown ratio | (GSCHWANTNER & SCHADAUER 2006) |
| Other weed tree species | Branches | Dbh, crown ratio | (GSCHWANTNER & SCHADAUER 2006) |
| All | Roots | Dbh | (WIRTH et al. 2004), (OFFENTHALER & HOCHBICHLER 2006) |

The use of these biomass functions leads to the following biomass expansion ratios for total tree biomass/stemwood biomass:

*Table 191: Average expansion ratios total tree biomass/stemwood biomass derived from the applied biomass functions for the Austrian forests for the period 1990–2002; (BFW 2006, pers. comm.).*

| Expansion ratio t dm stemwood → t dm whole tree (incl. also below ground biomass) | Coniferous | Deciduous |
|---|---|---|
| increment | 1.75 | 1.77 |
| harvest | 1.62 | 1.63 |

The resulting mean annual biomass increments and harvests of the other tree biomass compartments (needles, branches, roots) for the individual NFI periods are converted to figures for single years in the same way as described for stemwood (see above).

The time series of measured values for individual years ends with the year 2002. For the following years the mean values for the last inventory period (2000/02) are reported. This procedure is carried out for the following reasons:

The extrapolation of trends for increment and harvest from the inventory period 1986/90 to the 90ies led to figures, which had to be strongly revised downwards after the inventory period 1992/96. One of the main reasons was that increment did not increase as in the years before. The use of mean values for increment and for harvest, which are based on the last NFI results, for years after the last NFI provides more probable figures than an extrapolation of trends that is rather uncertain. This is particularly true for increment that strongly depends on weather conditions, but also for harvest, when e.g. storm fellings are taken into account.

**Dead wood**

The estimates on C-stock changes in dead wood include only standing dead wood, because any inclusion of lying dead wood would cause a double accounting (the estimates for "harvest" include all losses of tree biomass in forests, also for instance the falling of standing dead trees). Since national data on the stock of dead wood are available from the NFI a Tier 3 method was applied.

On average of all tree species the stock of dead wood is 4.5 $m^3$/ha for the inventory period 1992/96 and 6.1 $m^3$/ha for the inventory period 2000/02. Between the two periods 1986/90 to 1992/96 an increase of 10% of dead wood is estimated.

For the calculation of the C-stock changes the conversion factors for stemwood as shown in Table 189 were used. These conversion factors do not include any estimates for roots and branches of the dead trees. The rationale in behind is that dead roots are already part of the soil C pool and dead trees have usually only a negligible branch mass. It was assumed that the ratio between deciduous and coniferous dead wood is equal to the deciduous/coniferous ratio of the living trees.

The results of the NFI obviously show an increase of dead wood in Austria. However, the annual net C-stock changes amount to about 600 Gg $CO_2$, which is only a minor part of the total C-balance of Sector 5.

### Soil

As already mentioned in the introduction, (UMWELTBUNDESAMT 2000) estimated carbon-stocks of the Austrian forest soils are based on data of the Austrian forest soil survey (humus layers and mineral soil layers 0–50 cm were sampled at the grid points of an 8.7 x 8.7 km grid across all Austria in the period 1987 to 1989; BFW 1992). The changes in the carbon content of the soils are very small and slow and so far no reassessments of the Austrian soil inventories have taken place that would allow estimates for the carbon stock changes of the soils which are based on measured data. Therefore, modelling approaches were used to estimate the carbon stock change of the Austrian forest soils in the period 1961 to 1996 (UMWELTBUNDESAMT 2000). According to these estimates it is assumed that the Austrian forest soils were a carbon sink of about 10% of the net carbon sink of the forest biomass in the period 1961–1996. For the time period 1990 to 2006 these estimates resulted in a C stock increase of 0.5 Mt C per year (0.7 Mt C if temperature change is not considered). Main reasons for this estimated increase of the forest soil C pool in Austria were the increase in forest area (former land use changes to forests and the related higher C input to the soils), an increase in litter fall due to the biomass increase per ha in the Austrian forests and a higher input of harvest residues into the soil due to the increase in harvest.

However, these results have to be considered as hypothetical because repeated soil measurements are missing, which would help to verify the modelled carbon stock changes. An actual repetition of a soil inventory in England and Wales detected a decrease in soil C stocks independent from the land use. The authors assume an important influence of climate change in their findings (BELLAMY et al. 2005). For all these reasons, we follow the Tier 1 approach of the IPCC GPG and assume that the soil C pool of sector 5.A.1 (forests remain forests) did not change (0). The uncertainty of this assumption is estimated pragmatically to range from -0.4 to +0.5 Mt C per year. The positive end of this range is based on the totals of our estimates (see above). For the negative end the totals of only the C stock reducing impacts in our estimates are considered (e.g. temperature rise, increase in un-stocked forest area).

A re-assessment of the forest soil inventory is currently ongoing on selected sites. In addition, there is a project to derive models with the help of these measured data, with the available data of the NFIs on the changes of the organic humus layer as well as with relevant information in literature. This altogether will allow an improvement of the estimates for the carbon stock changes in the forest soils.

### Biomass burning

The controlled burning of managed forest is not carried out in Austria. $CO_2$ emissions caused by biomass burning due to wildfires are included in sector *5.A.1 Forest land remaining forest land*, as already reported in previous reports. Estimates of emissions from non-$CO_2$ gases from this category are reported. According to the IPCC (GPG 2003) a TIER 1 method following the equation 3.2.20 was applied.

$$Lfire\ (t\ GHG) = A * B * C * D * 10^{-6}$$

*A* *area burnt (ha)*

*B* *mass of available fuel, kg dm* $ha^{-1}$

*C* *combustion efficiency*

*D* *emission factor*

Data on the area affected by wildfires are available for the years 1990 to 2007. According to the references in the IPCC GPG a mean value of 19.8 t/ha biomass consumption and a combustion efficiency of 0.45 was applied. The emission factors for $N_2O$ and $CH_4$ where also taken from table 3.A.1.16 (IPCC GPG 2003).

However, the amounts of $N_2O$ and $CH_4$ emissions caused by biomass burning due to wildfires are negligible, as they range between 0.002 and 0.2 Gg $CO_2$ equivalents. This is due to the small area concerned (8–200 ha/year).

#### 7.2.1.2 QA/QC, Verification, Uncertainty Assessment

The NFI is based on a very comprehensive quality assurance system which allows the exact identification of the right location of the grid and sample points, guarantees the repeated measurement of the right trees (permanent marked grid) and indicates at once implausible figures for individual parameters during the measurements on site and any missing trees compared to the period before (further details are given in (SCHIELER & HAUK 2001)).

The calculation of the data for category 5 A 1 is embedded in the overall QA/QC-system of the Austrian GHG inventory (see Chapter 1.6).

An uncertainty estimate for the carbon stock changes of living biomass has been carried out several years ago (UMWELTBUNDESAMT 2000) (see Table 192). In the meanwhile, the calculation method has been changed and country specific biomass functions for Austria are used. These changes likely reduce the uncertainties given in Table 192. A new uncertainty assessment is planned.

This previous calculation of the uncertainty of the reported data for category 5.A.1 (biomass) took into account:

- the statistical uncertainty of the forest inventory,
- the uncertainty related to the calculation of annual data,
- the uncertainty related to the missing consistency of different statistics[57]
- and the uncertainty of each conversion and expansion factor.

The estimates of the uncertainty included a consistency approach with other national statistics. This approach went far beyond the usual approach of uncertainty estimates which are only based on single statistics or single input data (Table 192), details are described in (UMWELTBUNDESAMT 2000). Error propagation was used to calculate the overall uncertainty, which was on average ±30% for the annual net change of biomass C stocks between 1961 and 1996.

*Table 192:Relative uncertainties of the previous biomass estimates of sector 5.A.1 (UMWELTBUNDESAMT 2000).*

<table>
<tr><th></th><th colspan="5">Relative uncertainties [%]</th></tr>
<tr><th></th><th>Forest inventory</th><th>Uncertainty related to the calculation of annual data and to the necessary consistency of different statistics</th><th>Conversion factor „m³ o.b. → t dm“</th><th>Conversion factor „t dm stemwood → t dm whole tree“</th><th>Conversion factor „t dm → t C“</th></tr>
<tr><td>Increment</td><td>2.0</td><td>3.2</td><td rowspan="2">11.1</td><td rowspan="2">6.5</td><td rowspan="2">2.0</td></tr>
<tr><td>Harvest</td><td>3.5</td><td>12.2</td></tr>
</table>

[57] e.g.: There are three different Austrian statistics for annual harvest: measured harvest according to NFI, national annual records of wood felled, and the national wood balance.

#### 7.2.1.3 Recalculations

The figures of the area affected by wildfires were updated for the years 2003 to 2007. In general these areas are very small in Austria, thus the revised data did not result in noticeable changes of $N_2O$ and $CH_4$ emissions for these subcategories.

### 7.2.2 Land Use Changes to Forest Land (5.A.2)

#### 7.2.2.1 Methodological Issues

Since data on land use changes from and to forest land derive from the same data sets the methodology and activity data are described for both land use change activities from and to forests in this chapter.

**Activity data**

Areas were land use changes to and from forests take place are generally very small in Austria (see *Figure 26*). By means of the NFI, which follows a regular grid of 4 x 4 km (see also chapter 7.2.1.1) land use changes can only be observed by chance and therefore the number of grid points with observed land use change is small. Therefore the estimates for land use changes from and to forest uses have a significantly higher uncertainty compared to the uncertainty for the total forest land (see below).

In case a land use change has been observed at an inventory point of the last NFI (2000/02) the type of the neighbouring non-forest land was recorded. The evaluation of 2/3 of such forest boundary points led to the land use statistic shown in the Table 193 and Table 194. It is assumed, that the other third follows the same distribution.

The total increase of forest area between the NFI 1991/96 and 2000/02 was 68 000 ha (total forest area). The loss of forest area for the same period was calculated to be about 32 000 ha, leading to a net increase of the total forest area of about 36 000 ha (19 000 ha for the productive forest) between these NFIs.

*Table 193:Land use changes to forest (%, ha) observed for the period 2000/02; based on (BFW 2004a).*

| Categories of land use changes according to the IPCC GPG 2003 | Land use changes to forest land (% of total conversion to forest land) | Land use changes to forest land [1000 ha] |
|---|---|---|
| Cropland (5 A.2.1) | 16.0 | 10.9 |
| Grassland (5 A.2.2) | 59.0 | 40.3 |
| Wetlands (5 A.2.3) | 5.0 | 3.4 |
| Settlements (5 A.2.4) | 14.0 | 9.6 |
| Others (5 A.2.5) | 6.0 | 4.1 |
| **Total** | **100.0** | **68.3** |

*Table 194:Land use changes from forest (%, ha) observed for the period 2000/02; based on (BFW 2004a).*

| Categories of land use changes from forests according to the IPCC GPG 2003 | Land use changes from forest land (% of total conversion of forest land) | Land use changes from forest land [1 000 ha] |
|---|---|---|
| Cropland (5 B.2.1) | 5.0 | 1.6 |
| Grassland (5 C.2.2) | 53.0 | 16.8 |
| Wetlands (5 D.2.3) | 3.0 | 0.9 |
| Settlements (5 E.2.4) | 15.0 | 4.8 |
| Others (5 F.2.5) | 24.0 | 7.6 |
| **Total** | **100.0** | **31.8** |

As shown in Table 193 and Table 194 the land use changes to and from forests mainly appear from/to grassland sites (59% or 53%, respectively). The land use changes from or to other categories are far below this value and should only be seen as relative figures, due to a high degree of uncertainty (see 1.3.1.2).

For the years before 1997 back to 1970 it was assumed that the land use changes between two observation periods show the same ratio of distribution as in the latest inventory because only the total amount of forest increase and loss is available for previous NFI periods.

The annual increment of stemwood over bark (o.b.) on areas which have become forests was estimated with 3 $m^3$/ha.

The annual average loss of stemwood o.b. on lost forest areas was estimated with 60 $m^3$/ha on average for deciduous and coniferous trees.

An overview of the emissions/removal from land use changes from and to forests is given in Table 188.

### Conversion factors

In Table 195 the conversion factors for the total above ground biomass (with no further division into coniferous and deciduous) is shown.

*Table 195:Conversion factors for land use changes to forest land.*

| Conversion factors | Total biomass (conif. and dec.) |
|---|---|
| $m^3$ stemwood o.b.→ t dm whole tree (incl. also below ground biomass)<br>increment<br>harvest | <br>0.8<br>0.72 |
| t dm whole tree → t C whole tree | 0.49 |

### Soil

The estimates of the soil C stock changes of land use change areas from and to forests follow the equation below and the same methodological approach as described in Chapter 7.3.3.3.

$$\Delta\ SOC = (SOC_O - SOC_{O\text{-}T})/20$$

*Δ SOC = average annual carbon stock change in Austrian cropland soils (t C $ha^{-1}$ $a^{-1}$) over the first 20 years*

*$SOC_O$ = carbon stock in Austrian soils after conversion (e.g forest land→121 t C $ha^{-1}$)*

*$SOC_{O-T}$ = carbon stock in Austrian soils before conversion (e.g. area weighted mean value of soil C stocks from grassland converted to forest land: 102 t C $ha^{-1}$)*

The annual change in carbon stock of mineral soils converted from and to forest land equals Δ SOC * conversion area.

The input data for forest soil C stocks represent 0–50 cm soil depth. Estimates for the soil C stock changes of and between the other land use categories are based on a soil depth of 0–30 cm (see chapter 7.3.3.3).

Therefore, the following soil C stocks (0–50 cm) have been used to calculate emissions/removals of LUC from and to forests:

- Forests: 121 t C/ha (UMWELTBUNDESAMT 2000)
- Cropland: 60 t C/ha, (GERZABEK et al. 2005)
- Vineyards: 58 t C/ha, (GERZABEK et al. 2005)
- Orchards/garden: land 78 t C/ha, (GERZABEK et al. 2005)
- Grassland (intensive use): 81 t C/ha, (GERZABEK et al. 2005)
- Grassland (extensive use) 119 t C/ha (GERZABEK et al. 2005).
- Bogs: 150 t C/ha (expert judgement)
- Surface waters and reed beds: 0 t C/ha (expert judgement)
- Settlements and traffic area (on average): 50 t C/ha (expert judgement)
- Alpine shrub lands: 119 t C/ha (KÖRNER et al. 1993)
- Rocks and stone slopes: 0 t C/ha (expert judgement)
- Other land uses: 30 t C/ha (expert judgement)

The values for forests, cropland and grassland represent averages which are based on Austrian soil inventories for forests (BFW 1992) and agricultural land (AMT DER STEIERMÄRKISCHEN LANDESREGIERUNG 1988–1996, AMT DER TIROLER LANDESREGIERUNG 1988, AMT DER OBERÖSTERREICHISCHEN LANDESREGIERUNG 1993, AMT DER SALZBURGER LANDESREGIERUNG 1993, AMT DER NIEDERÖSTERREICHISCHEN LANDEREGIERUNG 1994, AMT DER BURGENLÄNDISCHEN LANDESREGIERUNG 1996, AMT DER KÄRNTNER LANDESREGIERUNG 1999, compiled in the Austrian Soil Information System BORIS).

Based on these soil C stock data and the measured land use change areas by the NFI an area weighted mean value of soil C stock was calculated for each land use category of the IPCC GPG.

*Table 196: Area weighted mean values for carbon stocks in mineral soils (0–50 cm) of land use change areas from and to forest land.*

| Land use categories (IPCC – GPG) | C-stocks (t $ha^{-1}$) in soils (0–50 cm) | |
|---|---|---|
| | LUC to forest land | LUC from forest land |
| Forest land | 121 | 121 |
| Cropland | 61 | 62 |
| Grassland | 102 | 104 |
| Wetland | 30 | 0 |
| Settlements | 43 | 32 |
| Other land | 30 | 41 |

#### 7.2.2.2 Uncertainty Assessment

The results of the NFI provide very accurate and reliable data on the increment, harvest, distribution of tree species and other characteristics of the Austrian forest as a whole. The regular grid of 4 x 4 km is an appropriate way to meet this information. It is obvious, that only a limited number of the observed grid points of the NFI by chance describe a forest boundary, where land use changes can be detected. In addition, the stock changes in soils due to LUC are based on accounting and discounting of representative mean values. Therefore a high uncertainty for the results of the sub categories on land use changes from and to forests must be considered (expert judgement: between 50 and 100%, depending on the other categories from or to which forest land changes).

#### 7.2.2.3 Recalculations

With regard to category 5.A.2.4 Settlement converted to forest land the decrease in biomass stocks in these areas was calculated with the C stocks for trees and shrubs (total 32,6 t C/ha) as described under 7.6.

## 7.3 Cropland (5.B)

In this category emissions/removals from cropland management are considered.

In 2007 1.45 Mio ha of Austria were arable land including annual and permanent crops (STATISTIK AUSTRIA 2008). The land use changes are derived from the IACS data base, in 2007 the land use change area to cropland was 36 600 ha. The annual emissions from 1990-2007 range between 1 987 Gg $CO_2$ equivalent and 2 308 Gg $CO_2$ equivalent. The source is mainly caused by soil C stock changes of land use change areas, particularly by grassland converted to cropland.

In Sector 5.B the estimate of emissions from cropland remaining cropland, land converted to cropland and liming is carried out.

During the in-country review of the initial report of Austria (February 2007) the ERT encouraged Austria to further improve the default values of biomass carbon stock in cropland. Accordingly the carbon stock of living biomass in cropland was recalculated by using country specific data from Statistic Austria (STATISTIK AUSTRIA 2007). For all annual crops mentioned in the Statistical Report the harvested yield as well as the yield of straw and leaves (potatoes, beets…) has been considered. For the current submission the root:shoot ratios of the United States Department of Agriculture were applied to estimate the total plant biomass. Since the U.S. belong also to the temperate region the use of the U.S. root:shoot ratios should allow good estimates. These factors represent the average root:shoot values from 1990-2005 for different types of annual crops (WEST 2008). The aboveground biomass was multiplied with the root:shoot ratio to provide an estimate of the below-ground biomass. The average mean of the aboveground and below ground biomass of the crops for a time-period of 10 years were calculated and weighted by the crop area. This leads to average carbon stocks of living biomass in cropland of 6.99 t C/ha. This country specific value is 40% higher than the IPCC-GPG (2003) default value.

For some perennial cropland types (Christmas trees, energy plants) also new country specific carbon biomass stocks were applied (chapter 7.3.1.1).

These calculations were made for the individual years from 1990 to 2007.

Some management practices (e.g. slash and burn etc.) and some sub categories (categories 5 B 2 3, 5 B 2 4, 5 B 2 5) do not occur in Austria.

Emissions/Removals were estimated for the sub categories and related sources/sinks as shown in Table 197.

*Table 197: Sources (or sinks) considered for cropland management.*

| **Category/source or sink** |
|---|
| 5 B Cropland – total |
| 5 B 1 Cropland remaining cropland |
| - carbon stock change in living biomass of perennial cropland and LUC between annual and perennial cropland |
| - carbon stock change due to changes in organic matter input (harvest residues) to cropland soils |
| - $CO_2$ emissions due to liming of cropland and grassland |
| 5 B 2 Land converted to cropland |
| 5 B 2 1 Forest land converted to cropland |
| 5 B 2 2 Grassland converted to cropland |
| - carbon stock change in living biomass of annual/perennial cropland |
| - carbon stock change due to changes in organic matter input to cropland soils |

*Table 198:Activity data for cropland (1990–2007) in ha –conversion status 20 years; other land use changes are not occuring.*

| | **5.B Total cropland** | **5.B.1.Cropland remaining Cropland** | **Perennial Cropland converted to Cropland** | **Cropland converted to perennial Cropland** | **5.B. 2. Land converted to Cropland** | **2.1 Forest Land converted to cropland** | **2.2 Grassland converted to Cropland** | **Grassland converted to perennial cropland** |
|---|---|---|---|---|---|---|---|---|
| 1990 | 1 507 533 | 1 000 606 | 9 451 | 11 309 | 506 927 | 9 650 | 495 750 | 1 526 |
| 1991 | 1 526 723 | 1 018 187 | 9 439 | 11 395 | 508 536 | 9 924 | 497 062 | 1 550 |
| 1992 | 1 518 074 | 1 008 043 | 9 427 | 11 478 | 510 031 | 10 198 | 498 260 | 1 573 |
| 1993 | 1 500 454 | 988 535 | 9 419 | 11 567 | 511 919 | 10 472 | 499 850 | 1 597 |
| 1994 | 1 501 408 | 988 359 | 9 411 | 11 655 | 513 049 | 9 978 | 501 450 | 1 621 |
| 1995 | 1 492 280 | 978 528 | 9 399 | 11 738 | 513 752 | 9 362 | 502 747 | 1 644 |
| 1996 | 1 491 907 | 976 952 | 9 394 | 11 828 | 514 955 | 8 745 | 504 542 | 1 668 |
| 1997 | 1 500 207 | 984 015 | 9 389 | 11 919 | 516 192 | 8 129 | 506 372 | 1 691 |
| 1998 | 1 507 728 | 990 661 | 9 380 | 12 003 | 517 067 | 7 512 | 507 840 | 1 715 |
| 1999 | 1 470 396 | 951 402 | 9 379 | 12 099 | 518 994 | 7 261 | 509 994 | 1 739 |
| 2000 | 1 462 108 | 941 558 | 9 374 | 12 188 | 520 550 | 7 010 | 511 778 | 1 763 |
| 2001 | 1 460 067 | 931 734 | 9 419 | 12 294 | 528 333 | 6 759 | 519 752 | 1 822 |
| 2002 | 1 459 095 | 930 412 | 9 277 | 12 454 | 528 683 | 6 507 | 520 335 | 1 841 |
| 2003 | 1 459 991 | 932 172 | 9 392 | 12 496 | 527 819 | 6 256 | 519 724 | 1 839 |
| 2004 | 1 454 572 | 920 863 | 9 339 | 12 453 | 533 709 | 6 062 | 525 828 | 1 819 |
| 2005 | 1 455 984 | 920 420 | 9 329 | 12 381 | 535 564 | 5 867 | 527 881 | 1 816 |
| 2006 | 1 453 893 | 920 228 | 9 283 | 12 272 | 533 665 | 5 672 | 526 195 | 1 797 |
| 2007 | 1 451 900 | 904 073 | 9 475 | 12 507 | 547 827 | 5 478 | 540 501 | 1 848 |

### 7.3.1 Cropland remaining Cropland (5.B.1)

This section provides information about emissions/removals for cropland remaining cropland. For the estimates of the relevant areas annual crops and woody perennial species like orchard, vineyards, house gardens, and plantations for Christmas trees and biomass are considered according to GPG (IPCC 2003). For the calculation of the biomass carbon stocks of Christmas trees, energy crops and the soil carbon stocks country specific values were used. The biomass carbon stock of orchards, vineyards and house garden were estimated applying the IPCC Tier 1 methodology. Below the source of activity data and in the following sub chapters the methodologies and emission factors used for the estimates are explained.

According to GPG (IPCC 2003) the emissions/removals of land use change from cropland to perennial cropland and vice versa have to be considered in this category.

The annual removals range between 287.5 Gg $CO_2$ and 87 Gg $CO_2$.

*Table 199: Emissions from cropland management (1990–2007) in Gg $CO_2$; other land use changes are not occuring.*

| | 5 B Total Cropland | 1 Cropland remaining Cropland | Liming | Perennial Cropland converted to Cropland | Cropland converted to perennial Cropland | 2 Land converted to Cropland | 2.1 Forest Land converted to Cropland | 2.2 Grassland converted to Cropland | Grassland converted to perennial Cropland | $N_2O$ [$CO_2$ e] |
|---|---|---|---|---|---|---|---|---|---|---|
| 1990 | 1 987.46 | -287.48 | 90.30 | 112.12 | -2.41 | 2 074.93 | 131.17 | 1 686.70 | 4.99 | 252.07 |
| 1991 | 1 994.48 | -289.26 | 91.06 | 112.84 | -2.43 | 2 082.27 | 134.12 | 1 690.35 | 5.05 | 252.74 |
| 1992 | 2 008.08 | -283.36 | 90.72 | 112.50 | -2.57 | 2 090.80 | 137.08 | 1 695.27 | 5.11 | 253.36 |
| 1993 | 2 044.11 | -257.23 | 90.69 | 111.62 | -2.79 | 2 101.82 | 140.03 | 1 702.47 | 5.15 | 254.17 |
| 1994 | 2 053.67 | -248.99 | 90.73 | 111.65 | -2.90 | 2 103.18 | 134.70 | 1 708.28 | 5.21 | 254.99 |
| 1995 | 2 054.49 | -239.06 | 91.97 | 110.60 | -3.13 | 2 094.11 | 118.54 | 1 714.67 | 5.25 | 255.66 |
| 1996 | 2 106.53 | -187.84 | 91.95 | 110.51 | -3.26 | 2 095.15 | 111.90 | 1 721.38 | 5.30 | 256.58 |
| 1997 | 2 123.60 | -171.85 | 92.08 | 110.47 | -3.38 | 2 096.28 | 105.25 | 1 728.15 | 5.36 | 257.51 |
| 1998 | 2 132.76 | -161.87 | 91.64 | 110.03 | -3.54 | 2 096.49 | 98.61 | 1 734.21 | 5.41 | 258.26 |
| 1999 | 2 159.06 | -141.79 | 91.63 | 110.01 | -3.66 | 2 102.87 | 95.90 | 1 742.13 | 5.47 | 259.37 |
| 2000 | 2 169.42 | -135.11 | 90.35 | 109.37 | -3.86 | 2 108.67 | 93.19 | 1 749.68 | 5.52 | 260.28 |
| 2001 | 2 174.82 | -142.41 | 90.27 | 119.66 | -3.71 | 2 111.01 | 90.49 | 1 750.04 | 6.13 | 264.34 |
| 2002 | 2 177.83 | -135.47 | 90.23 | 81.17 | -2.91 | 2 144.81 | 87.78 | 1 786.75 | 5.64 | 264.65 |
| 2003 | 2 239.21 | -129.34 | 90.27 | 126.91 | -5.86 | 2 157.23 | 85.08 | 1 802.54 | 5.28 | 264.34 |
| 2004 | 2 212.31 | -111.26 | 90.22 | 92.47 | -7.29 | 2 148.17 | 82.98 | 1 792.76 | 5.01 | 267.43 |
| 2005 | 2 247.38 | -110.43 | 90.28 | 101.36 | -7.72 | 2 173.90 | 80.88 | 1 819.33 | 5.22 | 268.47 |
| 2006 | 2 248.49 | -109.67 | 90.09 | 93.43 | -8.29 | 2 182.92 | 78.78 | 1 831.57 | 4.96 | 267.61 |
| 2007 | 2 308.96 | -87.00 | 90.04 | 142.59 | -2.40 | 2 165.74 | 76.68 | 1 808.17 | 6.00 | 274.88 |

**Methodological Issues**

***Activity data***

The data of the areas were taken from STATISTIK AUSTRIA (STATISTIK AUSTRIA 1990–2008). The area of cropland remaining cropland represents the total cropland area minus land converted to cropland.

Data for land use change between and within grassland and cropland were taken from IACS (Integrated Administrative Control System). This database for market organisation premiums and direct compensation for farmers is a central information system about agriculture. IACS provides information for land use change of cropland (annual, perennial) and grassland. Land use change from and to wetland is insufficiently collected in IACS. Land use change from and to settlement and other land is not provided by IACS.

For the year 2001– 2006 for the calculation of land use changes between and within grassland and cropland a sample survey representing more than 4.600 cadastral municipalities was taken to calculate the land use changes. From these results the land use changes in Austria were extrapolated (except for Alps and alpine meadows, which were not part of IACS). From the land use change of the years 2001-2003 an average "land use factor" for cropland and grassland was calculated and applied for the years 1990–2000.

In 2007 for the first time the complete survey of 7777 cadastral municipalities was provided. Hence in future the calculation of the land use change areas will be based on a full IACS survey. The results of the IACS sample survey and the IACS full survey showed a good agreement. It is proposed to obtain the full survey data from 2001 on and to recalculate the land use change areas.

In 2007 74% of the agriculturally used areas showed no land use change, 0,5% represented cropland converted to grassland and 1.3% grassland converted to cropland. As in 2007 the areas of alpine meadows were for the first time included in the IACS database there was  a share of non corresponding areas within the IACS of 25% from 2006 to 2007. In the years before the share of non corresponding areas in the landuse change data were about 5-7%.

#### 7.3.1.1 Changes of carbon stock in biomass of perennial cropland

The biomass of annual crops is not included in the estimation because it is harvested every year. Thus, there is no long term carbon storage.

The calculation of perennial crops includes orchards, vineyards, Christmas trees, energy crops and a share (50%) of house gardens which are assumed to be perennial.

According to Tier 1 GPG (2003) for perennial cultures as viticulture, horticulture and house gardens – a steady state of biomass increase in the first 30 years was assumed. 3.33% of these cultures are removed and cause emissions. For older cultures the annual increase of biomass is assumed to be equal to the losses by harvesting.

For Christmas trees and energy crops a country specific steady state of biomass increase in the first 10 years and 6 years respectively was assumed. The observation period started in 1960 based entirely on the data from Statistik Austria (Statistik 1960–2008).As the time series from 1960´s showed some inconsistencies due to the intervals of full agricultural surveys and changes in data collection, the data of the time series were interpolated.

*Table 200:Estimated area of perennial crops from 1990–2007 in ha.*

| | Viticulture | Horticulture | Garden | Energy crops | Christmas trees | Total area |
|---|---|---|---|---|---|---|
| 1990 | 58 203 | 19 693 | 13 809 | 1 027 | 1 167 | 93 899 |
| 1991 | 57 462 | 19 248 | 12 943 | 1 210 | 1 306 | 92 169 |
| 1992 | 56 720 | 18 804 | 12 077 | 1 394 | 1 444 | 90 439 |
| 1993 | 55 979 | 18 359 | 11 211 | 1 577 | 1 583 | 88 709 |
| 1994 | 55 803 | 18 704 | 10 345 | 1 571 | 1 707 | 88 130 |
| 1995 | 55 627 | 19 049 | 9 479 | 1 565 | 1 830 | 87 550 |
| 1996 | 54 061 | 18 673 | 9 129 | 1 615 | 1 878 | 85 355 |
| 1997 | 52 494 | 18 297 | 8 778 | 1 665 | 1 925 | 83 159 |
| 1998 | 52 067 | 17 995 | 8 050 | 1 542 | 1 973 | 81 627 |
| 1999 | 51 641 | 17 694 | 7 321 | 1 420 | 2 020 | 80 096 |
| 2000 | 51 214 | 17 392 | 6 593 | 1 297 | 2 068 | 78 564 |
| 2001 | 50 304 | 17 120 | 6 609 | 1 403 | 1 962 | 77 398 |
| 2002 | 49 393 | 16 849 | 6 625 | 1 510 | 1 856 | 76 232 |
| 2003 | 48 483 | 16 577 | 6 641 | 1 616 | 1 750 | 75 066 |
| 2004 | 47 572 | 16 305 | 6 657 | 1 722 | 1 644 | 73 900 |
| 2005 | 48 846 | 15 851 | 5 924 | 1 711 | 1 846 | 74 177 |
| 2006 | 50 119 | 15 396 | 5 191 | 1 700 | 2 048 | 74 454 |
| 2007 | 50 119 | 15 396 | 5 191 | 915 | 2 048 | 73 669 |

Figure 27 indicates the decrease of the total perennial cropland area from 1960 to 2007. This trend was mainly caused by the continous decline of the fruit growing area and the house garden area. According to IPCC-GPG 2003 (Tier 1 method) 3.33% of perennial crops are removed after the rotation period of 30 years. Hence the decrease of orchard and house garden area causes emissions. The area under vine production – which has the highest share of perennial crop area - increased until 1990, resulting in a net sink of the entire perennial crop category in the first years of the 1990´s. However the decline of the vine area after 1990 lead to a living biomass change from a sink to a source after 1994. Christmas trees and energy crops have only a small share of the perennial cropland area, and the calculation is based on country specific values (Tier 2). The energy crop cultivation was assumed to start in 1990 (according to Statistik Austria) with a rotation period of 6 years. After this period the energy crops also cause emissions.

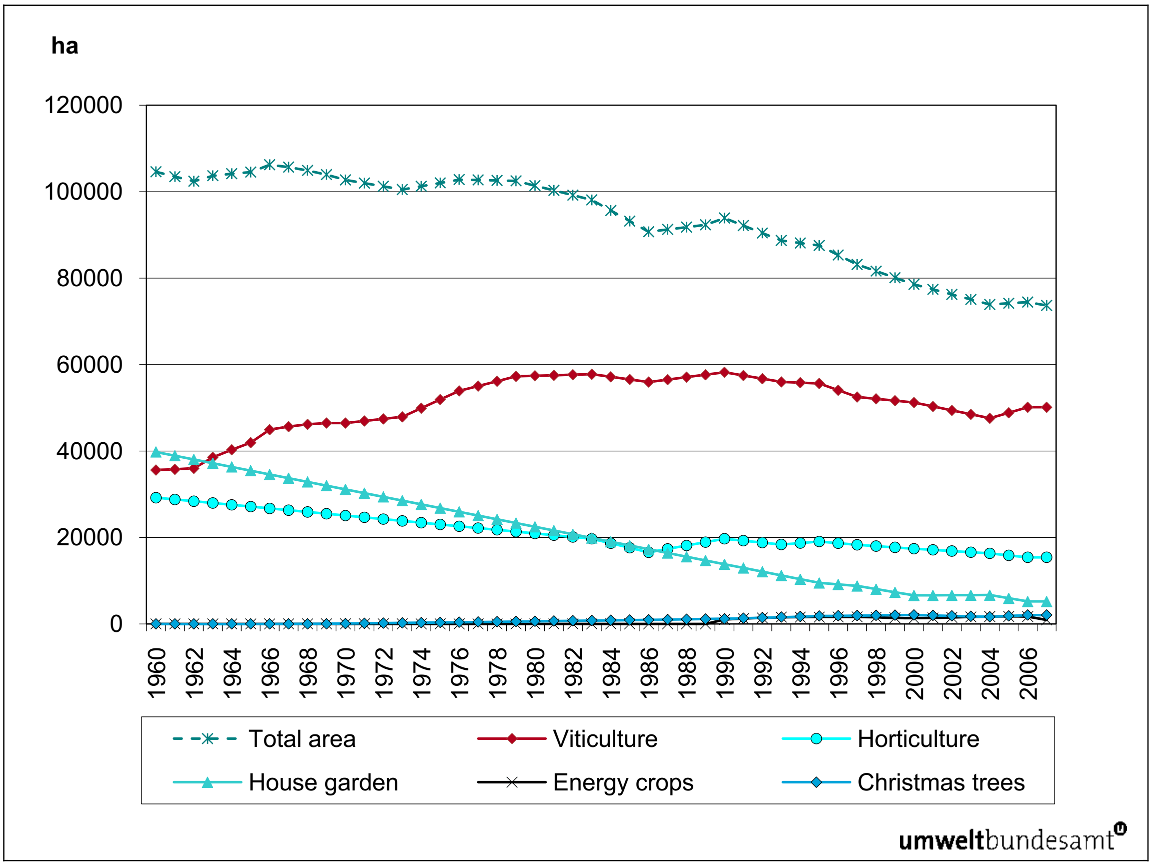


*Figure 27: Trend of perennial cropland area from 1960–2007.*

For calculating the carbon stock change of living biomass of viticulture, horticulture and house gardens the following Tier 1 formula was applied:

*Annual change in biomass = (area of perennial cropland * Carbon accumulation rate) – (area of perennial cropland before 30 years * 0.033 * biomass carbon stock at harvest)*

For the carbon accumulation rate the IPCC GPG default value of 2.1 t C $ha^{-1}a^{-1}$ was used.

For the above ground biomass carbon stock at harvest the IPCC GPG default value of 63 t C $ha^{-1}$ was used for house garden, viticulture and horticulture.

For calculating the carbon stock change of living biomass from Christmas trees the following formula was applied using country specific data:

*Annual change in biomass = (area of Christmas trees * Carbon accumulation rate) – (area of Christmas trees before 10 years * 0.1 * biomass carbon stock at harvest)*

According to (BMLFUW (2000a) and expert judgement for Christmas trees a country specific average value of 36 t C $ha^{-1}$ for the carbon stock at harvest was used. The rotation period for Christmas trees is 10 years that leads to an accumulation rate of 3.6 t C $ha^{-1}$ $a^{-1}$.

For energy crops also a country specific value of 30 t C $ha^{-1}$ for the carbon stock at harvest was used (SPLECHTNA & GLATZEL 2005). According to literature the rotation period for energy crops is 6 years that leads to an carbon accumulation rate of 5 t C $ha^{-1}$ $a^{-1}$

For calculating the carbon stock change of living biomass on energy crops the following formula was applied:

*Annual change in biomass of energy crops = (area * Carbon accumulation rate) – (area of energy crops before 6 years * 0,166 * biomass carbon stock at harvest)*

Figures for the area of energy crops are available since 1990 (STATISTIK AUSTRIA 1991).

*Table 201:Carbon biomass stock of perennial cropland.*

| Perennial crop | Annual increase in carbon stock biomass (t C $ha^{-1}$) | Rotation period (year) | Method |
|---|---|---|---|
| vine, orchards, garden | 2,1 | 30 | Tier 1 GPG (2003) |
| Christmas tree | 3.6 | 10 | Tier 2, country specific values |
| Energy crops | 5 | 6 | Tier 2, country specific values |

### 7.3.1.2 Changes of carbon stocks in biomass of perennial cropland converted to annual cropland

The annual land use change from perennial cropland converted to annual cropland in 2007 was 635 ha.

For the calculation of the annual change in carbon stocks of living biomass of land converted to cropland the IPCC Tier 1 method -equation 3.3.8 was applied (IPCC 2003) – for annual cropland the country specific value was used:

*Annual change in biomass =annual area of converted land * ($L_{conversion}$ + $\Delta C_{growth}$)*

*$L_{conversion} = C_{after} - C_{before}$*

*$C_{after}$ = carbon stock immediately after conversion is 0*

*$\Delta C_{growth}$ = country specific t value for annual crops carbon accumulation rate is 6.99 t C $ha^{-1}yr^{-1}$*

*$C_{before}$ = IPCC default value for carbon stock of woody biomass before conversion is 63 t C $ha^{-1}$*

### 7.3.1.3 Changes of carbon stocks in biomass of annual cropland converted to perennial cropland

The annual land use change from annual cropland converted to perennial cropland in 2007 was 762 ha.

For the calculation of the annual change in carbon stocks in living biomass of land converted to cropland the IPCC Tier 1 method -equation 3.3.8- was applied (GPG; IPCC 2003) – for annual cropland the country specific value was used:

*Annual change in biomass =annual area of converted land * ($L_{conversion}$ + $\Delta C_{growth}$)*

*L conversion= C after –C before*

*Cafter = carbon stock immediately after conversion is 0*

*ΔCgrowth = IPCC default value for perennial crops carbon accumulation rate is 2.1 t C ha-1yr-1*

*C before = country specific value of carbon stock of annual crops before conversion is 6,99 t C ha-1yr-1*

#### 7.3.1.4 Changes of carbon stock in mineral soils of cropland remaining cropland

According to the soil inventories in Austria organic soils are not occurring in arable land in Austria.

Emissions/removals were calculated using a country specific methodology. For the soil organic carbon content the Austrian specific average value of 50 t C/ ha for 0–30 cm depth of cropland was used which is based on the results of the Austrian soil inventory (GERZABEK et al. 2003, STREBL et al. 2003)

The methodology followed closely the GPG guidelines, where the IPCC formula includes a tillage factor ($F_{MG}$), a land use factor ($F_{LU}$) and an input factor ($F_I$) (table 3.3.4; IPCC 2003).

Average (weighted) management factors for Austria were calculated on basis of crop and management statistics of the Austrian agriculture (STATISTIK AUSTRIA 1985–2003, BMLFUW 1985–2003). Changes in agricultural management (e.g. increase of biological agriculture), tillage (e.g. crop residues remain on the fields) and crop rotation (increase of legumes and greening of arable areas) were considered since 1985.

*Table 202: Weighted mean values of management factors.*

| factor | $F_{LU}$ modified | $F_{MG}$ modified | $F_I$ modified |
|---|---|---|---|
| 1985 | 0.820 | 1.035 | 0.966 |
| 1990 | 0.822 | 1.035 | 0.976 |
| 1995 | 0.829 | 1.039 | 0.977 |
| 2003 | 0.828 | 1.042 | 0.990 |

It was assumed that the Austrian specific reference value for arable land of 50 t C $ha^{-1}$ represents the soil carbon stock of 1990. This assumption is supported by the fact that soil inventories were carried out between 1988 and 1996. The carbon stock changes of soil from 1990–2004 were calculated in consideration of the modified management factors. For the default inventory time of 20 years an increase from 50 t C $ha^{-1}$ to 51.41 t C $ha^{-1}$ was estimated.

The formula used for calculating the change in carbon stocks of cropland soils was:

$$SOC_{1990+20} = SOC_{1990} + (SOC_{1990} \text{ x } ((Flu \text{ x } Fmg \text{ x } Fi)_{2003}/(Flu \text{ x } Fmg \text{ x } Fi)_{1990} \text{ x } 100)$$

$$\Delta\ SOC_{20} = (SOC_{1990+20} - SOC_{1990})/\ 20 = 0.07t\ C\ ha^{-1}\ a^{-1}$$

*Annual change in carbon stock of mineral soils in cropland remaining cropland = $\Delta$ $SOC_{20}$ * land area*

*$SOC_{1990}$ .................. 50 t C $ha^{-1}$, Austrian specific soil carbon content per ha 0–30 cm for cropland in 1990 (GERZABEK et al. 2003)*

*$SOC_{1990+20}$............... av. soil carbon stock per ha after 20 years based on different land management factors of 2003 compared to 1990 (calculated value 51.41 t C $ha^{-1}$)*

*$\Delta$ $SOC_{20}$.................. average carbon stock change in Austrian cropland soils (t C $ha^{-1}$ $a^{-1}$) over a period of 20 years*

*$(Flu \text{ x } Fmg \text{ x } Fi)_{1990}$. Management factor 1990*

*$(Flu \text{ x } Fmg \text{ x } Fi)_{2003}$. Management factor 2003*

#### 7.3.1.5 Changes of carbon stock in soils of perennial cropland converted to annual cropland

The area in conversion status from perennial cropland to cropland for a time period of 20 years is rather stable and ranges from 9 451 ha to 9 475 ha for the period 1990 to 2007.

Emissions/removals were calculated by country specific values for carbon stocks in mineral soils of perennial cropland. According to the Austrian soil inventories (GERZABEK et al. 2003) the C-stock of soils in perennial cropland is between 48–67 t C $ha^{-1}$ (0–30 cm), with a weighted mean of 57 t C $ha^{-1}$.

According to IPCC GPG (Tier 1), the calculation steps for determining $SOC_0$, $SOC_{(0-T)}$ and net soil change per ha of area are as follows:

- Step 1: Select the reference carbon stock value ($SOC_{REF}$), based on climate and soil type, for each area of land being inventoried
  → not necessary as Austrian specific values were available.
- Step 2: Calculate the pre-conversion C stock ($SOC_{0-T}$) of land being converted into cropland, based on the reference carbon stock and management factors
  → average carbon stock in Austrian soils of perennial cropland 57 t C $ha^{-1}$
- Step 3: Calculate $SOC_0$ by repeating step 2 using the same reference carbon stock for Austrian cropland
  → average carbon stock in Austrian soils of annual cropland 50 t C $ha^{-1}$
- Step 4: Calculate the average annual change in soil C stock for the area over the inventory period (20 years)
- Step 5: multiply the average annual change in soil C stock by the conversion area.
  $\Delta SOC_{20} = (SOC_O - SOC_{O-T})/20 = -0.35\ t\ C\ ha^{-1}\ a^{-1}$
  *Annual land use change in carbon stock of mineral soils in perennial cropland converted to cropland=*
  *Δ SOC * conversion area*

*Δ $SOC_{20}$...average carbon stock change in Austrian cropland soils (t C $ha^{-1}$ $a^{-1}$) over a period of 20 years*

#### 7.3.1.6 Changes of carbon stock in soils of annual cropland converted to perennial Cropland

The area in conversion status from annual cropland to perennial cropland for a time period of 20 years ranges from 11 309 ha to 12 507 ha for the years 1990 to 2007

Emissions/removals were calculated by country specific values for carbon stocks in mineral soils of perennial cropland and annual cropland, respectively.

*Annual land use change in carbon stock of mineral soils in perennial cropland converted to cropland=*

*Δ $SOC_{20}$ * conversion area*

$\Delta SOC = (SOC_O - SOC_{O-T})/20 = 0.35\ t\ C\ ha^{-1}\ a^{-1}$

*Δ $SOC_{20}$...average carbon stock change in Austrian cropland soils (t C $ha^{-1}$ $a^{-1}$) over a period of 20 years*

*$SOC_O$…… carbon stock change in Austrian annual cropland soils after conversion →57 t C $ha^{-1}$*

*$SOC_{O-T}$….. carbon stock change in Austrian cropland soils before conversion→ 50 t C $ha^{-1}$*

Calculation steps see chapter 7.3.1.5.

#### 7.3.1.7 Liming

The application of lime to agricultural soils is a source of $CO_2$ emissions. There is no detailed data of lime application in Austria since 1994. Therefore, the estimated amount is based on expert judgement. Particularly with respect to lime quality (dolomite, $CaCO_3$) information is incomplete. For the estimation of $CO_2$ emissions from liming the calculation does not differentiate between cropland and grassland.

According to expert judgement the area for the calculation of liming comprises cropland (without perennial cropland), two and more cut meadows and cultivated pastures.

*Table 203: Area with lime application in ha.*

| Land use (ha) | 1990 | 2007 |
|---|---|---|
| Cropland | 1,406,394 | 1,376,043 |
| Grassland | 884,124 | 907,904 |
| Total | 2,290,518 | 2,283,947 |

The following assumptions were made:

- the recommended amount of lime that should be applied to cropland and grassland according to the Austrian advisory committee for good agricultural practices ("Fachbeirat für Bodenfruchtbarkeit") is 0.7 t $ha^{-1}$ $a^{-1}$.
- a pilot study on waste management in agriculture (UMWELTBUNDESAMT 2004c) showed that only 32% of this recommended amount is actually applied
- additionally it has to be considered that about 60% of Austrian cropland and grassland need no liming as they are based on carbonate parent material

→ with these input data the estimated amount is 0.09 t lime $ha^{-1}$ $a^{-1}$.

The GPG (IPCC 2003) procedure for calculating the $CO_2$ emissions was applied.

#### 7.3.1.8 Uncertainty assessment

The uncertainty estimates are based on the uncertainty values for IPCC default values taken from the GPG (for most sources these default values were used), and on expert judgement and literature (GERZABEK et al. 2003).

- cropland area: +/-10% (based on expert judgement)
- converted area: annual cropland to perennial +/- 50%
- perennial cropland to annual cropland +/- 20%
- country specific data for carbon stock in cropland soils is +/- 5% and perennial cropland +/- 15%
- emission factors for biomass carbon stock default values according IPCC

*Table 204:Uncertainties for areas of land use change (%).*

| | 2001 | 2002 | 2003 |
|---|---|---|---|
| Annual cropland to perennial | 21 | 26 | 28 |
| Perennial cropland to annual cropland | 38 | 30 | 52 |
| Grassland converted to cropland | 7 | 7 | 9 |

The estimated total uncertainty for this category ranges between +40 and -130% (expert judgement).

The estimated total uncertainties for liming range between +/- 50% (expert judgement).

### 7.3.2 Forest Land converted to Cropland (5.B.2.1)

The methodology and activity data are described in Chapter 7.2.2. For a time period of 20 years the area in conversion status from forest land to cropland ranges from 5 478 ha to 10 472 ha for the period 1990 and 2007 causing annual emission rates due to the loss of biomass and C changes in soil from 77 Gg $CO_2$ to 140 Gg $CO_2$.

For the calculation of the annual change of carbon stocks the IPCC Tier 2 approach is used. Emissions/removals were calculated by country specific values for carbon stocks (Chapter 7.2.2).

### 7.3.3 Grassland converted to Cropland (5.B.2.2)

The average annual landuse change area from grassland to cropland from 1990–2007 is 27 294 ha. The area in conversion status for a time period of 20 years ranges from 495 750 ha to 540 501 ha for the period 1990 to 2007. Considering the area of the 20 year time period this leads to emissions between 1 686.7 and 1 808.1 Gg $CO_2$.

The average annual landuse change area from grassland to perennial cropland from 1990–2007 is 95 ha.

**Methodological Issues**

Activity data

Data for land use change from grassland to cropland were estimated from IACS as described in Chapter 7.3.1. Activity data of grassland converted to cropland in the 20 year conversion status see Table 198.

Emissions were estimated applying a country specific methodology (Tier 2) for both biomass carbon stocks and for soil carbon stocks.

#### 7.3.3.1 Changes of carbon stock in biomass of grassland converted to annual cropland

The IPCC default value was substituted by using country specific data from the Agricultural Research and Education Centre Raumberg-Gumpenstein (Höhere Bundeslehr- und Forschungsanstalt Raumberg-Gumpenstein). According to the research results the stubble biomass is 0.5 t C $ha^{-1}$ and the root biomass is 2.1 t C $ha^{-1}$. For grassland biomass a value of 3,1 t C $ha^{-1}$ was applied (detailed description see chapter 7.4). That leads to a country specific value for carbon stock of above ground and below ground grassland biomass before conversion of 5.7 t C $ha^{-1}$.For the calculation of the annual change in carbon stocks in living biomass of grassland converted to cropland the following formula was applied – GPG IPPC (equation 3.3.8):

*Annual change in biomass =annual area of converted land * ($L_{conversion}$ + $\Delta C_{growth}$)*

$L_{conversion} = C_{after} - C_{before}$

*$\Delta C_{growth}$= country specific value for carbon accumulation rate in annual crops is 6.99 t C $ha^{-1}a^{-1}$*
*$C_{after}$ = carbon stock immediately after conversion is 0*
*$C_{before}$ = country specific value for carbon stock of grassland biomass before conversion is 5.7 t C $ha^{-1}$*

*6. 2 t DM= country specific above ground living biomass for grassland*
*4.2 t DM= country specific root biomass for grassland*
*1.0 t DM = country specific stubble biomass for grassland*
*0.5 t C/t DM default carbon content of biomass*

#### 7.3.3.2 Changes of carbon stock in biomass of grassland converted to perennial cropland

The annual land use change area from grassland to perennial cropland in 2007 is 121 ha.

*Annual change in biomass =annual area of converted land * ($L_{conversion}$ + $\Delta C_{growth}$)*

$L_{conversion} = C_{after} - C_{before}$

For the calculation the following values were used:

*$\Delta C_{growth}$ = IPCC default value for carbon accumulation rate in perennial crops is 2.1 t C $ha^{-1}a^{-1}$*
*$C_{after}$ = carbon stock immediately after conversion is 0*
*$C_{before}$= country specific value for carbon stock of grassland biomass before conversion 5,7 t C $ha^{-1}$ (description see chapter 7.3.3.1).*

In the current submission the data in the CRF table represent grassland converted to annual cropland and grassland converted to perennial cropland separately, as recommended by the ERT.

#### 7.3.3.3 Changes of carbon stock in mineral soils of grassland converted to annual cropland

Only mineral soils were considered in this category assuming that grassland on organic soils were not converted to cropland (soil inventories have shown that cropland with organic soils does not exist in Austria).

Emissions/removals were calculated by country specific values for carbon stocks in mineral soils of grassland and arable land. For the estimates Austrian specific values of 70 t C/ ha for 0–30 cm depth of grassland and 50 t C/ha for 0–30 cm depth of arable land were used (GERZABEK et al. 2003, STREBL et al. 2003). For the calculation of the annual change of carbon stocks in grassland soils converted to annual cropland soils the following formula according to IPCC GPG (2003) was applied (Calculation steps see chapter 7.3.1.5).

$$\Delta SOC = (SOC_O - SOC_{O-T})/ 20 = - 1.0 \ t \ C \ ha^{-1} \ a^{-1}$$

*annual change in carbon stock of mineral soils converted from grassland to cropland = Δ SOC * conversion area*

*Δ SOC = average annual carbon stock change in Austrian cropland soils (t C $ha^{-1}$ $a^{-1}$) over the first 20 years*

*$SOC_O$ = carbon stock in Austrian cropland soils after conversion from grassland →50 t C $ha^{-1}$*

*$SOC_{O-T}$ = carbon stock in Austrian grassland soils before conversion →70 t C $ha^{-1}$*

#### 7.3.3.4 Changes of carbon stock in mineral soils of grassland converted to perennial cropland

The average annual land use change area from grassland to perennial cropland ranges from 1 526 ha to 1 848 ha for the period 1990–2007 considering the area to be 20 years in the conversion category.

Emissions/removals were calculated by country specific values for carbon stocks in mineral soils of grassland and perennial land. For the soil organic carbon content the Austrian specific values of 70 t C/ha for 0–30 cm depth of grassland and 57 t C/ha for 0–30 cm depth of perennial land were used (GERZABEK et al. 2003; STREBL et al. 2003). For the calculation of the annual change of carbon stocks in grassland soils converted to cropland soils the following formula was applied – IPCC Tier 1 (Calculation steps see chapter 7.3.1.5).

$$\Delta SOC = (SOC_O - SOC_{O-T})/20 = -0.65\ t\ C\ ha^{-1}\ a^{-1}$$

*annual change in carbon stock of mineral soils converted from grassland to perennial cropland = Δ SOC * conversion area*

*$\Delta SOC$ = average annual carbon stock change in Austrian cropland soils ($t\ C\ ha^{-1}\ a^{-1}$) over the first 20 years*

*$SOC_O$ = carbon stock in Austrian perennial cropland soils after conversion from grassland →57 $t\ C\ ha^{-1}$*

*$SOC_{O-T}$ = carbon stock in Austrian grassland soils before conversion →70 $t\ C\ ha^{-1}$*

In the current submission the data in the CRF table represent grassland converted to annual cropland and grassland converted to perennial cropland, separately, as recommended by the ERT.

#### 7.3.3.5 $N_2O$ emissions in soils of grassland converted to cropland

This chapter deals with the increase in $N_2O$ emissions due to the conversion of grassland to cropland. The area of land converted (grassland to cropland and grassland to perennial cropland respectively) was taken from *Table 198*. The annual release of $N_2O$ was calculated with IPCC default values (TIER 1) using equations 3.3.14 and 3.3.15. (IPCC 2003).

The C:N ratio in soil organic matter was assumed to be 12 (based on Austrian soil inventory data, BORIS).

#### 7.3.3.6 Uncertainty assessment

The following uncertainties were estimated. They are based on uncertainty values for IPCC default values taken from the IPCC GPG as well as on expert judgement and literature (GERZABEK et al. 2003):

- cropland area: +/-10%
- converted area grassland to cropland: +/- 16%
- country specific data for carbon stock in cropland soils +/- 5% and in perennial cropland soils +/- 15%
- emission factors for biomass carbon stock default values according IPCC GPG guidance (2003):

Uncertainties from the converted area for the years 2001-2003 are listed in Table 204.

The total uncertainty of this category estimated by expert judgement is +/- 40%.

#### 7.3.3.7 Recalculations

The value for the carbon stock of annual cropland and grassland biomass before conversion was also improved by using country specific values, considering above and below ground biomass (chapter 7.3.3.1).

## 7.4 Grassland (5.C)

In this category emissions/removals from grassland management (grassland remaining grassland and land converted to grassland) are considered. In 2007, 1.84 Mio ha of Austria are grassland (Statistik Austria 2007). Total grassland includes one cut meadows; two and more cut meadows, cultivated pastures, litter meadows, rough pastures, alpine meadows and pastures and abandoned grassland.

During the in-country review of the initial report of Austria (February 2007) the ERT encouraged Austria to further improve the carbon stock in living biomass. The recalculation was done by using country specific grassland yield data from Statistic Austria (Statistik Austria 2007) and the Agricultural Research and Education Centre (AREC) Raumberg-Gumpenstein for a time period of 10 years (Höhere Bundeslehr- und Forschungsanstalt Raumberg-Gumpenstein-HBLFA).

The mean grassland yield of the categories one cut meadows, two cut meadows, litter meadows, rough pastures and cultivated pastures was calculated considering the area of the different grassland categories. The calculation led to an average biomass yield of 6.2 t dm $ha^{-1}$ for grassland under the Austrian situation, these are 3.10 t C $ha^{-1}$.

*Table 205:Area weighted mean values of grassland biomass.*

| | area in ha (avg 10 year) | yield in t (avg 10 year) | weighted mean (t/ha) |
|---|---|---|---|
| one cut meadows | 54 827 | 3.2 | 0.2 |
| two and more cut | 844 126 | 6.8 | 5.3 |
| litter meadows | 17 126 | 3.5 | 0.1 |
| culture pastures | 74 839 | 6.7 | 0.5 |
| rough pastures | 90 264 | 2.4 | 0.2 |
| | weighted grassland yield (t dm/ha) | | 6.2 |
| | C t/ha | | 3.1 |

The IPCC default root to shoot value was improved by using country specific data from the Agricultural Research and Education Centre Raumberg-Gumpenstein (Höhere Bundeslehr- und Forschungsanstalt Raumberg-Gumpenstein -HBLFA). According to the research results the above ground stubble biomass is 1.0 t dm $ha^{-1}$ (0.5 t C $ha^{-1}$) and the root biomass is 4.2 dm $ha^{-1}$ (2.1 t C $ha^{-1}$). This leads to a country specific value for carbon stock of grassland biomass before conversion of 5.7 t C $ha^{-1}$. The value is 87% higher than the GPG IPPC default value.

The annual removals of grassland in Austria range between 1 021.6 Gg $CO_2$ and 1 265.6 Gg $CO_2$ for the period from 1990 to 2007.

Some management practices (e.g. slash and burn etc.) and some sub categories (5 C 2 3, 5 C 2 4, 5 C 2 5) do not occur in Austria.

*Table 206: Sources (or sinks) considered for grassland management.*

| Category/source or sink |
|---|
| 5.C Grassland – total |
| 5.C.1 Grassland remaining grassland |
| - carbon stock change due to changes in organic matter input to grassland soils |
| 5.C.2 Land converted to grassland |
| 5.C.2.1 Forest land converted to grassland |
| 5.C.2.2 Cropland converted to grassland |
| - carbon stock change in living biomass of grassland |
| - carbon stock change due to changes in organic matter input (harvest residues) to grassland soils |

*Table 207:Activity data of grassland 1990–2007 in ha; other land use changes are not occurring.*

| | C. Total Grass-land | 1. Grassland remaining Grassland | 2. Land con-verted to Grassland | 2.1 Forest Land con-verted to Grassland | 2.2 Cropland converted to Grassland | 2.2.perennial Cropland con-verted to Grassland |
|---|---|---|---|---|---|---|
| 1990 | 1 992 765 | 1 391 963 | 600 802 | 102 294 | 496 412 | 2 097 |
| 1991 | 1 989 050 | 1 385 298 | 603 752 | 105 197 | 496 409 | 2 146 |
| 1992 | 1 985 335 | 1 378 723 | 606 612 | 108 100 | 496 318 | 2 194 |
| 1993 | 1 981 620 | 1 371 882 | 609 738 | 111 003 | 496 492 | 2 243 |
| 1994 | 1 979 096 | 1 374 362 | 604 734 | 105 768 | 496 674 | 2 292 |
| 1995 | 1 976 571 | 1 378 382 | 598 189 | 99 233 | 496 616 | 2 340 |
| 1996 | 1 978 490 | 1 386 487 | 592 002 | 92 697 | 496 916 | 2 389 |
| 1997 | 1 980 408 | 1 394 568 | 585 840 | 86 162 | 497 240 | 2 438 |
| 1998 | 1 972 662 | 1 393 254 | 579 408 | 79 627 | 497 294 | 2 486 |
| 1999 | 1 964 915 | 1 387 571 | 577 344 | 76 965 | 497 843 | 2 536 |
| 2000 | 1 957 169 | 1 382 169 | 575 000 | 74 303 | 498 112 | 2 585 |
| 2001 | 1 929 902 | 1 353 476 | 576 426 | 71 641 | 502 069 | 2 717 |
| 2002 | 1 902 636 | 1 331 242 | 571 394 | 68 979 | 499 722 | 2 692 |
| 2003 | 1 875 369 | 1 305 532 | 569 836 | 66 317 | 500 782 | 2 738 |
| 2004 | 1 848 102 | 1 286 635 | 561 467 | 64 254 | 494 502 | 2 710 |
| 2005 | 1 843 105 | 1 280 403 | 562 701 | 62 191 | 497 836 | 2 674 |
| 2006 | 1 838 107 | 1 280 808 | 557 299 | 60 128 | 494 515 | 2 656 |
| 2007 | 1 838 107 | 1 288 775 | 549 332 | 58 065 | 488 533 | 2 734 |

*Table 208:Emissions from grassland management in Gg $CO_2$; other land use changes are not occurring.*

| | 5 C Total Grass-land | 1. Grassland remaining Grassland | 2. Land conver-ted to Grassland | 2.1 Forest Land converted to Grassland | 2.2 Cropland converted to Grassland | 2.2.a perenial cropland con-verted to Grass-land |
|---|---|---|---|---|---|---|
| 1990 | -1 021.55 | 39.11 | -1 060.66 | 607.90 | -1 696.43 | 27.87 |
| 1991 | -1 011.04 | 39.49 | -1 050.54 | 616.98 | -1 695.52 | 27.99 |
| 1992 | -1 001.89 | 39.87 | -1 041.76 | 626.06 | -1 695.59 | 27.77 |
| 1993 | -994.52 | 40.27 | -1 034.79 | 635.15 | -1 697.30 | 27.37 |
| 1994 | -1 011.76 | 40.12 | -1 051.88 | 618.77 | -1 697.92 | 27.26 |
| 1995 | -1 134.84 | 39.89 | -1 174.73 | 497.44 | -1 698.98 | 26.81 |
| 1996 | -1 157.09 | 39.42 | -1 196.52 | 477.00 | -1 700.18 | 26.67 |
| 1997 | -1 179.37 | 38.96 | -1 218.33 | 456.56 | -1 701.42 | 26.54 |
| 1998 | -1 200.72 | 39.03 | -1 239.75 | 436.12 | -1 702.15 | 26.28 |
| 1999 | -1 210.87 | 39.36 | -1 250.23 | 427.79 | -1 704.18 | 26.16 |
| 2000 | -1 220.98 | 39.67 | -1 260.65 | 419.47 | -1 705.95 | 25.83 |
| 2001 | -1 207.83 | 41.33 | -1 249.16 | 411.14 | -1 703.31 | 43.01 |
| 2002 | -1 268.54 | 42.61 | -1 311.15 | 402.81 | -1 724.25 | 10.28 |
| 2003 | -1 259.15 | 44.10 | -1 303.25 | 394.49 | -1 720.91 | 23.17 |
| 2004 | -1 291.15 | 45.19 | -1 336.34 | 388.04 | -1 732.39 | 8.02 |
| 2005 | -1 265.56 | 45.55 | -1 311.11 | 381.58 | -1 698.98 | 6.29 |
| 2006 | -1 288.27 | 45.53 | -1 333.80 | 375.13 | -1 718.84 | 9.91 |
| 2007 | -1 265.62 | 45.07 | -1 310.69 | 368.68 | -1 709.43 | 30.06 |

**Methodological Issues**

**Activity data**

The area of grassland remaining grassland represents the total grassland minus land converted to grassland. The areas were estimated from national statistics of land use (STATISTIK AUSTRIA 1990– 2008). The grassland data are collected in the Austrian farm structure surveys 1993, 1995 (full survey), 1999 (full survey) , 2003 and 2005. For the years between the surveys the data have been interpolated.

Data for land use change were taken from IACS (description see chapter 7.3.1).

Emissions were estimated by applying country specific methodologies (Tier 2) for both biomass carbon stocks and soil carbon stocks.

## 7.4.1 Grassland remaining Grassland (5.C.1)

The area of grassland remaining grassland in 2007 was 1.29 Mio ha.

The annual emissions from grassland remaining grassland between 1990 and 2007 range from 39.1 Gg $CO_2$ to 45.1 Gg $CO_2$ including the emissions from mineral and organic grassland soils.

For the current submission the IPPC default value for carbon stock in living biomass was improved. The recalculation was done by using country specific grassland yield data from Statistic Austria (STATISTIK AUSTRIA 2007) and the Agricultural Research and Education Centre (AREC) Raumberg-Gumpenstein for a time period of 10 years (Höhere Bundeslehr- und Forschungsanstalt Raumberg-Gumpenstein -HBLFA).

The mean of the grassland yield of the categories one cut meadows, two cut meadows, litter-meadows, rough pastures and cultivated pastures was calculated also considering the area of the different grassland categories. The calculation led to an average biomass yield per year of 6.2 t dm $ha^{-1}$ for grassland under the Austrian situation, these are 3.1 t C per ha and year.

The IPCC default root to shoot value was improved by using country specific data from the Agricultural Research and Education Centre Raumberg-Gumpenstein (Höhere Bundeslehr- und Forschungsanstalt Raumberg-Gumpenstein -HBLFA). According to the research results the stubble biomass is 1.0 t dm $ha^{-1}$ (0.5 t C $ha^{-1}$) and the root biomass is 4.2 t dm $ha^{-1}$ (2.1 t C $ha^{-1}$). This leads to a country specific value for carbon stock of above ground and below ground grassland biomass before conversion of 5.7 t C $ha^{-1}$.

### 7.4.1.1 Changes in carbon stocks in biomass of grassland remaining grassland

According to GPG (IPCC 2003) the biomass of grassland is not considered in the estimates (it is harvested every year thus there is no long term carbon storage).

### 7.4.1.2 Changes in carbon stocks in mineral soils of grassland remaining grassland

Emissions/removals were calculated using a country specific methodology. For the soil organic carbon content the Austrian specific average value of 70 t C/ ha for 0–30 cm depth of grassland was used (GERZABEK et al. 2003, STREBL et al. 2003). This value is based on the Austrian nation-wide soil inventories.

The methodology follows closely the formula presented by the IPCC guidelines which includes a tillage factor ($F_{MG}$), land use factor ($F_{LU}$) and input factor ($F_I$) (table 3.3.4).

These factors were applied to the Austrian situation and average management factors for Austria were estimated on basis of national statistics for the grassland management (STATISTIK AUSTRIA 1985–2003; BMLFUW 1985–2003). Improvements (e.g. increase of biological agriculture) were considered in the calculation since 1985.

*Table 209:Weighted mean values of management factors for grassland soils.*

| factor | $F_{LU}$ modified | $F_{MG}$ modified | $F_I$ modified |
|---|---|---|---|
| 1985 | 1.000 | 1.062 | 1.048 |
| 1990 | 1.000 | 1.062 | 1.049 |
| 1995 | 1.000 | 1.064 | 1.052 |
| 2003 | 1.000 | 1.064 | 1.052 |

It was assumed that the Austrian specific average value of 70 t C $ha^{-1}$ for grassland soil represents the soil carbon stock of 1990. Most Austrian soil inventories were carried out between 1989 and 1996. The carbon stock change of soil from 1990–2005 was calculated by using the management factors above. For the default inventory time of 20 years an increase from 70 t C $ha^{-1}$ to 70.315 t C $ha^{-1}$ was estimated.

The formula used for calculating the change in carbon stocks of grassland soils was the same as for cropland (see chapter 7.3.1.4).

*Annual change in carbon stock of mineral soils in grassland remaining grassland =* $\Delta SOC_{20}$ ** land area*

$\Delta SOC_{20} = (SOC_{1990+20} – SOC_{1990})/ 20 = 0.0157$ t C $ha^{-1}$ $a^{-1}$

The amount of lime applied to grassland was estimated together with cropland in Chapter 7.3.1.7. Therefore the $CO_2$ emissions resulting from liming of grassland are included in category 5 B 1.

#### 7.4.1.3 Changes in carbon stocks of organic soils of grassland remaining grassland

The area of organic grassland soils was estimated with data of the soil inventories of the Federal Provinces of Austria which are compiled in the Austrian Soil Information System – BORIS – (http://www.borisdaten.com). The carbon content from the upper soil horizon (weighted mean for 0–30 cm) was calculated out of 200 grassland sites. Sites with more than 17% $C_{org}$ (NESTROY et al. 2000) were selected as "organic soils" and their area was extrapolated.

The estimation resulted in a total area of 12 954 ha organic grassland soils.

For the calculation of emissions from organic soils IPCC Tier 1 method was used. The emission factor of 2.5 t C $ha^{-1}$ $a^{-1}$ for warm and temperate climate was chosen.

The calculated emission from organic grassland soils was 118.7 Gg $CO_2$.

### 7.4.2 Forest Land converted to Grassland (5.C.2.1)

The methodology and activity data are described in Chapter 7.2.2. The area in conversion status from Forest Land to Grassland for a time period of 20 year ranges from 58 065 ha to 111 003 ha between the years 1990 and 2007. The main part of conversion takes place from forests to pasture causing annual emission rates due to the loss of biomass and C changes in soils from 369 Gg $CO_2$ to 635 Gg $CO_2$.

For the calculation of the annual change of carbon stocks in forest soils IPCC Tier 2 approach is used. Emissions/removals were calculated by country specific values (Chapter 7.2.2).

### 7.4.3 Cropland converted to Grassland (5.C.2.2)

The average annual landuse change area from cropland to grassland from 1990–2007 is 24 536 ha. The area in conversion status for a time period of 20 years ranges from 496 412 ha to 488 533 ha between the years 1990 and 2007. Considering the area of the 20 years time period this leads to annual removals from 1 696.4 to 1 709.4 Gg $CO_2$ between 1990–2007. The average annual landuse change area (1990-2007) from perennial cropland to grassland is 141 ha.

#### 7.4.3.1 Changes of carbon stock in biomass of cropland converted to grassland

For the current submission the carbon stock of living biomass in cropland was improved by using country specific data from Statistic Austria (STATISTIK AUSTRIA 2007). For all annual crops mentioned in the Statistical Report the harvested yield as well as the yield of straw and leaves (potatoes, beets…) has been considered. The average mean of the above and belowground biomass of the crops was calculated and weighted by the crop area for a time period of 10 years. That leads to an average carbon stock of living biomass in cropland of 6.99 t C $ha^{-1}$.

For the calculation of the annual change in carbon stocks of living biomass of cropland converted to grassland the following formula was applied – IPCC GPG (equation 3.3.8).

$$\textit{Annual change in biomass} = \textit{annual area of converted land} * (L_{conversion} + \Delta C_{growth})$$

$$L_{conversion} = C_{after} - C_{before}$$

*$C_{after}$ = carbon stock immediately after conversion is 0*

*$\Delta C_{growth}$ = country specific value for grassland 3.10 t C $ha^{-1} yr^{-1}$*

*$C_{before}$ = country specific value of carbon stock of annual crops before conversion is 6.99 t C $ha^{-1} yr^{-1}$*

#### 7.4.3.2 Changes of carbon stock in biomass of perennial cropland converted to grassland

The area of landuse change from perennial cropland converted to grassland in 2007 is 174 ha Equation and default values are described in chapter 7.4.3.1.

*$C_{before}$= IPCC default value of carbon stock of perennial crops before conversion is 63 t C $ha^{-1} yr^{-1}$*

The data in the CRF table show the sum of biomass carbon stock changes of cropland converted to grassland and perennial cropland converted to grassland.

#### 7.4.3.3 Changes of carbon stock in mineral soil of cropland converted to grassland

The area in conversion status from cropland converted to grassland for a time period of 20 years ranges from 496 412 ha to 494 515 ha between the years 1990 and 2006.

The IPCC Tier 1 method with a four step approach was applied. The calculation steps for determining $SOC_0$, $SOC_{(0-T)}$ and net soil change per ha of area are as follows:

- Step 1: Selecting Austrian specific values for cropland before conversion →$SOC_{O-T}$
- Step 2: Selecting Austrian specific values for grassland after conversion → SOC O
- Step 3: Calculation of average annual carbon stock change f. the inventory period of 20 y.
- Step 4: Multiply the annual carbon stock change by the conversion area.

$$\textit{Average annual carbon stock change } (t\ C\ ha^{-1}\ a^{-1}) = (SOC_O - SOC_{O-T})/\ 20 = 1.0$$

*$SOC_O$…… carbon stock in Austrian grassland soils after conversion →70 t C $ha^{-1}$*

*$SOC_{O-T}$….. carbon stock change in Austrian cropland soils before conversion→ 50 t C $ha^{-1}$*

#### 7.4.3.4 Changes of carbon stock in mineral soil of perennial cropland converted to grassland

The area in conversion status from perennial cropland converted to grassland for a time period of 20 years ranges from 2 097 ha to 2 734 ha between the years 1990 and 2007:

Emissions/removals were calculated by country specific values for carbon stocks in mineral soils of perennial cropland. Equation and calculation steps see chapter 7.4.3.3.

$\Delta\ SOC = (SOC_O - SOC_{O\text{-}T})/20 = 0.65\ t\ C\ ha^{-1}\ a^{-1}$

*annual change in carbon stock of mineral soils converted from grassland to perennial cropland = Δ SOC * conversion area*

*$SOC_O$…… carbon stock in Austrian grassland soils after conversion →70t C $ha^{-1}$*
*$SOC_{O\text{-}T}$…… carbon stock in Austrian perennial cropland soils before conversion →57 t C $ha^{-1}$*

The data in the CRF table present the sum of soil carbon stock changes of cropland converted to grassland and perennial cropland converted to grassland respectively.

### 7.4.4 Uncertainty assessment

The following uncertainties were estimated: They are based on uncertainty values for IPCC default values taken from the IPCC GPG, and on expert judgement and literature (GERZABEK et al. 2003):

- grassland area → +/-10%
- converted area: annual cropland to grassland +/- 15%
- perennial cropland to grassland +/- 23%
- country specific data for carbon stock in grassland soils is +/- 9%
- country specific data for carbon stock in perennial cropland soils +/- 15%
- emission factors for biomass carbon stock default values according IPCC (GPG 2003).

*Table 210:Uncertainties of land area converted to grassland (%).*

| | 2001 | 2002 | 2003 |
|---|---|---|---|
| Perennial cropland to grassland | 91 | 28 | 77 |
| Annual cropland to grassland | 7 | 6 | 6 |

The total uncertainties estimated by expert judgement are: for conversion from cropland to grassland +/- 30% and from perennial cropland to grassland +/- 120%.

#### 7.4.4.1 Recalculations

The value for carbon stock of grassland biomass before conversion was also improved using country specific research values considering above and below ground biomass (Chapter 7.3.3.1).

## 7.5 Wetlands 5.D

In this category only emissions/removals from the sub-categories "Land converted to wetland" are considered.

The wetland area from 1990–2007 ranges from 133 068 ha to 143 477 ha.

*Table 211:Activity data of wetland 1990–2007 in ha.*

| | **5 D Total Wetland** | **1. Wetland remaining Wetland** | **2. Land converted to Wetland** | **2.1 Forest Land converted to Wetlands** | **2.2 Cropland converted to Wetlands** | **2.3 Grassland converted to Wetlands** | **2.4 Settlements converted to Wetlands** | **2.5 Other Land converted to Wetlands** |
|---|---|---|---|---|---|---|---|---|
| 1990 | 133 068 | 124 579 | 8 489 | 5 790 | NO | 2 699 | NO | - |
| 1991 | 133 519 | 123 891 | 9 628 | 5 955 | NO | 3 674 | NO | - |
| 1992 | 133 970 | 123 203 | 10 767 | 6 119 | NO | 4 648 | NO | - |
| 1993 | 134 422 | 122 516 | 11 906 | 6 283 | NO | 5 623 | NO | - |
| 1994 | 134 873 | 122 289 | 12 584 | 5 987 | NO | 6 597 | NO | - |
| 1995 | 135 587 | 122 307 | 13 281 | 5 617 | NO | 7 664 | NO | - |
| 1996 | 136 302 | 122 325 | 13 977 | 5 247 | NO | 7 664 | NO | 1 066 |
| 1997 | 137 016 | 122 343 | 14 673 | 4 877 | NO | 7 664 | NO | 2 132 |
| 1998 | 137 731 | 122 362 | 15 369 | 4 507 | NO | 8 730 | NO | 2 132 |
| 1999 | 138 445 | 122 160 | 16 285 | 4 357 | NO | 9 796 | NO | 2 132 |
| 2000 | 139 160 | 121 959 | 17 200 | 4 206 | NO | 10 862 | NO | 2 132 |
| 2001 | 139 874 | 121 923 | 17 952 | 4 055 | NO | 11 764 | NO | 2 132 |
| 2002 | 140 589 | 121 886 | 18 703 | 3 904 | NO | 12 666 | NO | 2 132 |
| 2003 | 141 303 | 121 849 | 19 454 | 3 754 | NO | 13 568 | NO | 2 132 |
| 2004 | 142 018 | 121 812 | 20 206 | 3 637 | NO | 14 436 | NO | 2 132 |
| 2005 | 142 245 | 121 775 | 20 470 | 3 520 | NO | 14 818 | NO | 2 132 |
| 2006 | 142 575 | 121 738 | 20 837 | 3 403 | NO | 14 619 | NO | 2 814 |
| 2007 | 143 477 | 121 701 | 21 776 | 3 287 | NO | 14 421 | NO | 4 068 |

*Table 212:Emissions of wetland 1990–2007 in Gg $CO_2$.*

| | 5 D Total Wetland | 1. Wetland remaining Wetland | 2. Land converted to Wetland | 2.1 Forest Land converted to Wetlands | 2.2 Cropland converted to Wetlands | 2.3 Grassland converted to Wetlands | 2.4 Settlements converted to Wetlands | 2.5 Other Land converted to Wetlands |
|---|---|---|---|---|---|---|---|---|
| 1990 | 199.73 | NE | 199.73 | 144.75 | NO | 54.99 | NO | 0.00 |
| 1991 | 215.89 | NE | 215.89 | 148.39 | NO | 67.50 | NO | 0.00 |
| 1992 | 232.04 | NE | 232.04 | 152.04 | NO | 80.00 | NO | 0.00 |
| 1993 | 248.19 | NE | 248.19 | 155.68 | NO | 92.51 | NO | 0.00 |
| 1994 | 254.13 | NE | 254.13 | 149.11 | NO | 105.02 | NO | 0.00 |
| 1995 | 255.80 | NE | 255.80 | 135.19 | NO | 120.61 | NO | 0.00 |
| 1996 | 281.84 | NE | 281.84 | 126.99 | NO | 98.35 | NO | 56.51 |
| 1997 | 287.56 | NE | 287.56 | 118.78 | NO | 98.35 | NO | 70.43 |
| 1998 | 272.72 | NE | 272.72 | 110.57 | NO | 134.30 | NO | 27.85 |
| 1999 | 283.06 | NE | 283.06 | 107.23 | NO | 147.98 | NO | 27.85 |
| 2000 | 293.40 | NE | 293.40 | 103.89 | NO | 161.66 | NO | 27.85 |
| 2001 | 301.63 | NE | 301.63 | 100.55 | NO | 173.24 | NO | 27.85 |
| 2002 | 309.87 | NE | 309.87 | 97.20 | NO | 184.81 | NO | 27.85 |
| 2003 | 318.10 | NE | 318.10 | 93.86 | NO | 196.39 | NO | 27.85 |
| 2004 | 326.65 | NE | 326.65 | 91.27 | NO | 207.53 | NO | 27.85 |
| 2005 | 318.79 | NE | 318.79 | 88.68 | NO | 202.26 | NO | 27.85 |
| 2006 | 337.67 | NE | 337.67 | 86.09 | NO | 187.62 | NO | 63.96 |
| 2007 | 371.78 | NE | 371.78 | 83.50 | NO | 185.07 | NO | 103.20 |

**Methodological Issues**

Activity data

The total wetland area was taken from the regional information derived from the Real Estate Database available since 1995 (BEV 2008). The change in the annual water body area was calculated from mean average increase (714 ha) of water bodies from the period 1990–2004. According to methodological changes in the inventory of the regional information derived from the Real Estate Database the real annual reported wetland area was taken since 2005. Due to the fact that the peat areas are protected in most Austrian provinces, it is assumed that there is no further draining of peat land. According to the peat land database of (STEINER & REITER 1992) a constant bog area of 22 239 ha was taken into account for the total reporting period.

The area in conversion status of land converted to wetland for a time period of 20 years ranges from 8 489 ha to 21 776 ha for the period 1990 to 2007.

### 7.5.1 Forest Land converted to Wetland (5.D.2.1)

The methodology and activity data are described in chapter 7.2.2. The area in conversion status from forest land to wetland for a time period of 20 years ranges from 3 287 ha to 6 283 ha between the years 1990 and 2007 causing annual emission rates due to the loss of biomass and C changes in soils from 83 Gg $CO_2$ to 156 Gg $CO_2$.

For the calculation of the annual change of carbon stocks IPCC Tier 2 approach is used. Emissions/removals were calculated by country specific values (Chapter 7.2.2).

### 7.5.2 Cropland converted to Wetland (5.D.2.2)

Based on expert judgment it is assumed that no conversion occurs from cropland to wetland in Austria. The conversion areas are mainly from grassland or other land.

### 7.5.3 Grassland converted to Wetland (5.D.2.3)

#### 7.5.3.1 Changes in carbon stocks in biomass of grassland converted to wetland

For the calculation of the annual change in carbon stocks of living biomass in grassland converted to wetland the following formula was applied – IPCC TIER 1 (equation 3.5.6 GPG)

Annual change in carbon stocks of living biomass in land converted to wetland (tones $C.y^{-1}$):

$$\Delta C_{LW\ flood} = (Sum\ A_i * (B_{after} - B_{before})$$

*Ai = area of land converted annually to flooded land from original land use, ha*

*$B_{before}$ = living biomass in land immediately before conversion to wetland = for grassland 5.7 t C $ha.y^{-1}$*

*$B_{after}$ = living biomass in land immediately after conversion to wetland (default = 0 t C $ha.y^{-1}$)*

#### 7.5.3.2 Changes in carbon stocks in soil of grassland converted to wetland

The area in conversion status from grassland to wetland for a time period of 20 years showed an increase and ranges from 2 699 ha and 14 421 ha between 1990 and 2007.

Calculation:

$$\Delta C_{LW\ flood} = (Sum\ A_i * (B_{after} - B_{before}) / 20$$

*$A_i$ = area of land converted annually to flooded land from original land use, ha*

*$B_{before}$ = carbon stock in soil immediately before conversion to wetland = for grassland 70 t C ha.y-1*

*$B_{after}$ = carbon stock in soil immediately after conversion to wetland (default = 0 t C $ha.y^{-1}$)*

### 7.5.4 Settlement converted to Wetland (5.D.2.4)

Based on expert judgment it is assumed that in Austria no conversion from settlement to wetland occurs.

### 7.5.5 Other Land converted to Wetland (5.D.2.5)

The area in conversion status from other land to wetland for a time period of 20 years ranges from 1 066 ha to 4 068 ha for the period 1990 to 2007.

#### 7.5.5.1 Changes in carbon stocks in biomass of other land converted to wetland

For the calculation of the annual change in carbon stocks of living biomass in other land converted to wetland the following formula was applied – IPCC Tier 1 (equation 3.5.6 GPG).

Annual change in carbon stocks of living biomass in land converted to wetland (tons $C.y^{-1}$):

$$\Delta C_{LW\ flood} = (Sum\ A_i * (B_{after} - B_{before})$$

*$A_i$ = area of land converted annually to flooded land from original land use, ha*

*$B_{before}$ = living biomass in land immediately before conversion to wetland = for other land 10.89 t C $ha.y^{-1}$ see chapter 7.7*

*$B_{after}$ = living biomass in land immediately after conversion to wetland (default = 0 t C $ha.y^{-1}$)*

#### 7.5.5.2 Changes in carbon stocks in soil of other land converted to wetland

Calculation:

$$\Delta C_{LW\ flood} = (Sum\ A_i * (B_{after} - B_{before})/20$$

*$A_i$ = area of land converted annually to flooded land from original land use, ha*

*$B_{before}$ = carbon stock in soil immediately before conversion to wetland = for other land 71.24 t $C.ha.y^{-1}$ see chapter 7.7*

*$B_{after}$ = carbon stock in soil immediately after conversion to wetland (default=0)*

### 7.5.6 Uncertainty assessment

According to a first rough expert judgement, the uncertainty of this subcategory is -90 to +50% (expert judgement). This high uncertainty is mainly due to the unknown processes for the soil C stock after conversion.

## 7.6 Settlements (5.E)

In this category only emissions/removals from the sub-categories "Land converted to settlement" are considered.

About 0.49 Mio ha of Austria's surface can be allocated to the IPCC land use category "Settlement" (BEV 2007). The area in conversion status from "Land converted to Settlement" for a time period of 20 years ranges from 171 804 ha to 190 583 ha between the years 1990 and 2007 causing annual emission rates due to C stock changes of biomass and soils from 508 Gg $CO_2$ to 845 Gg $CO_2$.

**Methodological Issues**

Activity data

The basis for the area that can be allocated to this land use category is the regional information derived from the real estate database (BEV 2008). The total settlement area comprises the following sub-categories: building land – sealed, partly sealed and unsealed area; parks and gardens; road, railway, track and excavation area and other, not further differentiated settlement area. For the years before 1980 data were extrapolated following a mean annual increase/decrease between the years 1980–1990.

The real estate database is updated in case of occasion; therefore a mean annual increase of the settlement area was calculated for the years 1970–1980 with 6 610 $ha.a^{-1}$, for the years 1981–2002 with 7 036 $ha.a^{-1}$, for the years 2003–2005 with 6 898 $ha.a^{-1}$. For the following years, so for 2006, the yearly reported data from the regional information are taken into consideration.

Obviously, the annual increase of settlement area results in a decrease of other land use categories. Therefore, the following criteria were set up to allocate to the categories of land use changes:

- land use changes from forests are based on the statistical results of the NFI.
- further increases of the settlement area were considered to come to the same relative parts from agricultural land and grassland.
- in cases where the changes from forest land and the decreases of cropland and grassland did not cover the increases of the settlement area, the remaining parts were taken from "Other land".

In compliance with this method the following land use changes to settlement area were derived for the period 1990 to 2006.

*Table 213:Derived land use changes for the subcategory 5 E for the period 1990 to 2007 in ha.*

| | 5 E Total Settlement | 5.E.1. Settlement remaining settlement | 5.E.2. Land converted to Settlement | 5.E.2.1 Forest Land converted to Settlement | 5.E.2.2 Cropland converted to Settlement | 5.E.2.3 Grassland converted to Settlement | 5.E.2.4 Wetland converted to Settlement | 5.F.2.4 Other land converted to Settlement |
|---|---|---|---|---|---|---|---|---|
| 1990 | 384 065 | 193 482 | 190 583 | 28 951 | 38 113 | 106 661 | NO | 16 858 |
| 1991 | 391 101 | 198 497 | 192 604 | 29 773 | 38 113 | 102 561 | NO | 22 157 |
| 1992 | 398 137 | 203 512 | 194 625 | 30 594 | 44 218 | 97 656 | NO | 22 157 |
| 1993 | 405 173 | 208 527 | 196 647 | 31 416 | 45 279 | 97 795 | NO | 22 157 |
| 1994 | 412 209 | 218 162 | 194 047 | 29 934 | 45 279 | 90 187 | NO | 28 646 |
| 1995 | 419 245 | 228 484 | 190 761 | 28 085 | 49 923 | 84 106 | NO | 28 646 |
| 1996 | 426 281 | 238 807 | 187 475 | 26 235 | 50 296 | 74 949 | NO | 35 994 |
| 1997 | 433 317 | 249 129 | 184 189 | 24 386 | 48 094 | 67 995 | NO | 43 715 |
| 1998 | 440 353 | 259 451 | 180 902 | 22 536 | 48 094 | 65 517 | NO | 44 755 |
| 1999 | 447 389 | 267 574 | 179 815 | 21 783 | 49 367 | 63 910 | NO | 44 755 |
| 2000 | 454 425 | 275 697 | 178 728 | 21 029 | 53 642 | 59 302 | NO | 44 755 |
| 2001 | 461 461 | 284 246 | 177 215 | 20 276 | 51 894 | 60 290 | NO | 44 755 |
| 2002 | 468 497 | 292 795 | 175 702 | 19 522 | 52 170 | 59 255 | NO | 44 755 |
| 2003 | 475 395 | 301 344 | 174 051 | 18 769 | 44 958 | 65 569 | NO | 44 755 |
| 2004 | 482 293 | 308 783 | 173 510 | 18 185 | 46 257 | 69 299 | NO | 39 768 |
| 2005 | 489 190 | 316 221 | 172 969 | 17 601 | 46 257 | 66 747 | NO | 42 364 |
| 2006 | 494 950 | 323 660 | 171 290 | 17 017 | 39 848 | 65 617 | NO | 48 809 |
| 2007 | 502 903 | 331 099 | 171 804 | 16 433 | 48 485 | 60 191 | NO | 46 695 |

*Table 214:Emissions/removals from land use changes to settlement for the period 1990 to 2007 in Gg $CO_2$.*

| | 5.E.2. Land converted to Settlement | 5.E.2.1 Forest land converted to settlement | 5.E.2.2 Crop-land converted to settlement | 5.E.2.3 Grass-land converted to settlement | 5.E.2.4 Wetland converted to settlement | 5.E.2.5 Other Land con-verted to set-tlement |
|---|---|---|---|---|---|---|
| 1990 | 760 | 492 | 55 | 182 | NO | 30 |
| 1991 | 843 | 504 | -81 | 199 | NO | 221 |
| 1992 | 762 | 516 | 28 | 179 | NO | 39 |
| 1993 | 776 | 527 | 43 | 166 | NO | 39 |
| 1994 | 845 | 506 | -97 | 162 | NO | 274 |
| 1995 | 674 | 451 | 27 | 145 | NO | 50 |
| 1996 | 779 | 425 | -100 | 137 | NO | 316 |
| 1997 | 743 | 399 | -103 | 104 | NO | 343 |
| 1998 | 588 | 373 | -103 | 203 | NO | 115 |
| 1999 | 583 | 362 | 26 | 116 | NO | 79 |
| 2000 | 545 | 351 | -29 | 144 | NO | 79 |
| 2001 | 522 | 341 | -100 | 202 | NO | 79 |
| 2002 | 508 | 330 | -106 | 205 | NO | 79 |
| 2003 | 519 | 319 | -96 | 217 | NO | 79 |
| 2004 | 511 | 311 | -73 | 203 | NO | 70 |
| 2005 | 642 | 303 | -99 | 102 | NO | 336 |
| 2006 | 618 | 294 | -85 | 100 | NO | 308 |
| 2007 | 531 | 286 | 70 | 92 | NO | 82 |

**Methodology Issues**

**Biomass**

Estimates about living biomass in settlement areas were based on the results of a scientific study carried out in Vienna (DÖRFLINGER et al. 1995). In this study the total living biomass was calculated for different ecological sub-systems in Vienna. For the reporting to this sector biomass data from the sub systems gardens  urban industrial areas and brown fields were taken into consideration. Based on the biomass data of trees  shrubs and ground vegetation an average biomass per ha settlement area was calculated. An average rotation period of 60 years for trees and 20 years for shrubs was defined by expert judgement to derive an average annual biomass increment. The biomass of ground vegetation is calculated as yearly C-pool.

The following stocks (t C $ha^{-1}$) and average annual increments (t C $ha^{-1}a^{-1}$) of biomass were calculated:

| t C $ha^{-1}$ | | | | t C $ha^{-1}$ $a^{-1}$ | | | |
|---|---|---|---|---|---|---|---|
| **trees** | **shrubs** | **ground veg.** | **total** | **trees** | **shrubs** | **ground veg.** | **total** |
| 31.4 | 1.2 | 1.5 | 34.1 | 0.52 | 0.06 | 1.5 | 2.08 |

**Soil**

For the calculation of the annual changes of carbon stocks in soils converted to settlement the IPCC approach of 20 years discounting of soil C stock changes is used in combination with country specific soil data.

The calculations of emissions from soils due to land use changes from forests to settlements are based on country specific values for carbon stocks in soils of forest land (121 t C $ha^{-1}$) and carbon stocks in mineral soils of settlement land (32 t C $ha^{-1}$ area weighted mean value of input data described in chapter 7.2.2). These C stocks refer to a soil depth of 0–50 cm.

For the calculation of emissions from soil C stocks changes due to land use changes from the other IPCC land use categories the following values were used (0–30 cm soil depth).

- Cropland: 50 t $ha^{-1}$
- Grassland: 70 t $ha^{-1}$
- Wetlands: 0 t $ha^{-1}$
- Other land: 71 t $ha^{-1}$

**Uncertainty assessment**

According to a first expert guess the uncertainty of this category is ±70%.

### 7.6.1 Forest Land converted to Settlement (5.E.2.1)

The methodology and activity data are described in Chapter 7.2.2. The area in conversion status from Forest Land to settlement for a time period of 20 years ranges from 16 433 ha to 31 416 ha between the years 1990 and 2007 causing annual emission rates due to the loss of biomass and C changes in soils from 286 Gg $CO_2$ to 527 Gg $CO_2$.

#### 7.6.1.1 Changes in carbon stocks in biomass of forest land converted to settlement

The annual net emission rates due to loss of forest biomass and increase of biomass on settlement area range from 7 to 18 Gg $CO_2$ in the years 1990 to 2007.

#### 7.6.1.2 Changes in carbon stocks in soil of forest land converted to settlement

For the calculation of the annual change of carbon stocks in forest soils converted to soils of settlements the IPCC Tier 2 approach is used. Emissions/removals were calculated by country specific values for carbon stocks in mineral soils of forest land (121 t C $ha^{-1}$) and settlement areas (32 t C $ha^{-1}$ area weighted mean value of input data described in chapter 7.2.2). The annual emission rates due to loss of soil carbon in soils range from 268 to 513 Gg $CO_2$ in the years 1990–2007.

### 7.6.2 Cropland converted to Settlement (5.E.2.2)

The area in conversion status from cropland to settlement for a time period of 20 years ranges from 38 113 to 53 642 ha in the years 1990–2007.

#### 7.6.2.1 Changes in carbon stocks in biomass of cropland converted to settlement

For the calculation of the annual change in carbon stocks of living biomass in cropland converted to settlement the IPCC Tier 2 approach is used. The method follows the approaches as in Chapters 7.3.3 and 7.4.3 with country specific biomass data for settlements.

The annual emission or removal rates due to increase of biomass on settlement area ranges from -106 to 70 Gg $CO_2$ in the years 1990 to 2007.

#### 7.6.2.2 Changes in carbon stocks in soil of cropland converted to settlement

By expert judgement the carbon stocks on unsealed areas of settlement is estimated to be as high as in grassland soils (70 t $ha^{-1}$). Carbon stocks of sealed areas are set 0. Based on calcuations of the regional information derived from the real estate database national 2/3 of the settlement area is unsealed. That results in a carbon stock in soil for settlement area of 50 t $ha^{-1}$ (= 2/3 * 70 t $ha^{-1}$) on average. The estimates for soil carbon stocks in cropland are also about 50 t $ha^{-1}$.

Consequently, no emissions or removals result from carbon stock changes in soils due to land use conversion from cropland to settlement.

### 7.6.3 Grassland converted to Settlement (5.E.2.3)

The area in conversion status from grassland to settlement for a time period of 20 years ranges from 59 255 to 106 661 ha in the years 1990–2007 resulting in annual emission rates due to C stock changes of biomass and soils from 92 Gg $CO_2$ to 217 Gg $CO_2$.

#### 7.6.3.1 Changes in carbon stocks in biomass of grassland converted to settlement

For the calculation of the annual change in carbon stocks of living biomass in grassland converted to settlement the IPCC Tier 2 approach is used. The method follows the approaches as in Chapters 7.3.3 and 7.4.3 with country specific biomass data for settlements.

The annual removal rates due to increase of biomass on settlement area ranges from 12 to 209 Gg $CO_2$ in the years 1990–2007.

#### 7.6.3.2 Changes in carbon stocks in soil of grassland converted to settlement

For the calculation of the annual change in carbon stocks of soils in grassland converted to settlement the IPCC Tier 2 approach is used. The method follows the approaches as in Chapters 7.3.3 and 7.4.3 with a soil C stock for settlements as described in Chapter 7.6.2.2.

The annual emission rates due to loss of soil carbon in soils ranges from 217 to 376 Gg $CO_2$ in the years 1990–2007.

### 7.6.4 Wetland converted to Settlement (5.E.2.4)

It is assumed by expert judgment that in Austria no conversion from wetland to settlement occurred in the years 1990–2007. Evidence for this assumption is given by law that protects most of the remaining natural wetlands in Austria as natural reservation area.

### 7.6.5 Other land converted to Settlement (5.E.2.5)

The area in conversion status from other land to settlement for a time period of 20 years ranges from 16 858 to 48 809 ha in the years 1990–2006 resulting in annual emissions due to C stock changes of biomass and soils from 30 Gg $CO_2$ to 343 Gg $CO_2$.

#### 7.6.5.1 Changes in carbon stocks in biomass of other land converted to settlement

For the calculation of the annual change in carbon stocks of living biomass in grassland converted to settlement the IPCC Tier 2 approach is used. The method follows the approaches as in Chapters 7.3.3 and 7.4.3 with country specific biomass data for settlements.

The annual removal/emission rates due to increase of biomass on settlement area ranges from -100 to 176 Gg $CO_2$ in the years 1990–2007.

#### 7.6.5.2 Changes in carbon stocks in soil of other land converted to settlement

For the calculation of the annual change in carbon stocks of soils in grassland converted to settlement the IPCC Tier 2 approach is used. The method follows the approaches as in Chapters 7.3.3 and 7.4.3 with a soil C stock for settlements as described in Chapter 7.6.2.2.

The annual emission rates due to loss of soil carbon in soils ranges from 66 and 190 Gg $CO_2$ in the years 1990–2007.

### 7.6.6 Recalculations

The whole time series was recalculated for the sub sectors in 5.E.2 for the following reasons:

- The rotation period of shrubs was extended to 20 years (expert judgment)
- Error correction concerning the increase of biomass at LUC areas to settlement.
- National data for above and below ground biomass for cropland and grassland were used to calculate the net changes of biomass for these land use classes.

## 7.7 Other Land 5.F

The soil carbon content and the biomass carbon content of other land were estimated by using data compiled in (KÖRNER et al. 1993) who estimated the C stock of the Austrian landscape.

**Methodological Issues**

**Biomass**

Estimations of living biomass in other land areas were based on the results of a study (KÖRNER et al. 1993). It gives an overview of the constitution (mixture) of “other land” area. The study provides also information about the carbon stock of living biomass as well as about the soil carbon stock of the different plant societies and land use.

*Table 215:Carbon content of living biomass and soil of other land.*

| | ha | biomass t C $ha^{-1}$ | soil t C $ha^{-1}$ |
|---|---|---|---|
| **glacier bolder** | **109 200** | 0 | 0 |
| **unproductive area** | **168 900** | | |
| alpine Urweiden | 56 300 | 8.2 | 99.6 |
| Schutt-Felsvegetation | 56 300 | 0.4 | 13.3 |
| Schneetälchengesellschaften | 18 000 | 0.9 | 14.3 |
| Spalierstrauch | 18 800 | 7.6 | 83.6 |
| Kahlflächen | 18 700 | 0 | 0 |
| **abandoned alpine meadows** | **243 200** | 20.7 | 119 |

According to the share of the different land use areas (glaciers  unproductive area  abandoned alpine meadows) in the category other land a weighted mean for living biomass was calculated. The estimated amount for biomass is 10.89 t C per ha.

### Soil

Estimates for the soil carbon stock in other land areas were also based on the results of the study (KÖRNER et al. 1993). According to the share of the different areas (glaciers  unproductive area  abandoned alpine meadows) in the category other land a weighted mean for the soil carbon stock of 71.24 t C per ha was calculated.

## 7.7.1 Forest Land converted to Other Land (5.F.2.1)

The methodology and activity data are described in Chapter 7.2.2. The area in conversion status from forest land to other land for a time period of 20 years ranges from 26 294 ha to 50 266 ha in the years 1990 to 2007 causing annual emission rates due to the loss of biomass and C changes in soils from 470 Gg $CO_2$ to 868 Gg $CO_2$.

### 7.7.1.1 Changes in carbon stocks in biomass of forest land converted to other land

For the calculation of the annual change in carbon stocks of living biomass of forest land converted to other land the IPCC Tier 2 approach is used.

The annual emission rates due to increase of biomass on settlement area range from 85 to 130 Gg $CO_2$ in the years 1990–2007.

### 7.7.1.2 Changes in carbon stocks in soil of forest land converted to other land

For the calculation of the annual change of carbon stocks in forest soils converted to soils of other land the IPCC Tier 2 approach is used. Emissions/removals were calculated by country specific values for carbon stocks in mineral soils of forest land (121 t C $ha^{-1}$) and other land (41 t C $ha^{-1}$ area weighted mean value of input data described in chapter 7.2.2).

The annual emission rates due to loss of soil carbon in soils range from 386 to 737 Gg $CO_2$ in the years 1990–2007.

## 7.8 QA/QC Verification

The calculations of the data for category 5 are embedded in the overall QA/QC-system of the Austrian GHG inventory (see Chapter 1.6).

**Important elements of QA/QC:**

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

**Specific elements of QA/QC for LULUCF:**

The input data, estimates and results are checked as follows. The results of these checks are described in the QA/QC documentation:

**1) Bottom-up check**

1.1) Input data

1.1.1) Check for the plausibility of the activity data and their trend

Step 1: Documentation of the most important reasons for changes and non-changes of activity data

Step 2: Check and documentation, if these changes or non-changes of activity data fit to trends of underlying conditions

Step3: If step 1 and 2 do not allow any explanation, further check of the used statistics and their estimates (see 1.2) and/or comunication with the data providers

1.1.2) Check for plausibilty of the emission factors as well as the related input data and their trends

Step 1: Documentation of the most important reasons for changes and non-changes of emission factors

Step 2: Check and documentation, if these changes or non-changes of emission factors fit to trends of underlying conditions

Step 3: If step 1 and 2 do not allow any explanation, further check of the used statistics and their estimates (see 1.2) and/or comunication with the data providers

1.1.3) Check of input data for completeness

1.2) Estimations

1.2.1) Check of the correctness of all equations in the estimate files

1.2.2) Check of the correctness of all interim results

1.3) Check of the plausibility of the results and their trends related to point 1.1 and documentation of the plausibility of changes and non-changes on basis of point 1.1

1.4) Check of the correctness of all data and results transfer

**2) Top-down check**

2.1) Check of the consistance of the total area for Austria.

2.2) Comparison of the used activity data with those from other statistics. Documentation of the results of these comparisons and documentation of the reasons for the choice of statistics when data deviate more than 5 % compared to other statistics

2.3) Comparision of the used emission factors and underlying input data with those of other data sources (e.g. from literature, results in NIRs of other comparable regions, IPCC default values). Documentation of the results of these comparisons. Further check according to points 1.1 and 1.2 as well as check on the suitability of the used input data in case of inplausible differences. Documentation of this further check.

## 7.9 Planned improvements

There is a steady re-evaluation and substitution of the used input parameters and the applied methods.

The following issues will be considered for the following submissions:

- Update of the estimates on the uncertainties of sector 5
- Improvement of the values for biomass C-stocks in viticulture and horticulture
- Model based approach for C-stock changes in soil for sector 5A1
- Improvement of the consistency of the LUC between cropland and grassland based on the IACS data

# 8 WASTE (CRF SECTOR 6)

## 8.1 Sector overview

This chapter includes information on methods for estimating greenhouse gas emissions as well as references of activity data and emission factors concerning waste management and treatment activities reported under CRF Category 6 Waste.

The emissions addressed in this chapter include emissions from solid waste disposal on land, wastewater handling, waste incineration and category 'other waste' (compost production).

Waste management and treatment activities are sources of methane ($CH_4$), carbon dioxide ($CO_2$) and nitrous oxide ($N_2O$) emissions.

### 8.1.1 Emission trend

Overall greenhouse gas emissions from waste management and treatment activities during the year 2007 amounted to 2 176 Gg $CO_2$ equivalent (1990: 3 649). These are about 2.5% of total greenhouse gas emissions in Austria in 2007 and 4.6% in the base year. In 2007, greenhouse gas emissions from the waste sector were 40.4% below the level of the base year. Figure 28 presents the trend of GHG emissions from waste for 1990 to 2007.

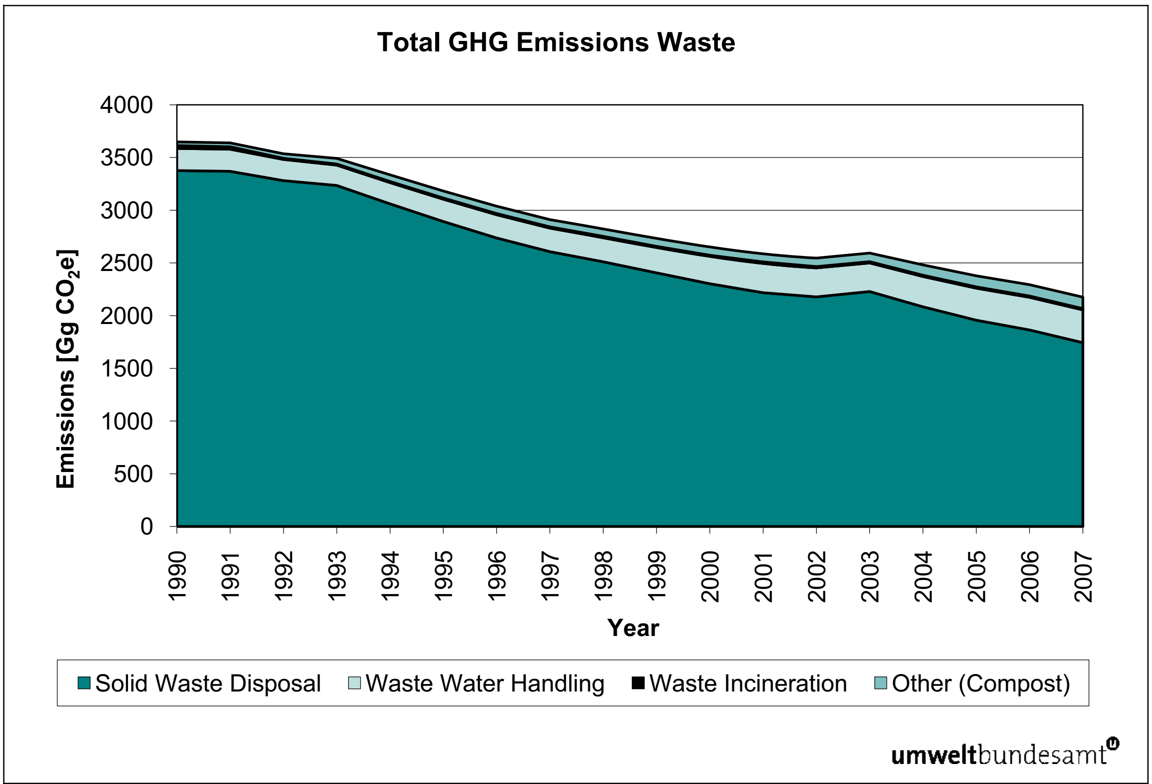


*Figure 28: GHG emissions from waste 1990–2007.*

Table 216 presents the emission trend by GHG. The major greenhouse gas emissions from this sector are $CH_4$ emissions, which represent 83.2% of all emissions from this sector in 2007, followed by $N_2O$ (16.2%) and $CO_2$ (0.6%).

### $CH_4$ emissions

$CH_4$ emissions originate from all subcategories within the sector, but the largest source is *Solid Waste Disposal on Land.* 96.3% of total $CH_4$ emissions from this sector are attributable to this subcategory 6.A.

The decrease of $CH_4$ emissions is a result of waste management policies. The amount of land filled waste decreased significantly and methane recovery systems have increasingly been implemented during the period, reducing the amount of methane emitted.

### $N_2O$ emissions

$N_2O$ emissions from the waste sector remarkably increased over the considered period (see Table 216). In 2007, $N_2O$ emissions from the Waste sector amounted to 353 Gg $CO_2$ equivalent. This was 166.9% above the level of the base year.

About 79.2 % of $N_2O$ emissions from waste originate from waste water handling and about 20.8% from 'other waste' (compost production). In both categories emissions are increasing; waste incineration (municipal solid waste and waste oil) is a minor source of $N_2O$ emissions.

### $CO_2$ emissions

$CO_2$ emissions from waste decreased (see Table 216). In 2007, $CO_2$ emissions from this sector amounted to 12.3 Gg $CO_2$ equivalent, this was 54.4% below the level of the base year.

$CO_2$ emissions originate from waste incineration (municipal solid waste, waste oil and hospital waste). The only plant incinerating municipal waste without energy recovery was shut down in 1991, which resulted in a drop of $CO_2$ emissions from 1991–1992.

*Table 216: Emissions of greenhouse gases from waste and trend from 1990–2007.*

| | $CO_2$ [Gg] | $CH_4$ [Gg $CO_2$ e] | $N_2O$ [Gg $CO_2$ e] | Total [Gg $CO_2$ e] |
|---|---|---|---|---|
| 1990 | 26.89 | 3 489.47 | 132.22 | 3 648.57 |
| 1991 | 23.40 | 3 483.11 | 132.75 | 3 639.26 |
| 1992 | 10.86 | 3 394.22 | 131.30 | 3 536.38 |
| 1993 | 10.60 | 3 348.71 | 133.16 | 3 492.47 |
| 1994 | 10.65 | 3 173.77 | 152.00 | 3 336.42 |
| 1995 | 10.97 | 3 003.77 | 168.27 | 3 183.01 |
| 1996 | 11.30 | 2 841.69 | 186.27 | 3 039.25 |
| 1997 | 11.62 | 2 704.30 | 195.41 | 2 911.33 |
| 1998 | 11.94 | 2 602.20 | 210.04 | 2 824.18 |
| 1999 | 12.26 | 2 493.00 | 227.48 | 2 732.74 |
| 2000 | 12.26 | 2 384.99 | 253.63 | 2 650.88 |
| 2001 | 12.26 | 2 295.22 | 281.47 | 2 588.95 |
| 2002 | 12.26 | 2 250.86 | 283.27 | 2 546.39 |
| 2003 | 12.26 | 2 297.35 | 284.51 | 2 594.13 |
| 2004 | 12.26 | 2 157.54 | 312.17 | 2 481.96 |
| 2005 | 12.26 | 2 032.84 | 333.22 | 2 378.32 |
| 2006 | 12.26 | 1 930.86 | 350.97 | 2 294.10 |
| 2007 | 12.26 | 1 810.69 | 352.91 | 2 175.87 |
| *Trend 1990–2007* | *-54.39%* | *-48.11%* | *166.92%* | *-40.36%* |

**Emission trends by sub categories**

Table 217 presents the greenhouse gas emissions by subcategories of waste. As can be seen the dominant sub-category is solid waste disposal on land (6.A). In 2007, this category contributed 80.2% to total greenhouse gas emissions of the waste sector.

*Table 217: Total greenhouse gas emissions of waste by subcategories and trend from 1990–2007.*

| $CO_2$ equivalent [Gg] | 6 A | 6 B | 6 C | 6 D | Total |
|---|---|---|---|---|---|
| 1990 | 3 376.63 | 210.28 | 27.09 | 34.57 | 3 648.57 |
| 1991 | 3 369.98 | 209.46 | 23.58 | 36.24 | 3 639.26 |
| 1992 | 3 281.66 | 200.88 | 10.91 | 42.94 | 3 536.38 |
| 1993 | 3 235.80 | 192.82 | 10.64 | 53.21 | 3 492.47 |
| 1994 | 3 061.09 | 201.51 | 10.69 | 63.12 | 3 336.42 |
| 1995 | 2 893.60 | 211.73 | 11.01 | 66.67 | 3 183.01 |
| 1996 | 2 737.51 | 220.53 | 11.33 | 69.87 | 3 039.25 |
| 1997 | 2 607.54 | 223.29 | 11.66 | 68.84 | 2 911.33 |
| 1998 | 2 511.77 | 229.15 | 11.98 | 71.28 | 2 824.18 |
| 1999 | 2 406.74 | 238.76 | 12.30 | 74.93 | 2 732.74 |
| 2000 | 2 303.32 | 258.12 | 12.30 | 77.13 | 2 650.88 |
| 2001 | 2 218.07 | 279.73 | 12.30 | 78.85 | 2 588.95 |
| 2002 | 2 178.41 | 275.18 | 12.30 | 80.49 | 2 546.39 |
| 2003 | 2 229.43 | 270.78 | 12.30 | 81.61 | 2 594.13 |
| 2004 | 2 084.37 | 287.28 | 12.30 | 98.00 | 2 481.96 |
| 2005 | 1 957.31 | 303.72 | 12.30 | 104.99 | 2 378.32 |
| 2006 | 1 864.83 | 309.47 | 12.30 | 107.50 | 2 294.10 |
| 2007 | 1 744.20 | 310.72 | 12.30 | 108.65 | 2 175.87 |
| *Trend 1990-2007* | *-48.34%* | *47.76%* | *-54.57%* | *214.24%* | *-40.36%* |

## 8.1.2 Key Categories

Methodology and results of the key category analysis is presented in 1.5. Table 218 summarizes the key categories in the waste sector.

*Table 218: Key sources of Category 6 Waste.*

| IPCC Category | Source Categories | Key Sources | |
|---|---|---|---|
| | | GHG | KS-Assessment |
| 6.A | Managed Waste Disposal on Land | $CH_4$ | LA90-LA07; TA |
| 6.B | Wastewater Handling | $N_2O$ | TA |

*LA90 = Level Assessment 1990*

*TA = Trend Assessment BY–2007*

In the base year, 4.5% of total greenhouse gas emissions originated from the two key categories of the waste sector compared to 2.3% in 2007. The key categories cover 94% of total GHG emissions from sector waste in 2007.

### 8.1.3 Methodology

Detailed information on the methodology can be found in the corresponding subchapters.

### 8.1.4 Quality Assurance and Quality Control (QA/QC)

In addition to QC activities described in Chapter 1.6.3, the following source specific checks are performed:

Activity data on deposited waste (6.A) are reported annually by landfill operators to the Umweltbundesamt, where they are incorporated in the landfill database. In the course of the data collection and administration, a quality control of the incoming data is implemented: data is checked in terms of completeness and of plausibility by comparison with previous reports. To clarify any discrepancies landfill operators are contacted.

Furthermore, during emission calculation, activity data - waste volumes deposited (6.A) or composted/treated in mechanical-biological treatment plants (6.D) – is checked for time series consistency: if dips and jumps exceeding 20% compared to the year before are observed, waste experts (the provider of data) at the Umweltbundesamt are consulted to either find an explanation or to identify a possible inconsistency or an error.

To keep the inventory up-to-date, the availability of updated data for the applied parameters (such as data on recovered landfill gas or on the connection rate to wastewater treatment plants) are checked annually (6.A, 6.B).

Data on separately collected bio waste (6.D) is taken from various reports from the Austrian federal provinces and is checked against the information published in the corresponding national report (BAWP).

Finally, after the calculation is finished, experts of the Umweltbundesamt not involved in emission calculation of that year are asked to check the applied parameters, the calculation and the trend description in the NIR.

### 8.1.5 Uncertainty Assessment

Uncertainty estimates based on expert judgement by Umweltbundesamt and (WINIWARTER 2008) for the sub-categories solid waste disposal on land and wastewater handling are provided (see respective subchapter).

### 8.1.6 Recalculations

Recalculations have been made for managed waste disposal on land (see Table 228), wastewater handling (see Table 232) and 'other waste' (compost) (see Table 240). For further information please refer to the respective subchapters.

### 8.1.7 Completeness

Table 219 gives an overview of the IPCC 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 subcategories. A "✓" indicates that emissions from this sub-category have been estimated.

*Table 219: Overview of subcategories of Category Waste: transformation into SNAP Codes and status of estimation.*

| IPCC Category | SNAP | $CO_2$ | $CH_4$ | $N_2O$ |
|---|---|---|---|---|
| **6 A SOLID WASTE DISPOSAL ON LAND** | | | | |
| 6 A 1 Managed Waste Disposal | 090401 Solid Waste Disposal on Land | NA | ✓ | NA |
| 6 A 2 Unmanaged Waste*) Disposal | 090402 Unmanaged Waste Disposal | NO | NO | NO |
| **6 B WASTEWATER HANDLING** | | | | |
| 6 B 1 Industrial Wastewater | 091001 Wastewater treatment in industry | NA | NA | ✓ |
| 6 B 2 Domestic and Commercial Wastewater | 091002 Wastewater treatment in residential/commercial sect. | NA | ✓ | ✓ |
| **6 C WASTE INCINERATION** | | | | |
| | 090201 Incineration of domestic or municipal waste | ✓ | ✓ | ✓ |
| | 090207 Incineration of hospital wastes | ✓ | ✓ | ✓ |
| | 090208 Incineration of waste oil | ✓ | NA | ✓ |
| **6 D OTHER WASTE** | | | | |
| | 091003 Sludge spreading**) | IE | IE | IE |
| | 091005 Compost production | NA | ✓ | ✓ |

**) In Austria all waste disposal sites are managed sites (also see Chapter 8.2.1);*

***) Sludge spreading is included in category 4.D.1.*

## 8.2 Managed waste disposal on land (CRF Category 6.A.1)

### 8.2.1 Source Category Description

*Key Source: Yes*

*Emissions: $CH_4$*

In Austria all waste disposal sites are managed sites (landfills).

In the year 2007 about 548 landfill sites received waste (see Table 220), whereas only the landfills for mass waste and residual waste are sources of $CH_4$ emissions. Landfills for excavated soil and construction waste serve for the depositing of excavated soil, construction waste, waste concrete and road-construction waste are not relevant for GHG emissions. In comparison to last year the total number of landfills and also the number of each landfill type decreased.

*Table 220: Number and type of landfill sites.*

| Landfills for | 2002 | 2003 | 2004 | 2005 | 2006[58] | 2007 |
|---|---|---|---|---|---|---|
| mass waste | 61 | 62 | 58 | 50 | 54 | 53 |
| residual waste/treated waste | 18 | 23 | 30 | 27 | 29 | 31 |
| construction-waste | 64 | 63 | 124 | 74 | 84 | 87 |
| excavated-soil | 108 | 211 | 454 | 340 | 376 | 377 |

The amount of deposited waste is taken into account from 1950 onwards. From 1950 to 1990 a steady increase occurred with a peak at 1989, which is due to the introduction of disposal fees. This fee originates from an Austrian Law for cleaning up contaminated sites with the objective to finance cleaning up and securing activities for contaminated site. As long as disposal fees were low, high amounts were deposited, which was the case in 1989. From 1990 to 1994 amounts of deposited waste decreased, as waste management was regulated by a new law – the Austrian Waste Management Law[59] (1990). Due to this, waste separation and reuse and recycling activities respectively, increased. The potential of waste prevention and waste recycling was however exhausted after 1994, so amounts of deposited waste did not decrease any further. The amount of deposited waste peaked in 2003, probably because from beginning of 2004 only pre-treated waste was allowed to be deposited (see Landfill Ordinance[60]).

The strong decrease after 2003 is due to the taking effect of the Landfill Ordinance, which only allows the disposal of treated waste and therefore leads to reduced waste volumes and masses, as well as decreased carbon content in deposited waste.

Table 221 presents $CH_4$ emissions from managed waste disposal on land as well as activity data of "residual waste" and "non residual waste" for the period 1990–2007.

*Table 221: Activity data for "residual waste" and "non residual waste", greenhouse gas emissions and implied emission factors 1990–2007.*

| Year | Non Residual Waste [Mg/a] | Residual Waste [Mg/a] | Total Waste [Mg/a] | $CH_4$ Emissions [Mg] | IEF $CH_4$ [kg/Mg] |
|---|---|---|---|---|---|
| 1990 | 664 536 | 1 995 747 | 2 660 283 | 160 792 | 60.4 |
| 1991 | 677 827 | 1 799 718 | 2 477 545 | 160 475 | 64.8 |
| 1992 | 691 383 | 1 614 157 | 2 305 541 | 156 269 | 67.8 |
| 1993 | 705 211 | 1 644 718 | 2 349 929 | 154 086 | 65.6 |
| 1994 | 719 315 | 1 142 067 | 1 861 382 | 145 766 | 78.3 |
| 1995 | 733 702 | 1 049 709 | 1 783 410 | 137 790 | 77.3 |
| 1996 | 748 376 | 1 124 169 | 1 872 545 | 130 358 | 69.6 |
| 1997 | 763 343 | 1 082 634 | 1 845 977 | 124 168 | 67.3 |
| 1998 | 778 610 | 1 081 114 | 1 859 724 | 119 608 | 64.3 |

[58] Compared to last year's NIR the figures for 2006 increased due to reports from landfill operators received after the due date which were considered for this year's submission (also see Chapter 8.2.4)

[59] Abfallwirtschaftsgesetz 2002, BGBl. I Nr. 102/2002

[60] Verordnung über die Ablagerung von Abfällen (Deponieverordnung), BGBl. Nr. 164/1996 in der Fassung BGBl. II Nr. 49/2004 Deponieverordnung 2008 (BGBl. II Nr. 39/2008)

| Year | Non Residual Waste [Mg/a] | Residual Waste [Mg/a] | Total Waste [Mg/a] | $CH_4$ Emissions [Mg] | IEF $CH_4$ [kg/Mg] |
|---|---|---|---|---|---|
| 1999 | 841 169 | 1 084 625 | 1 925 794 | 114 607 | 59.5 |
| 2000 | 843 780 | 1 052 061 | 1 895 841 | 109 682 | 57.9 |
| 2001 | 795 262 | 1 065 592 | 1 860 854 | 105 622 | 56.8 |
| 2002 | 812 080 | 1 174 543 | 1 986 623 | 103 734 | 52.2 |
| 2003 | 899 563 | 1 385 944 | 2 285 507 | 106 164 | 46.5 |
| 2004 | 356 973 | 282 656 | 639 629 | 99 256 | 155.2 |
| 2005 | 340 676 | 241 733 | 582 409 | 93 205 | 160.0 |
| 2006 | 374 663 | 260 068 | 634 732 | 88 801 | 139.9 |
| 2007 | 387 617 | 152 885 | 540 502 | 83 057 | 153.7 |

### 8.2.2 Methodological Issues

IPCC Tier 2 method is applied.

Until submission 2006, country specific methodologies were used (BAUMELER et al. 1998). In 2005 a national study (UMWELTBUNDESAMT 2005) proved that the IPCC tier 2 method is more appropriate and accurate. The change to IPCC tier 2 was also approved by the ERT during the in-country review of the initial report of Austria (February 2007).

#### Activity data – residual waste

"Residual waste" corresponds to waste from households and similar establishments remaining after separation of paper, glass, plastic etc. at the source. It originates from private households, administrative facilities of commerce, industry and public administration, kindergartens, schools, hospitals, small enterprises, agriculture, market places and other generation points covered by the municipal waste collecting system.

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

*Table 222: Recycling and treatment of waste from households and similar establishments*

| Treatment | 1989[1)] | 1999[2)] | 2004[2)] | 2006[3)] |
|---|---|---|---|---|
| mechanical-biological treatment | 16.7%[4)] | 6.3 % | 11.2% | 17.9 % |
| thermal treatment (incineration) | 5.9% | 14.7 % | 28.3% | 23.7% |
| treatment in plants for hazardous waste | 0.4% | 0.8 % | 1.2% | 1.8% |
| recycling | 12.9% | 34.3 % | 35.6% | 34.8 % |
| recycling (biogenous waste) | 1.0% | 15.4 % | 16.0% | 17.9% |
| direct deposition at landfills ("residual waste") | 63.1% | 28.5 % | 7.7% | 3.8 % |

1) *(BUNDESABFALLWIRTSCHAFTSPLAN 2001)*

2) *(BUNDESABFALLWIRTSCHAFTSPLAN 2006)*

3) *annual update (2008) of specific chapters of the (BUNDESABFALLWIRTSCHAFTSPLAN 2006)*

4) *this value also included plants used in the past to reduce oduor emissions*

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

- From 1998 to 2007 data were taken from the database for solid waste disposals "Deponiedatenbank" ("Austrian landfill database"): according to the Landfill Ordinance[61], which came into force in 1997, operators of landfill sites have to report type and amount of waste they deposit at their landfill site annually. The Umweltbundesamt stores the data in the landfill database.
- From 1950 to 1997 the amounts of deposited residual waste were taken fromnational studies (HACKL & MAUSCHITZ 1999, UMWELTBUNDESAMT 2001c) and the respective Federal Waste Management Plans (BUNDESABFALLWIRTSCHAFTPLAN 1995, 2001).

In the national study (HACKL & MAUSCHITZ 1999) as well as in the federal waste management plans the amounts of residual waste from administrative facilities of businesses and industries were not considered and therefore originally not included in the data of the years 1950 to 1999. Waste from these sources is however deposited and hence reported by the operators of landfill sites (therefore included in the Austrian landfill database) and thus considered in the time series from 1998 onwards. To achieve a consistent time series, data of the two overlapping years[62] (1998 and 1999) were examined and the difference – which represents the residual waste from administrative facilities of industries and businesses – was calculated. This difference, relative to the change of residual waste from households, was then applied to the years 1950 to 1997 accordingly.

**Activity data – non residual waste**

"Non residual waste" is directly deposited waste other than residual waste but with biodegradeable lots. Non residual waste comprises for example:

- bulky waste
- construction waste
- mixed industrial waste
- road sweepings
- sewage sludge
- rakings
- residual matter from waste treatment

The quantities of "non residual waste" from 1998 to 2007 were taken from the database for solid waste disposals ("Deponiedatenbank", "Austrian landfill database"), whereas only the amount of waste with biodegradable 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. In order to get a more robust estimate, a 20 year average value was used.

Table 223 presents a summary of all considered waste types and the corresponding identification numbers (List of waste).

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

[62] Data available from the federal waste management plan (Bundesabfallwirtschaftsplan - BAWP) as well as from the Austrian landfill database.

*Table 223: Considered types of waste (list of waste[63] pursuant to Article 1 (a) of Directive 75/442/EEC on waste).*

| Waste Identification No | Type of Waste | Waste Identification No | Type of Waste |
|---|---|---|---|
| 0303 | wastes from pulp, paper and cardboard production and processing | 170903 | other construction and demolition wastes (including mixed wastes) containing dangerous substances |
| 1905 | wastes from aerobic treatment of solid waste | 170904 | mixed construction and demolition waste |
| 1908 | wastes from wastewater treatment plants not otherwise specified | 190805 | sludge from treatment of urban wastewater |
| 1909 | wastes from the preparation of water intended for human consumption or water for industrial use | 190809 | grease and oil mixture from oil/water separation containing only edible oil and fats |
| 1912 | wastes from the mechanical treatment of waste (for example sorting. crushing. compacting. pelletising) not otherwise specified | 200101/ 200102 | paper and cardboard |
| 020303 | waste from solvent extraction | 200108 | biodegradable kitchen and canteen waste |
| 30105 | Sawdust, shavings, cuttings, wood, particle board and veneer | 200111 | textiles |
| 30304 | de-inking sludge from paper recycling | 200201 | Bio-degradable wastes |
| 30307 | mechanically separated rejects from pulping of waste paper and cardboard | 200302 | waste from markets |
| 30310 | fibre rejects. fibre-. filler-. and coating sludge from mechanical separation | 200307 | bulky waste |
| 40106 | Sludge, in particular from on-site effluent treatment containing chromium | 190811–14 | sludge from treatment of industrial wastewater |
| 40109 | waste from dressing and finishing | 200125 | edible oil and fat |
| 40221 | wastes from unprocessed textile fibres | 170201 | wood |
| 150103 | wooden packaging | | |

For calculating emissions of residual waste the waste types were aggregated to the categories wood, paper, sludge, other waste, bio waste, textiles, construction waste and fats.

The composition of non residual waste for 2007 as considered in the inventory is illustrated in Figure 29.

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

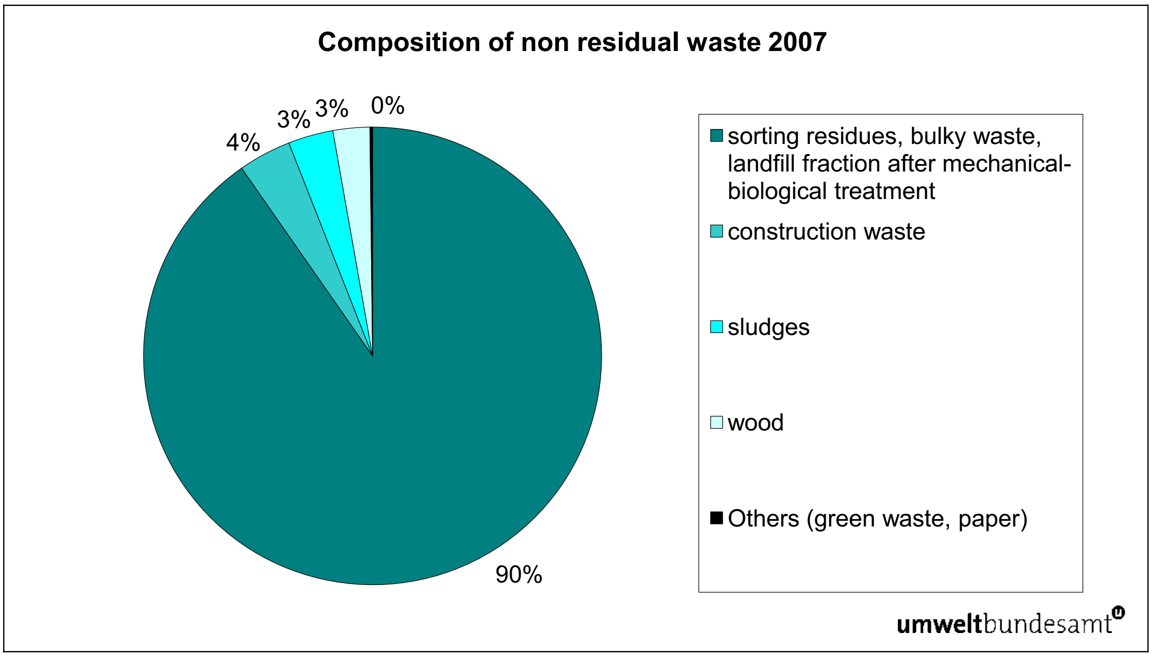


*Figure 29: Composition of non residual waste 2007.*

At present, mainly sorting residues remaining after mechanical, biological and mechanical-biological treatment and bulky waste are deposited (90% in 2007). Other fractions deposited are construction waste, sludges and wood. As bio waste, paper and textiles have been increasingly composted, recycled or reused – which is due to the implementing of the Abfallwirtschaftsgesetz – their share in the total deposition is very low now. Fats were not deposited any more.

## Methodology

Where available, country specific parameters are used and checked if they are in the range of the IPCC guidelines. If country specific parameters were not available IPCC default values are taken. Table 224 summarises the parameters used plus the corresponding references.

*Table 224:Parameters for calculating $CH_4$ emissions of SWDS.*

| Waste category/ Parameters | residual waste | wood | paper | sludges | bulky waste and other waste | Bio-waste | textiles | Construct. waste | fats |
|---|---|---|---|---|---|---|---|---|---|
| Methane correction factor | 1<br>IPCC default for managed SWDS | | | | | | | | |
| 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 (see Figure 30). IPCC default taking into account national waste expertises. | | | | | | | | |
| DOC | See Table 226 | 0.45 | 0.3 | 0.11 | 0.16 | 0.16 | 0.5 | 0.09 | 0.2 |
| | (HACKL & MAUSCHITZ 1999) (UMWELTBUNDESAMT 2003) (BAWP 2006) | (BAUMELER et al. 1998) | | | | | | | |
| Half life period | 7 | 25 | 15 | 7 | 20 | 10 | 15 | 20 | 4 |
| | National waste experts | (GILBERG et al. 2005) | (GILBERG et al. 2005) | Assumption: same as residual waste | IPCC default slow decay | Assumption: same as paper | Assumption: same as paper | IPCC default slow decay | (GILBERG et al. 2005) |
| Number of considered years | 57<br>IPCC default including data for 3 to 5 half lives | | | | | | | | |
| Fraction of $CH_4$ in Landfill Gas | 0.55<br>Mean value cited in the literature, also within the IPCC range. | | | | | | | | |
| Methane Oxidation in the upper layer | 10%<br>IPCC default | | | | | | | | |
| Landfill gas recovery | see Figure 31<br>(UMWELTBUNDESAMT 2004e, 2008c) | | | | | | | | |

### Biodegradable organic carbon (DOC) of residual waste

(UMWELTBUNDESAMT 2003) estimated the carbon content in residual waste (DOC) based on the waste composition (mixture of different waste fractions in residual waste deposited), and taking into account the carbon contents of the relevant fractions (based on literature on direct waste analysis, presented in (UMWELTBUNDESAMT 2003)).

For the year 1990 a DOC content of 200 g/kg residual waste was determined (UMWELTBUNDESAMT 2003), the values for the years before were taken from another national study (HACKL & MAUSCHITZ 1999).

In last years' submission the DOC value was updated for the year 2004 based on the most recent composition of residual waste (shares of the different fractions). It was calculated taking into account

- the current composition of the residual waste (BUNDESABFALLWIRTSCHAFTSPLAN 2006) and
- the different carbon contents of the fractions, taken from (UMWELTBUNDESAMT 2003)

For 2005, 2006 and 2007 the same DOC value as for 2004 was used as no new information on the waste composition was available.

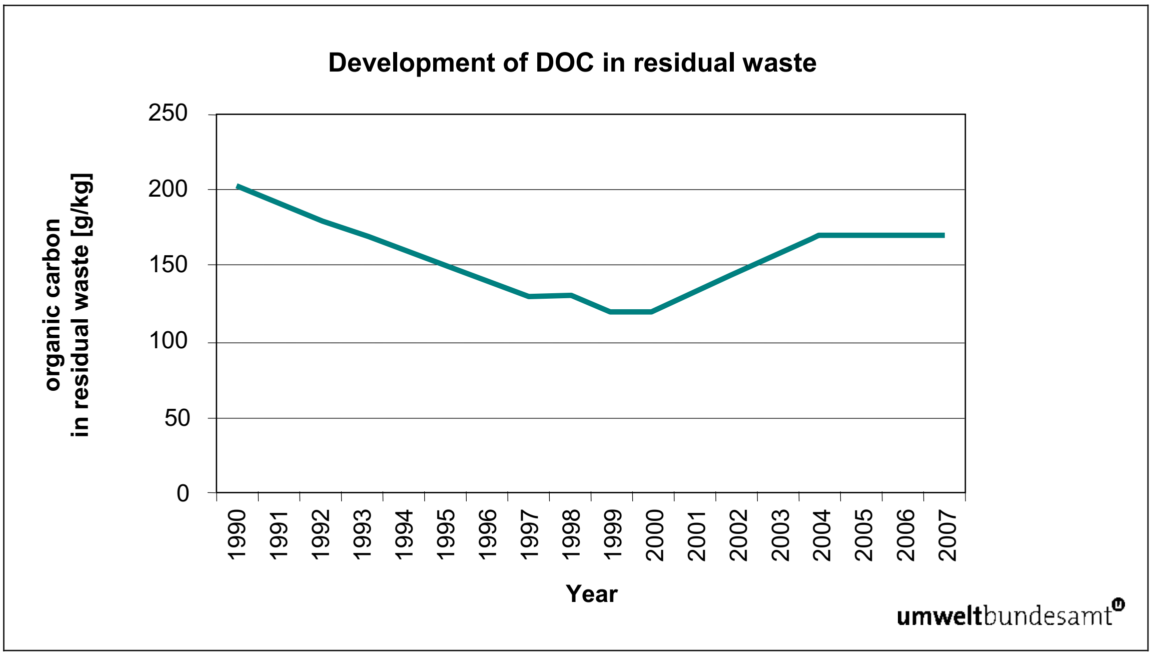


*Figure 30: Development of DOC in residual waste.*

The increasing separate collection of bio-organic and paper waste (leading to a changed composition of residual waste) was the reason for the decrease of the DOC in residual waste during the 1990ies.

Since 2000 the DOC of residual waste is rising as biogenic components in residual waste are increasing. Due to decreasing home composting. Depending on the public awareness, this biogenic waste is either collected separately or is part of the residual waste.

*Table 225: Composition of residual waste.*

| Residual waste | 1990[1)] | 1993[1)] | 1996[1)] | 1999[1)] | 2004[2)] |
|---|---|---|---|---|---|
| | [% of moist mass] | [% of moist mass] | [% of moist mass] | [% of moist mass] | [% of moist mass] |
| Paper, cardboard | 21.9 | 18.3 | 13.5 | 14 | 11 |
| Glass | 7.8 | 6.3 | 4.4 | 3 | 5 |
| Metal | 5.2 | 4.4 | 4.5 | 4.6 | 3 |
| Plastic | 9.8 | 9.3 | 10.6 | 15 | 10 |
| Composite materials | 11.3 | 11.3 | 13.8 | – | 8 |
| Textiles | 3.3 | 3.1 | 4.1 | 4.2 | 6 |

| Residual waste | 1990[1)] | 1993[1)] | 1996[1)] | 1999[1)] | 2004[2)] |
|---|---|---|---|---|---|
| | [% of moist mass] | [% of moist mass] | [% of moist mass] | [% of moist mass] | [% of moist mass] |
| 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 |

[1)] *(UMWELTBUNDESAMT 2003)*

[2)] *(BUNDESABFALLWIRTSCHAFTSPLAN 2006)*

*Table 226: Time series of bio-degradable organic carbon content of directly deposited residual waste*

| Year | bio-degradable organic carbon [g/kg Waste (moist mass)] | Year | bio-degradable organic carbon [g/kg Waste (moist mass)] |
|---|---|---|---|
| 1950–1959 | 240 [1)] | 1997 | 130 [2)] |
| 1960–1969 | 230 [1)] | 1998 | 130 [2)] |
| 1970–1979 | 220 [1)] | 1999 | 120 [2)] |
| 1980–1989 | 210 [1)] | 2000 | 120 [2)] |
| 1990 | 200 [2)] | 2001 | 132 [3)] |
| 1991 | 190 [2)] | 2002 | 144 [3)] |
| 1992 | 180 [2)] | 2003 | 157 [3)] |
| 1993 | 170 [2)] | 2004 | 169 [3)] |
| 1994 | 160 [2)] | 2005 | 169 [3)] |
| 1995 | 150 [2)] | 2006 | 169 [3)] |
| 1996 | 140 [2)] | 2007 | 169 [3)] |

[1)] *(HACKL & MAUSCHITZ 1999)*

[2)] *(UMWELTBUNDESAMT 2003)*

[3)] *(BUNDESABFALLWIRTSCHAFTSPLAN 2006)*

### Landfill gas recovery

In 2004, the Umweltbundesamt investigated the amount of annually collected landfill gas by questionnaires sent to landfill operators (UMWELTBUNDESAMT 2004e). The amount of collected and burnt landfill gas increased constantly over the time period (Figure 31); it was about 2% in 1990, increasing to 13% in the year 2002.

In 2008 a further study was conducted (UMWELTBUNDESAMT 2008c) again sending questionnaires to landfill operators to get new data on collected landfill gas as well as information on its use. Results show that the amount of collected landfill gas decreased significantly (- 30 %) since 2002, as the methane generation decreased as a consequence of the reduced carbon content of deposited waste. These new data led to new updated values for the years 2002 to 2006.

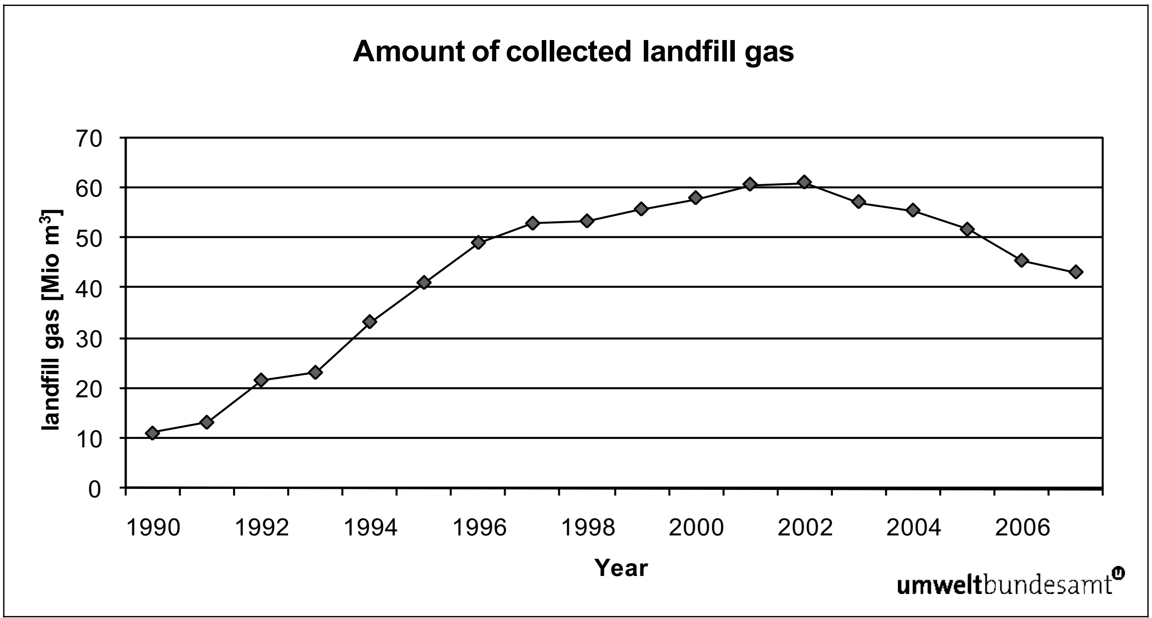


*Figure 31: Amount of collected landfill gas 1990 to 2007 (UMWELTBUNDESAMT 2004e, 2008c).*

### 8.2.3 Uncertainty Assessment

The Uncertainty Assessment is originally based on a national study (WINIWARTER & RYPDAL 2000) and was improved and revised by expert judgement for the submission 2005. These values were confirmed in the latest uncertainty study (WINIWARTER 2008).

The uncertainty decreased due to the following reasons:

- Now IPCC Tier 2 method is applied;
- activity data is now taken from the Austrian landfill database, which is based on reports from landfill operators;
- data on the amount of annually collected landfill gas became available;
- the DOC was updated according to a study of the *Umweltbundesamt*;
- emission factors, taking into account IPCC default values and national expert know-how on waste and landfills are used.

*Table 227: Uncertainty assessment for managed waste disposal on land.*

| | (WINIWARTER & RYPDAL 2000) | Expert judgement 2005 (WINIWARTER 2008) |
|---|---|---|
| Activity data | 25% | 12% |
| Emission factor | 35% | 25% |

### 8.2.4 Recalculations

The following improvements have been made compared to last year's submission:

- Activity data for 2006 has been updated. According to the Austrian Landfill Ordinance, the operators of landfill sites have to report their activity data annually. Based on reports received after the due date and updates, the amount of deposited waste in 2006 changed slightly (+ 6 %) compared to the previous submission.

- New data on collected landfill gas became available for 2002–2006 (UMWELTBUNDESAMT 2008c). This new information – decreasing methane collection values due to decreasing methane generation – was taken into account when calculating the actually emitted $CH_4$.

*Table 228: Recalculations with respect to previous submission for managed waste disposal on land.*

| Difference | 2002 | 2003 | 2004 | 2005 | 2006 |
|---|---|---|---|---|---|
| $CH_4$ [Gg] | -0.13 | 1.12 | 1.67 | 2.89 | 5.01 |
| *[%]* | *-0.1%* | *1.1%* | *1.7%* | *3.2%* | *6.0%* |

## 8.3 Wastewater Handling (CRF Source Category 6.B)

### 8.3.1 Source Category Description

*Key Source: Yes ($N_2O$)*

*Emissions: $CH_4$, $N_2O$*

In the year 2007, greenhouse gas emissions from wastewater handling contributed 0.4% to total greenhouse gas emissions in Austria.

From 1990 to 2007 greenhouse gas emissions increased by 47.8% due to increasing amounts of wastewater that is treated in treatment plants and increasing amount of denitrification. Table 229 presents $CH_4$ and $N_2O$ emissions from wastewater handling for the period from 1990 to 2007.

Emissions from wastewater handling are estimated separately for industrial wastewater and for domestic and commercial wastewater.

*Table 229: Greenhouse gas emissions from industrial as well as domestic and commercial wastewater treatment 1990–2007.*

| | 6.B.1 Industrial wastewater | 6.B.2 Domestic and commercial wastewater | | Total |
|---|---|---|---|---|
| | $N_2O$ emissions [Gg] | $CH_4$ emissions [Gg] | $N_2O$ emissions [Gg] | [Gg $CO_2$ equivalent] |
| 1990 | 0.01 | 4.85 | 0.34 | 210.28 |
| 1991 | 0.01 | 4.84 | 0.33 | 209.46 |
| 1992 | 0.01 | 4.70 | 0.32 | 200.88 |
| 1993 | 0.01 | 4.56 | 0.30 | 192.82 |
| 1994 | 0.03 | 4.39 | 0.32 | 201.51 |
| 1995 | 0.05 | 4.21 | 0.35 | 211.73 |
| 1996 | 0.06 | 3.87 | 0.39 | 220.53 |
| 1997 | 0.07 | 3.53 | 0.41 | 223.29 |
| 1998 | 0.09 | 3.19 | 0.44 | 229.15 |
| 1999 | 0.10 | 2.93 | 0.47 | 238.76 |
| 2000 | 0.12 | 2.68 | 0.53 | 258.12 |
| 2001 | 0.14 | 2.43 | 0.59 | 279.73 |
| 2002 | 0.15 | 2.18 | 0.59 | 275.18 |
| 2003 | 0.15 | 1.95 | 0.59 | 270.78 |

| | 6.B.1 Industrial wastewater | 6.B.2 Domestic and commercial wastewater | | Total |
|---|---|---|---|---|
| | $N_2O$ emissions [Gg] | $CH_4$ emissions [Gg] | $N_2O$ emissions [Gg] | [Gg $CO_2$ equivalent] |
| 2004 | 0.16 | 1.96 | 0.63 | 287.28 |
| 2005 | 0.17 | 1.97 | 0.67 | 303.72 |
| 2006 | 0.19 | 1.49 | 0.71 | 309.47 |
| 2007 | 0.19 | 1.49 | 0.71 | 310.72 |
| *Trend 1990–2007* | *1 399%* | *-69%* | *111%* | *48%* |

Since 1990 a clear shift towards municipal sewage systems can be observed, i.e. the share of population connected to wastewater treatment plans has increased, at the same time the use of septic tanks has declined. This is the reason for the decrease of $CH_4$ emissions – especially between 1995 and 2003 – and the increase of $N_2O$ emissions.

## 8.3.2 Methodological Issues

In the year 2006, 91.7% of the Austrian population was connected to municipal wastewater treatment plants. The remaining wastewater is treated either in septic tanks (5.1% of the Austrian population), domestic wastewater treatment plants (2.8%), or other disposal facilities, which are not further specified in the respective data sources ("unspecified disposal routes" – 0.3%). Wastewater treatment plants are using aerobic procedures (resulting in $N_2O$ emissions), whereas septic tanks are characterised by anaerobic conditions (resulting in $CH_4$ emissions).

### Activity data

Data on wastewater disposal and connection rates to the sewage system were taken from the respective Austrian reports on water pollution control (GEWÄSSERSCHUTZBERICHT 1993, 1996, 1999, 2002) and situation reports on municipal wastewater and sludge (BMLFUW 2006, BMLFUW 2008). Data for the years 1971, 1981, 1991, 1995, 1998, 2001, 2003 and 2006 were available. The missing data was interpolated.

Until 1998, Statistic Austria collected detailed data on waste water disposal: in addition to wastewater treated in municipal plants ("population connected") the following types of waste water treatment were covered ("population not connected"):

- domestic wastewater treatment plants,
- septic tanks and
- "unspecified disposal routes".

However, Statistics Austria changed its data collection and did not offer a detailed split of the population not connected to municipal wastewater treatment plants any more. For this reason, the share (%) of inhabitants using septic tanks – a parameter necessary for the calculation of $CH_4$ emissions - had to be extrapolated from the year 2000 onwards.

#### 8.3.2.1 $CH_4$ emissions

**Domestic and commercial wastewater**

Wastewater treatment in Austria mainly use aerobic procedures (in wastewater treatment plants). There are still some sparsely populated areas where inhabitants are not connected to sewage systems and treatment plants, but use septic tanks and cesspools. Due to the anaerobic conditions in these tanks, methane emissions are produced.

$CH_4$ emissions from cesspools and septic tanks are calculated following to the IPCC methodology. The following parameters were used:

- Average organic load: .......................... 60 g $BOD_5$ per inhabitant and day [IPCC default]
- Methane producing capacity $B_o$:........... 0.6 kg $CH_4$/ kg $BoB_5$ [IPCC default]
- Methane conversion factor MCF: ......... 0.27 (STEINLECHNER et al. 1994)

The MCF defines the share of methane producing capacity ($B_o$) that degrades anaerobically and may vary between 0.0 (completely aerobic) to 1.0 (completely anaerobic). Furthermore, the MCF is temperature dependent. To estimate a mean MCF value for the whole year the following assumptions were made: 20°C for 2/3 of the year with a MCF of 35% and 10°C for 1/3 of the year with a MCF of 10% (STEINLECHNER et al. 1994), resulting in a mean MFC value of 27%.

**Activity data**

For calculation of $CH_4$ emissions from wastewater handling the share of wastewater disposed to septic tanks is used (see Chapter 8.3.2 activity data).

*Table 230:Share of population using septic tanks the calculation of $CH_4$ emissions for 1990–2007.*

| 1990 | 1995 | 2000 | 2005 | 2006 | 2007 |
|---|---|---|---|---|---|
| 18.0% | 15.1% | 9.5% | 6.8% | 5.1% | 5.1% |

**Sewage sludge treatment**

In Austria sewage sludge treatment is carried out on the one hand by aerobic stabilisation and on the other hand by anaerobic digestion. Under aerobic conditions (stabilisation), only a negligible amount of methane emissions is produced. Methane gas produced in the digestion processes is usually used for energy recovery or is flared. As the $CH_4$ emissions from both processes are negligible, they are not estimated.

**Industrial wastewater treatment**

Industrial wastewater treatment and sewage sludge treatment is carried out under aerobic as well as anaerobic conditions. Due to lack of data the overall amount of industrial wastewater cannot be estimated. But according to national experts the amount of $CH_4$ emissions from industrial wastewater treatment and sewage sludge treatment is negligible because $CH_4$ gas is usually used for energy recovery or is flared. In the energy sector sewage gas is considered as an energy source.

#### 8.3.2.2 $N_2O$ emissions

**Domestic and commercial wastewater handling**

$N_2O$ emissions from domestic and commercial wastewater handling are calculated separately for wastewater arising from the population connected and the population not connected to the municipal sewage system. This approach was chosen because of a recommendation by the ERT during the in-country review of the initial report of Austria (February 2007).

$N_2O$ emissions resulting from wastewater handling of ***population not connected*** to the municipal sewage system were calculated according to the IPCC default method, as described in the Revised 1996 IPCC Guidelines. The data for the daily protein intake per person are taken from FAO statistics. The number of inhabitants is provided by STATISTIK AUSTRIA. Emission factor (0.01) and fraction of nitrogen in protein (0.16) are IPCC default values.

$N_2O$ emissions arising in waste water treatment plants (i.e. emissions from ***population connected*** to the municipal sewage system) are calculated by using a country-specific method based on IPCC. According to a national study (ORTHOFER et al. 1995), in addition to the amount of wastewater treated in sewage plants, the amount of nitrogen that is denitrificated is considered. This approach better reflects Austria circumstances with advanced centralized wastewater treatment plants with denitrification steps. Denitrification is obligatory in Austria for municipal waste water treatment plants (the waste water emission ordinance for municipal waste water treatment plants with an organic design capacity larger than 5 000 population equivalents[64] forces a minimum reduction rate of 70% of total nitrogen). The objective of denitrification is to reduce the risk of eutrophication of surface waters. In 1990 waste water treatment was at its beginning and only 10% of the nitrogen was denitrificated. In 2006 this value increased to 77%.

According to (ORTHOFER et al. 1995) only 1% of the total nitrogen in the denitrification process is emitted as $N_2O$. The formula for estimating the $N_2O$ emissions from wastewater treatment is:

*$N_2O$ Emissions = $N_2O$ Emissions [population connected] + $N_2O$ Emissions [population not connected]*

*$N_2O$ Emissions [population connected] = (Inhabitants * P * $Frac_{NPR}$) * cr * DF * 0,01 * F*

*$N_2O$ Emissions [population not connected] = (Inhabitants * P * $Frac_{NPR}$) * (1-cr) * 0,01 * F*

*Where:*

| | |
|---|---|
| *CR* | *connection rate to public sewage system* |
| *DF* | *percentage of nitrogen that is denitrificated* |
| *P* | *annual protein intake per capita [kg protein/ person/ a]* |
| *$Frac_{NPR}$* | *Fraction of nitrogen in protein (IPCC default value – 0.16 kg N/kg protein)* |
| *Inhabitants* | *total number of inhabitants in Austria* |
| *F* | *Factor [1.57 kg $N_2O$-N/ kg N]* |

Finally the $N_2O$ emissions arising from waste water treatment plants (i.e. population connected) and other treatment (i.e. population not connected) are summed up.

[64] Abwasseremissionsverordnung für kommunales Abwasser (BGBl. 210/1996)

### Industrial wastewater handling

It is assumed that industrial wastewater handling additionally contributes 30% of $N_2O$ emissions from municipal wastewater treatment plants (ORTHOFER et al. 1995). As this share represents only the situation in the 1990ies, the ERT recommended a survey to verify this assumption. In this survey (UMWELTBUNDESAMT 2007c) several methods and different international approaches were compared and literature was reviewed. It concluded that the consideration of industrial $N_2O$ with 30% of $N_2O$ emissions from municipal wastewater treatment plants is still justified.

### Activity data and parameters used for calculation

The amount of wastewater treated in sewage plants as well as the denitrification rate increased over the time series as presented in Table 231. Data were taken from the Austrian reports on water pollution control (GEWÄSSERSCHUTZBERICHTE 1993, 1996, 1999, 2002) and situation reports on the disposal of urban wastewater and sludge (BMLFUW 2006, BMLFUW 2008). Missing data in between were interpolated.

*Table 231:Parameters used for the calculation of $N_2O$ emissions for 1990–2007.*

| | Connection rate to municipal sewage systems [%] | Denitrification rate [%] | Protein intake (g/day/capita) | Total Inhabitants |
|---|---|---|---|---|
| 1990 | 59.0% | 0.1 | 102 | 7 677 850 |
| 1991 | **60.0%** [a)] | 0.1 | 102 | 7 754 891 |
| 1992 | 63.4% | 0.1 | 102 | 7 840 709 |
| 1993 | 66.8% | 0.1 | 103 | 7 905 632 |
| 1994 | 70.1% | 0.18 | 104 | 7 936 118 |
| 1995 | **73.5%** [a)] | 0.27 | 105 | 7 948 278 |
| 1996 | 76.0% | **0.35** [a)] | 105 | 7 959 016 |
| 1997 | 78.4% | 0.40 | 105 | 7 968 041 |
| 1998 | **80.9%** [a)] | 0.46 | 107 | 7 976 789 |
| 1999 | 82.6% | **0.51** [a)] | 108 | 7 992 323 |
| 2000 | 84.3% | 0.60 | 110 | 8 011 566 |
| 2001 | **86.0%** [b)] | **0.68** [a)] | 111 | 8 043 046 |
| 2002 | 87.5% | 0.68 | 111 | 8 083 797 |
| 2003 | **88.9%** [b)] | 0.68 | 111 | 8 117 754 |
| 2004 | 88.9% | **0.68** [b)] | 118 | 8 174 733 |
| 2005 | 88.9% | 0.73 | 118 | 8 233 306 |
| 2006 | **91.7%** [b)] | **0.77** [b)] | 118 | 8 281 948 |
| 2007 | 91.7% | 0.77 | 118 | 8 315 379 |

[a]) *Source: Austrian reports on water pollution control (GEWÄSSERSCHUTZBERICHT E 1993, 1996, 1999, 2002);*

[b]) *Source: Situation reports on the disposal of urban wastewater and sludge (BMLFUW 2006, BMLFUW 2008 )*

### 8.3.3 Recalculations

New information on the connection rate for 2006 was available resulting in a recalculation of emissions from waste water handling. The minor recalculation of the other years was due to the correction of a rounded value.

*Table 232: Recalculations with respect to previous submission from wastewater handling*

| Difference | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 |
|---|---|---|---|---|---|---|
| $CH_4$ [Gg] | 0.01 | 0 | 0.01 | 0.01 | 0.01 | -0.49 |
| $N_2O$ [Gg] | 0 | 0 | 0 | 0 | 0 | 0.00 |
| *$CO_2$ eq [%]* | *0.06%* | *0%* | *0.09%* | *0.09%* | *0.08%* | *-3.20%* |

## 8.4 Waste incineration (CRF Category 6.C)

### 8.4.1 Source Category Description

*Key source: No*

In this category emissions from incineration of waste oil are included as well as emissions from municipal waste incineration without energy recovery. All $CO_2$ emissions from waste are caused by waste incineration. The share in total emissions from waste is 0.7% for the year 1990 and 0.6% for the year 2007.

In Austria waste oil is incinerated in especially designed so called "USK-facilities". The emissions of waste oil combustion for energy recovery (e.g. in cement industry) are reported under fuel combustion.

In general, municipal, industrial and hazardous waste are combusted for energy recovery in district heating plants or in industrial sites and therefore the emissions are reported under fuel combustion. There is only one waste incineration plant without energy recovery which has been operated until 1991 with a capacity of 22 000 tons of municipal waste per year. This plant has been rebuilt as a district heating plant starting operation in 1996. Therefore the emissions since the re-opening of this plant are reported under fuel combustion from 1996 onwards.

*Table 233: Greenhouse gas emissions from Category 6.C.*

| | $CO_2$ [Gg] | $CH_4$ [Gg] | $N_2O$ [Gg] | $CO_2$ equiv. [Gg] |
|---|---|---|---|---|
| 1990 | 27 | 0.003 | 0.0004 | 27 |
| 1991 | 23 | 0.003 | 0.0004 | 24 |
| 1992 | 11 | 0.001 | 0.0001 | 11 |
| 1993 | 11 | 0.000 | 0.0001 | 11 |
| 1994 | 11 | 0.000 | 0.0001 | 11 |
| 1995 | 11 | 0.000 | 0.0001 | 11 |
| 1996 | 11 | 0.000 | 0.0001 | 11 |
| 1997 | 12 | 0.000 | 0.0001 | 12 |
| 1998 | 12 | 0.000 | 0.0001 | 12 |
| 1999 | 12 | 0.000 | 0.0001 | 12 |
| 2000 | 12 | 0.000 | 0.0001 | 12 |
| 2001 | 12 | 0.000 | 0.0001 | 12 |
| 2002 | 12 | 0.000 | 0.0001 | 12 |
| 2003 | 12 | 0.000 | 0.0001 | 12 |
| 2004 | 12 | 0.000 | 0.0001 | 12 |
| 2005 | 12 | 0.000 | 0.0001 | 12 |
| 2006 | 12 | 0.000 | 0.0001 | 12 |
| 2007 | 12 | 0.000 | 0.0001 | 12 |
| *Trend 1990–2007* | -54% | -90% | -74% | -55% |

## 8.4.2 Methodological Issues

CORINAIR methodology is applied: the quantity of waste is multiplied by an emission factor for $CO_2$, $CH_4$ and $N_2O$.

### Emission factors

National emission factors for $CH_4$ are derived from residual fuel oil VOC emission factors (BMWA-EB 1990, BMWA-EB 1996, UMWELTBUNDESAMT 2001a). $N_2O$ emission factors are taken from a national study (ORTHOFER et al. 1995).

For waste oil, the same $CO_2$ emission factor as for *1 A 1 a* heavy oil ($CO_2$: 80 [t/TJ]) is used and a heating value of 40.3 GJ/Mg waste oil (source: Energy balance-residual fuel oil) is used to convert the emission factors from [kg/TJ] to [kg/Mg].

For municipal solid waste and clinical waste the $CO_2$ emission factor is calculated by means of default assumptions from (IPCC-GPG 2000) as presented in Table 234.

*Table 234: Emission factors and parameters of IPCC Category 6.C Waste Incineration.*

| Waste Type | Carbon content | Share in fossil carbon | Combustion efficiency | $CO_2$ [kg/ Mg] | $CH_4$ [g/Mg] | $N_2O$ [g/Mg] |
|---|---|---|---|---|---|---|
| Municipal Waste | 40% | 40% | 95% | 557.70 | 104.40 | 12.18 |
| Clinical Waste | 60% | 40% | 95% | 836.00 | 100.00 | 12.00 |
| Waste Oil | – | – | – | 3 224.00 | NA | 24.18 |

**Activity data**

For municipal solid waste the capacity (22 000 tons of waste per year) of one operating waste incineration plant without energy recovery was used.

Waste oil activity data 1990 to 1999 were taken from (UMWELTBUNDESAMT 1995). For 2000 to 2004 the activity data of 1999 was used. (UMWELTBUNDESAMT 2001d) 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. It is planned for the future to update activity data for clinical waste and waste oil incineration.

*Table 235: Activity data for IPCC Category 6 C Waste Incineration.*

| Year | Municipal Waste [Mg] | Clinical Waste [Mg] | Waste Oil [Mg] |
|---|---|---|---|
| 1990 | 22 000 | 9 000 | 2 200 |
| 1991 | 22 000 | 7 525 | 1 500 |
| 1992 | 0 | 6 050 | 1 800 |
| 1993 | 0 | 4 575 | 2 100 |
| 1994 | 0 | 3 100 | 2 500 |
| 1995 | 0 | 3 100 | 2 600 |
| 1996 | 0 | 3 100 | 2 700 |
| 1997 | 0 | 3 100 | 2 800 |
| 1998 | 0 | 3 100 | 2 900 |
| 1999 to 2007 | 0 | 3 100 | 3 000 |

The following table shows activity data of waste incineration with energy recovery.

*Table 236: Activity data for waste incineration with energy recovery.*

| Year | 1.A.1.a Public Electricity and Heat[1)] | | | 1.A.2.f Cement Industry[2)] | | 1.A.2 Manuf. Industries[3)] |
|---|---|---|---|---|---|---|
| | MSW [Mg] | hazardous waste [Mg] [4)] | sewage sludge [Mg] | Industrial waste [Mg] | of which waste oil [Mg] | Ind. Waste [TJ] |
| 1990 | 299 256 | 80 000 | 55 000 | 59 422 | 11 716 | 3 220 |
| 1991 | 341 001 | 80 000 | 55 000 | 66 552 | 22 069 | 4 556 |
| 1992 | 403 307 | 80 000 | 55 000 | 78 803 | 24 141 | 5 271 |
| 1993 | 421 907 | 72 500 | 64 500 | 78 568 | 21 273 | 4 179 |
| 1994 | 442 479 | 75 000 | 61 600 | 82 658 | 25 047 | 4 726 |
| 1995 | 441 502 | 71 337 | 60 672 | 86 998 | 28 675 | 5 270 |
| 1996 | 438 549 | 75 812 | 61 372 | 100 036 | 25 719 | 6 349 |

| Year | 1.A.1.a Public Electricity and Heat[1] | | | 1.A.2.f Cement Industry[2] | | 1.A.2 Manuf. Industries[3] |
|---|---|---|---|---|---|---|
| | MSW [Mg] | hazardous waste [Mg] [4] | sewage sludge [Mg] | Industrial waste [Mg] | of which waste oil [Mg] | Ind. Waste [TJ] |
| 1997 | 446 471 | 95 334 | 64 778 | 101 063 | 22 781 | 5 692 |
| 1998 | 608 505 | 86 098 | 68 316 | 121 719 | 28 279 | 5 891 |
| 1999 | 526 928 | 70 513 | 80 406 | 135 065 | 26 607 | 5 298 |
| 2000 | 528 365 | 70 513 | 80 406 | 169 888 | 27 794 | 6 157 |
| 2001 | 535 641 | 70 513 | 75 117 | 218 048 | 26 437 | 8 140 |
| 2002 | 561 801 | 70 513 | 64 225 | 238 959 | 30 017 | 8 902 |
| 2003 | 645 807 | 70 513 | 62 970 | 253 874 | 30 057 | 9 846 |
| 2004 | 845 500 | 90 771 | 59 460 | 257 360 | 28 370 | 12 044 |
| 2005 | 773 160 | 103 024 | 58 979 | 262 059 | 26 701 | 11 208 |
| 2006 | 1 147 980 | 113 695 | 60 216 | 301 374 | 21 596 | 15 331 |
| 2007 | 799 682 | 260 226 | 62 376 | 334 946 | 23 808 | 17 000 |

1) *Umweltbundesamt, Statistik Austria 2008.*
2) *(HACKL & MAUSCHITZ 1995, 1997, 2001, 2003, 2007, MAUSCHITZ 2004), ETS data.*
3) *1.A.2.f other fuels – activity data*
4) *including waste oil and clinical waste*

**Recalculations**

No recalculations have been carried out.

## 8.5 Other waste (CRF Category 6.D)

*Key Source: No*

*Emission: $CH_4$, $N_2O$*

In this category biological treatment of solid waste is considered, in the CRF the category is named "compost production" – it is planend to rename this category for next submission.

This category includes $CH_4$ and $N_2O$ emissions from mechanical-biological treatment of residual waste and composted waste. Emission data is presented in Table 237 for the period from 1990 to 2007.

Both $CH_4$ and $N_2O$ emissions increased over the observed time period as a result of the increasing amount of composted as well as mechanical-biologically treated waste.

*Table 237:Greenhouse gas emissions from 'other waste' 1990–2007.*

| | $CH_4$ emissions [Gg] | $N_2O$ emissions [Gg] | Total [Gg $CO_2$ eq.] |
|---|---|---|---|
| 1990 | 0.52 | 0.08 | 34.57 |
| 1991 | 0.55 | 0.08 | 36.24 |
| 1992 | 0.65 | 0.09 | 42.94 |
| 1993 | 0.82 | 0.12 | 53.21 |
| 1994 | 0.98 | 0.14 | 63.12 |

| | $CH_4$ emissions [Gg] | $N_2O$ emissions [Gg] | Total [Gg $CO_2$ eq.] |
|---|---|---|---|
| 1995 | 1.04 | 0.14 | 66.67 |
| 1996 | 1.09 | 0.15 | 69.87 |
| 1997 | 1.08 | 0.15 | 68.84 |
| 1998 | 1.12 | 0.15 | 71.28 |
| 1999 | 1.18 | 0.16 | 74.93 |
| 2000 | 1.21 | 0.17 | 77.13 |
| 2001 | 1.24 | 0.17 | 78.85 |
| 2002 | 1.27 | 0.17 | 80.49 |
| 2003 | 1.29 | 0.18 | 81.61 |
| 2004 | 1.52 | 0.21 | 98.00 |
| 2005 | 1.62 | 0.23 | 104.99 |
| 2006 | 1.66 | 0.23 | 107.50 |
| 2007 | 1.67 | 0.24 | 108.65 |
| *Trend 1990-2007* | *222%* | *211%* | *214%* |

### 8.5.1 Methodological Issues

Emissions were estimated using a country specific methodology.

Two different fractions of 'other waste' were considered:

- residual waste treated in mechanical-biological treatment plants
- composted waste: bio-waste collected separately, loppings, home composting

Emissions were calculated by multiplying the quantity of waste by the corresponding emission factor.

**Activity data**

The activity data were taken from several national studies. For years where no data were available inter- or extrapolation was done.

*Table 238:Activity data and sources for 'other waste'.*

| | Total waste | Mechanical-biological waste treatment | | Bio waste collected separately[1] | Loppings; gardening waste | | Home composting | |
|---|---|---|---|---|---|---|---|---|
| | [Gg] | [Mg] | source | [Mg] | [Mg] | source | [Mg] | source |
| 1990 | 762.8 | 345 000 | (BAUMELER et al. 1998) | 10 436 | 37 370 | Sum of data reported by the Austrian federal provinces, (AMLINGER 2003) | 370 000 | (AMLINGER 2003) |
| 1991 | 798.4 | 345 000 | | 27 372 | 50 995 | | 375 000 | |
| 1992 | 941.7 | 345 000 | | 88 243 | 48 464 | | 460 000 | |
| 1993 | 1161.4 | 345 000 | | 156 936 | 149 470 | | 510 000 | |
| 1994 | 1373.5 | 345 000 | | 246 375 | 197 130 | | 584 985 | |
| 1995 | 1446.1 | 295 000 | (ANGERER 1997) | 301 809 | 249 264 | | 600 000 | |
| 1996 | 1513.5 | 280 000 | expert judgement | 334 371 | 283 127 | | 616 000 | |
| 1997 | 1489.1 | 245 000 | (LAHL 1998) | 351 862 | 229 643 | | 662 571 | |
| 1998 | 1540.9 | 240 000 | (LAHL 2000) | 362 572 | 241 835 | | 696 487 | |
| 1999 | 1620.7 | 265 000 | (UMWELTBUNDESAMT 2001e) | 378 796 | 244 587 | | 732 273 | |
| 2000 | 1666.9 | 253 156 | interpolated | 374 271 | 267 670 | Interpol-ated | 771 773 | |
| 2001 | 1702.9 | 241 312 | | 399 090 | 290 752 | | 771 773 | value of 2002 |
| 2002 | 1737.2 | 229 468 | | 422 126 | 313 835 | | 771 773 | |
| 2003 | 1760.2 | 217 625 | (UMWELTBUN-DESAMT 2008d) | 433 911 | 336 917 | | 771 773 | |
| 2004 | 2129.2 | 487 623 | | 481 581 | 360 000 | (BAWP 2006) | 800 000 | (BAWP 2006) |
| 2005 | 2287.9 | 623 393 | | 504 467 | 360 000 | value of 2004 | 800 000 | |
| 2006 | 2343.9 | 660 231 | | 523 626 | 360 000 | | 800 000 | (BAWP 2006)[2] |
| 2007 | 2370.1 | 684 322 | | 535 777 | 350 000 | (BAWP 2006)[2] | 800 000 | |

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

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

### Emission factors

Due to different emission factors in different national references an average value was used for both fractions of composted waste.

*Table 239: Emission factors for 'other waste'.*

| | $CH_4$ [kg/t FS] | $N_2O$ [kg/t FS] | References |
|---|---|---|---|
| Mechanical-biologically treated residual waste | 0.6 | 0.1 | (UBA BERLIN 1999)<br>(AMLINGER et al. 2003)<br>(ANGERER & FRÖHLICH 2002)<br>(DOEDENS et al. 1999) |
| bio-waste, loppings, home composting | 0.75 | 0.1 | (AMLINGER et al. 2003) |

### 8.5.2 Recalculations

The following improvements have been made compared to last year's submission:

- *A*ctivity data for mechanical-biological treatment have been updated for the years 2003-2006, as new data on incoming quantities became available (UMWELTBUNDESAMT 2008d).
- Activity Data for separately collected bio-waste (mainly) of the previous year was updated, because some of the nine federal provinces (Bundesländer) published new or updated data in their Waste Management Concepts and Plans. This has led to a slightly differing overall amount compared to previous years' submission.

*Table 240:Recalculations with respect to previous submission from 'other waste' (compost) 1990–2006.*

| **Difference** | **1990** | **1991** | **1992** | **1993** | **1994** | **1995** | **1996** | **1997** | **1998** | **1999** |
|---|---|---|---|---|---|---|---|---|---|---|
| $CH_4$ [Gg] | 0.00 | 0.00 | 0.00 | 0.00 | 0 | 0.00 | 0 | 0 | 0 | 0 |
| $N_2O$ [Gg] | 0.00 | 0.00 | 0.00 | 0.00 | 0 | -0.00 | 0 | 0 | 0 | 0 |
| *$CO_2$ eq. [%]* | *0.6%* | *0.7%* | *0.6%* | *0.0%* | *0%* | *-0.0%* | *0%* | *0%* | *0%* | *0%* |
| **Difference** | **2000** | **2001** | **2002** | **2003** | **2004** | **2005** | **2006** | | | |
| $CH_4$ [Gg] | 0.00 | -0.01 | -0.02 | -0.03 | 0.00 | 0.00 | 0.03 | | | |
| $N_2O$ [Gg] | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | | | |
| *$CO_2$ eq. [%]* | *0.1%* | *-0.4%* | *-1.2%* | *-2.0%* | *-0.3%* | *-0.2%* | *1.9%* | | | |

# 9 RECALCULATIONS AND IMPROVEMENTS

This chapter quantifies the changes in emissions for all six greenhouse gases compared to the previous submission. Recalculations are quantified for total GHG gas emissions for all years and by gas for 1990 and 2006. The implications of the recalculations for emission levels by category for $CO_2$, $CH_4$, $N_2O$ and FCs are presented in Annex 5.

Recalculations of previously submitted inventory data are performed following the IPCC Good Practice Guidance, Chapter 7 "Methodological Choice and Recalculation" with the only purpose to improve the GHG inventory.

The figures presented in this report replace data reported earlier by Austria under the reporting framework of the UNFCCC, in particular data which had been included in the inventory chapter of the Fourth National Communication of the Austrian Federal Government (2006) and in Austria's 2006, 2007 and 2008 submissions to the UNFCCC (Austrian Greenhouse Gas Emissions 1990–2004, 1990–2005 and 1990–2006).

## 9.1 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, plant operators, studies, personal information or 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 (CRF) 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 sometimes necessary to make some revisions (called recalculations) under the following circumstances:

- An emission source was not considered in the previous inventory.
- A source/data supplier has delivered new data. The causes might be: Previous data were preliminary data only (by estimation, extrapolation), improvements in methodology.
- Occurrence of errors in data transfer or processing: wrong data, unit-conversion, software errors, etc.
- Methodological changes: a new methodology must be applied to fulfil the reporting obligations 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.
  - the methodology is no longer appropriate.

For detailed information on recalculations and their justifications see Chapters 2.3.1 to 2.3.6 and the corresponding subchapters of Chapters *3 Energy – 8 Waste*.

Improvements made in response to the issues raised in the UNFCCC review process are summarized in Table 241.

*Table 241: Improvements made in response to the UNFCCC review process*

| Finding | Reference | Improvement made |
|---|---|---|
| **General** | | |
| The ERT recommends Austria to include the LULUCF sector in the key categories reported in the NIR. | FCCC/ARR/2006/AUT para6 | LULUCF sector was included in the key categories reported in the NIR 2007. |
| The ERT recommends Austria to carry out the uncertainty analysis for all categories. | FCCC/ARR/2006/AUT para12 | Uncertainty analysis for all categories except LULUCF is presented in the NIR 2008. |
| highlight in the NIR all the work that has been done on QA/QC of the inventory information | FCCC/ARR/2006/AUT para17<br>FCCC/IRR/2007/AUT para35 | A more detailed description of category specific QA/QC activities is included in the NIR 2008 in the sectors Energy, Industrial Processes, and partly in LULUCF. |
| **Energy** | | |
| Multilateral operations: The ERT recommends Austria to report them as "not occurring" ("NO") since emissions from multilateral operations do not occur in Austria. | FCCC/ARR/2006/AUT para22<br>FCCC/IRR/2007/AUT para40 | Emissions are now reported as "NO". |
| 1.A.3.a civil aviation – jet kerosene: the ERT encourages the Party to use updated data in its next submission. | FCCC/ARR/2006/AUT para32 | Data from 2000 onwards was updated following the CORINAIR Tier 3a bottom-up method. |
| 1.A.3.a domestic civil aviation: the ERT recommends Austria to check the consistency of the time series and provide clear explanations in the NIR regarding the increase in emissions. | FCCC/ARR/2006/AUT para33 | Data from 2000 onwards was updated following the CORINAIR Tier 3a bottom-up method. |
| **IP & Fugitive** | | |
| the ERT recommended that Austria investigate any possible double counting of $CO_2$ emissions between ammonia and urea production. Austria agreed with the ERT's recommendations, and subsequently provided revised estimates that reduced the estimates of $CO_2$ emissions from ammonia production by the quantity double counted. | FCCC/ARR/2006/AUT para40<br>FCCC/IRR/2007/AUT para53 | Revised methodology was reported for the first time in NIR 2007. |
| Semiconductors: To enhance transparency in the inventory for this and other categories where company-specific data are reported, Austria is encouraged to provide information on the monitoring methods used, as well as the subsequent QA/QC procedures carried out to ensure data quality. | FCCC/ARR/2006/AUT para43 | The NIR 2008 includes further description on methods and relevant parameters. |
| Aluminium Production: The ERT encourages Austria to include this QA/QC documentation in its future inventory submissions. | FCCC/IRR/2007/AUT para56 | A more detailed description of category specific QA/QC activities was included in the NIR 2007 |

| Finding | Reference | Improvement made |
|---|---|---|
| **Agriculture** | | |
| The ERT recommends that Austria further improve the transparency of the NIR by providing more information about supporting studies. | FCCC/ARR/2006/AUT para46<br>FCCC/IRR/2007/AUT para60 | The NIR 2008 includes further background information on the supporting studies. |
| …..inter-annual variations in the number of dairy cows and mother cows. The ERT recommends that Austria make further efforts to improve the consistency of the time series. | FCCC/ARR/2006/AUT para47<br>FCCC/IRR/2007/AUT para61 | The inter-annual variations are explained in NIR 2008. It is planned to further investigate this issue during an audit and include additional information on the method of collecting data applied by Statistik Austria in future NIRs. |
| The ERT recommends that Austria make efforts to improve the consistency in the time trend of milk yield, dairy cows and mother cows and further verify the strong inter-annual variation from 1994 to 1995. | FCCC/ARR/2006/AUT para48 | Milk yield dairy cows:<br>The value of 1990 was confirmed by Statistik Austria. It is planned to further investigate this issue during an audit and include additional information on the method of collecting data applied by Statistik Austria in future NIRs.<br>Milk yield suckling cows:<br>Underlying background studies are described in NIR 2008. |
| The ERT recommends Austria to include the relevant information about the determination of volatilization ratios in its future NIRs. | FCCC/ARR/2006/AUT para54<br>FCCC/IRR/2007/AUT para67 | The NIR 2008 includes additional information about the determination of volatilization ratios. |
| **Waste** | | |
| Solid waste disposal on land: The ERT encourages Austria to implement the data checks from statistics during the QA/QC procedures in order to identify possible double counting of data. | FCCC/ARR/2006/AUT para76 | A specific QA/QC procedure for waste statistics to avoid possible double counting or omission of data was implemented. |
| Waste Water Handling: During the review Austria provided a well-based recalculation which shows that the missing estimate for 1990 is 0.29 Gg $N_2O$ (i.e. 91 Gg $CO_2$ equivalent) and for 2004 is 28 Gg $CO_2$ equivalent. Austria is encouraged to take into account the recalculation for the whole time series and to apply the same approach to its next submission. | FCCC/ARR/2006/AUT para80 | Recalculations were made for the whole time-series and revised methodology was reported for the first time in the NIR 2007. |
| This assumption is not supported by data at present, but Austria plans to conduct a study on $N_2O$ emissions from industrial waste-water handling. The ERT encourages it to take the results of that study into account in its future submissions. | FCCC/ARR/2006/AUT para81 | A study was conducted in 2007 and results were taken into account for the NIR 2008. |

The sub chapters list all methodological changes and activity data update that led to recalculations of emissions with respect to the previous submission to the UNFCCC (April 2008).

### 9.1.1 Energy (Sector 1)

#### Combustion Activities (1 A)

***Update of activity data:***

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

*Energy balance update and corrections:*

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

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

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

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

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

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

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

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

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

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

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

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

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

*1.A.2.f Manufacturing Industries and Construction – Other – mobile sources:* Activity data for mobile machineries were updated with data from a new study (see description for 1.A.4 *mobile sources*), now the activity of mobile machineries in industry is considerably lower.

*1.A.3.a Aviation:* Previously the split for national/international aviation was extrapolated for the years after 2000 using the split from 2000 (the last year for which detailed data was collected). This year data from 2000 onwards was updated following the CORINAIR Tier 3a bottom-up method. Tier 3a takes into account cruise emissions for different flight distances, depending on aircraft types. However, for 1990 – 1999 the calculations are based on the very detailed methodology (Tier 3b) from the CORINAIR guidebook in an advanced version - based on the MEET 1999 model – but data on this level of detail was not available. This recalculation affects primarily $CO_2$ emissions.

*1.A.3.b Transport – Road:* Update of statistical energy data, particularly the biodiesel consumption. The new study for off-road transport (see description for *1.A.4 Other sectors – mobile*) concludes that less fuel is used by off-road vehicles, especially in industry and forestry. However, as total fuel consumption is a robust value, this only resulted in a shift in fuel consumption and emissions from mobile machinery in industry and agriculture and forestry to road transport.

*1.A.4.Other Sectors - mobile sources:* Activity data for mobile machineries were updated with data from a new study (old data based on a study from the year 2000), it is based on the most recent "Nutz-Energie-Analyse" by Statistik Austria (which is a survey analysing the energy use); now the activity of mobile machineries in forestry is considerably lower.

**Improvements of methodologies and emission factors:**

*1.A.2.c Chemical Industry*

Due to more detailed plant specific information about the type of fuel waste reported by energy statistics the $CO_2$ emission factor has been revised for 2000-2006. The new $CO_2$ emission factor considers solid waste with the previously used default emission factor of 104 t/TJ and non-solid waste with an emission factor of 52 t/TJ.

*1.A.4.b Residential – stationary:*

Revise of the split into heating types from 2001 onwards by means of new 2004 household census data. This affects the calculation of $N_2O$ and $CH_4$ emissions from residential heatings.

Fuel consumption of new biomass, gas and oil heatings has been revised from the year 2005 onwards by means of boiler sales statistics. This affects the calculation of $N_2O$ and $CH_4$ emissions from residential heatings.

*1.A.2.f Manufacturing Industries and Construction – Other – mobile sources:* Updated $N_2O$ und $CH_4$ emission factors for mobile machineries based on a new study commissioned by the Umweltbundesamt were applied.

*1.A.3.a Aviation:* Emission factors for domestic (LTO and cruise) aviation according to the CORINAIR Tier 3a bottom-up approach for the years after 2000 were updated.

*1.A.3.b Road Transport*: Statistics on road charge were incorporated in the calculation model for road transport for the first time, this led to an update of vehicle-kilometres, ton-kilometres and passenger-kilometres for the whole time series – according to this statistics heavy duty vehicles were recently underestimated.

*1.A.4 Other Sectors – Mobile Sources:* Updated $N_2O$ und $CH_4$ emission factors for mobile machineries based on a new study commissioned by the Umweltbundesamt were applied.

### Fugitive Emissions (1 B)

***Update of activity data:***

*1.B.2.a Refining/Storage:* Activity data for 2005 and 2006 was updated according to data from the national energy balance.

## 9.1.2 Industrial Processes (Sector 2)

***Update of activity data:***

*2.A.3. Limestone and Dolomite Use:* A transcription error of limestone and dolomite use in glass industry was corrected for 2006.

*2.A.4. Soda ash use*: A transcription error of soda ash use in glass industry was corrected for 2006.

*2.B.1. Ammonia Production*:
Process-specific $CO_2$ emissions from ammonia production for 2004 were recalculated as the underlying activity data used for the calculation (non-energy use of natural gas) was updated in the national energy balance.

*2.C.1. Iron and Steel:*
Process-specific $CO_2$ emissions from pig iron production for 2006 were recalculated as the underlying activity data used for the calculation (non-energy use of coke) was updated in the national energy balance.

*2.C.2. Ferroalloys:* Activity data for 2006 was updated.

*2.F.2. Foam blowing:* Potential emissions have been updated for the years 2005–2006 according to new information provided by foam producers.

*2.F.4. Aerosols and 2.F.5 Solvents:*
Potential emissions have been updated for the years 2002–2006 according to recalculations of the Austrian GDP in these years.

**Improvements of methodologies and emission factors:**

*2.A.3. Limestone and Dolomite Use:* Plant specific emission factors became available for the sub-category limestone use for desulphurization. CO2 emissions were updated accordingly for the years 2005 and 2006.

## 9.1.3 Solvent and other Product Use (Sector 3)

To improve and update the solvent model a study was finalized, the main results will be presented in the NIR 2009.

***Update of activity data:***

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

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

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

***Improvements of methodologies and emission factors:***

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

A modification of the solvent model led to a shift in emissions: In sub sector *3 C Chemical Products, Manufacture and Processing* now only the share of the solvent content that is emitted during production is considered as input – therefore the "artificial" emission factor is 100%. The remaining amount of solvent in the products, which are emitted during application and use, is reported as input and emissions of sub sectors 3.A and 3.D.

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

### 9.1.4 Agriculture (Sector 4)

***Improvements of methodologies and emission factors:***

*4.A.9 Poultry:* The gross energy intake data (GE) and the methane conversion rate (Ym) of poultry were revised. The new values were obtained from the National Inventory Report of Switzerland 2008. Following the Swiss NIR, data on energy intake are taken from (SBV 2007)[65]. The Ym value is based on an in vivo trial with broilers (Hadorn & Wenk 1996)[66]. The revision results in 50% higher $CH_4$ emissions from 1990-2007.

### 9.1.5 LULUCF (Sector 5)

*Revision of the data series for LULUCF due to the following changes:*

*5.B Cropland:*

Additional figures for the root biomass of annual cropland plants were estimated which leads to new emission factors for LUC from and to cropland.

Shortcomings within the biomass emission factors for Christmas tree cultures and plantations for energy wood were corrected leading to new emission factors of the sub-category perennial cropland remaining perennial cropland.

A mistake in the estimates of the soil emission factor for LUC from forest land to cropland was corrected.

*5.C Grassland:* revised figures for the biomasses for grassland were used (including all biomass of grassland for LUC estimates) which leads to new emission factors for LUC from and to grassland.

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[65] SBV 2007: Statistische Erhebungen und Schätzungen über Landwirtschaft und Ernährung 2006. Swiss Farmers Union, Brugg. [available in German and French] http://www.sbv-usp.ch/de/shop/statistische-erhebungen [24.01.2008]

[66] Hadorn, R., Wenk, C. 1996: Effect of different sources of dietary fibre on nutrient and energy utilization in broilers. 2. Energy and N-balance as well as whole body composition. Archiv für Geflügelkunde 60: 22-29.

*5.E Settlements:*

Shortcomings in the time series of the area of settlements remaining settlements was identified and corrected.

The growth factor for shrubs was corrected, which leads to revised biomass emission factors for settlements with related impacts for categories with LUC to and from settlements.

### 9.1.6 Waste (Sector 6)

***Update of activity data***

*6.A.1 Managed waste disposal on land:* activity data for the year 2006 has been updated. According to the Austrian Landfill Ordinance, the operators of landfill sites have to report their activity data annually. Based on reports received after the due date and updates, the amount of deposited waste in 2006 changed slightly (+6%) compared to the previous submission. Futhermore, new data on collected landfill gas became available for 2002 – 2006 from questionnaires sent to landfill operators. The amount of collected landfill gas has decreased over time as methane generation declined too.

*6.B Waste water handling:* new information on the connection rate for 2006 was available[67]. This was accounted for in this years' submission.

*6.D Other:* activity data for mechanical-biological treatment have been updated for the years 2003-2006, as new data on incoming quantities became available[68].

Activity data for separately collected bio-waste (mainly) of the previous year was updated, because some of the nine Federal Provinces (Bundesländer) published new or updated data in their Waste Management Concepts and Plans. This has led to a slightly differing overall amount compared to previous years' submission.

[67] Kommunale Abwasserrichtlinie der EU – 91/271/EWG. Österreichischer Bericht 2008", Hrsg. BMLFUW, G. Windhofer, Katharina Lenz, Irene Zieritz, S. 12) = (BMLFUW 2008b).

[68] Behandlung von gemischten Siedlungs- und Gewerbeabfällen in Österreich – Betrachtungszeitraum 2003–2007", Christian Neubauer, Birgit Walter = (UMWELTBUNDESAMT 2008d)

## 9.2 Implication for Emission Levels

As a result of the continuous improvement of Austria's GHG inventory, emissions of some sources have been recalculated on the basis of updated data or revised methodologies, thus emission data for 1990 to 2006 which are submitted this year differ from data reported previously.

The following table presents the recalculation difference with respect to last year's submission for each gas (positive values indicate that this year's estimate is higher).

*Table 242: Recalculation difference of Austria's greenhouse gas emissions compared to the previous submission*

| | 1990 (Base year) | 2006 |
|---|---|---|
| | Recalculation Difference [%] | |
| TOTAL | -0.17% | +0.47% |
| $CO_2$ | -0.01% | +0.39% |
| $CH_4$ | -0.01% | +2.07% |
| $N_2O$ | -2.07% | -0.40% |
| HFC, PFC, SF6 | ±0.00% | +0.20% |

*Emissions without LULUCF*

The most significant changes relate to the $N_2O$ and $CH_4$ emissions and result from improvements of activity data for off-road transport and landfill gas collection:

The decrease of emissions in the base year is mainly due to a recalculation of **$N_2O$ emissions** from transport: more reliable/ consistent data on the fuel consumption of off road vehicles became available, resulting in lower fuel consumption of industrial and agricultural mobile machineries. This is valid for the whole time series (where the effect is stronger for the beginning of the time series); however, for the end of the time series this effect has been counterbalanced by an increase of reported $N_2O$ emissions from residential fuel combustion, which is due to the revision of the split into heating types using new census data with a shift to heating types with higher specific $N_2O$ emissions (biomass stoves).

The recalculation difference for **$CH_4$ emissions** (+ 6.8 Gg 2006) is mainly due to revised landfill gas collection rates of *Solid Waste Disposal on Land* (previously the absolute value of 2001 was used for the years 2002-2006; however, as the amount of deposited waste and therefore also the amount of generated landfill gas declined over the years, the subtraction of an absolute value for collected landfill gas led to an underestimation of emission).

**$CO_2$ emissions** have been revised from 1999 onwards based on improvements of the national energy balance, mainly due to a revised evaluation of census data 2004/2006 (see Chapter 3.5.1: recalculations in the energy sector). Furthermore, an important recalculation for $CO_2$ emissions, as for $N_2O$ emissions, was the recalculation of emissions from off-road transport. However, as total fuel consumption is a robust value, this only resulted in a shift in fuel consumption and emissions from mobile machinery in industry and agriculture and forestry to road transport.

For the years from 2002 onwards data for **F-gas** consumption in the aerosols sub category was revised because GDP data used to extrapolate the consumption has been revised by the statistical institute.

Table 243 presents the recalculation differences of national total GHG emissions for all years. The implications of recalculations for emission levels by category for $CO_2$, $CH_4$, $N_2O$ and FCs and the recalculation differences of national total emissions by gas are presented in Annex 5.

*Table 243:Recalculation Difference of National Total GHG Emissions.*

| Year | National Total GHG emissions without LUCF | | |
|---|---|---|---|
| | Submission 2008 [Gg $CO_2$e] | Submission 2009 [Gg $CO_2$e] | Recalculation Difference [%] |
| 1990* | 79 172 | 79 037 | -0.17% |
| 1991 | 83 243 | 83 121 | -0.15% |
| 1992 | 76 525 | 76 401 | -0.16% |
| 1993 | 76 425 | 76 307 | -0.15% |
| 1994 | 77 340 | 77 210 | -0.17% |
| 1995 | 80 624 | 80 506 | -0.15% |
| 1996 | 83 695 | 83 581 | -0.14% |
| 1997 | 83 259 | 83 133 | -0.15% |
| 1998 | 82 614 | 82 500 | -0.14% |
| 1999 | 81 018 | 80 925 | -0.11% |
| 2000 | 81 136 | 81 078 | -0.07% |
| 2001 | 85 279 | 85 083 | -0.23% |
| 2002 | 87 166 | 87 031 | -0.15% |
| 2003 | 93 300 | 93 112 | -0.20% |
| 2004 | 91 663 | 91 775 | 0.12% |
| 2005 | 93 260 | 92 832 | -0.46% |
| 2006 | 91 090 | 91 518 | 0.47% |

**Base year is 1990 for all gases*

## 9.3 Implications for Emission Trends

As can be seen in Table 243 and Figure 32, Austria's greenhouse gas emissions as reported in the UNFCCC submission 2009 are slightly different compared to the values reported last year due to recalculations: for the base year recalculated national total emissions excluding LULUCF are 0.17% lower than those reported last year, and 0.47% higher for the year 2006. Thus the trend for 1990 to 2006 reported last year (+ 15.1%) slightly enhanced: it now equals + 15.8% (for explanations please refer to Chapters 9.1 and 9.2).

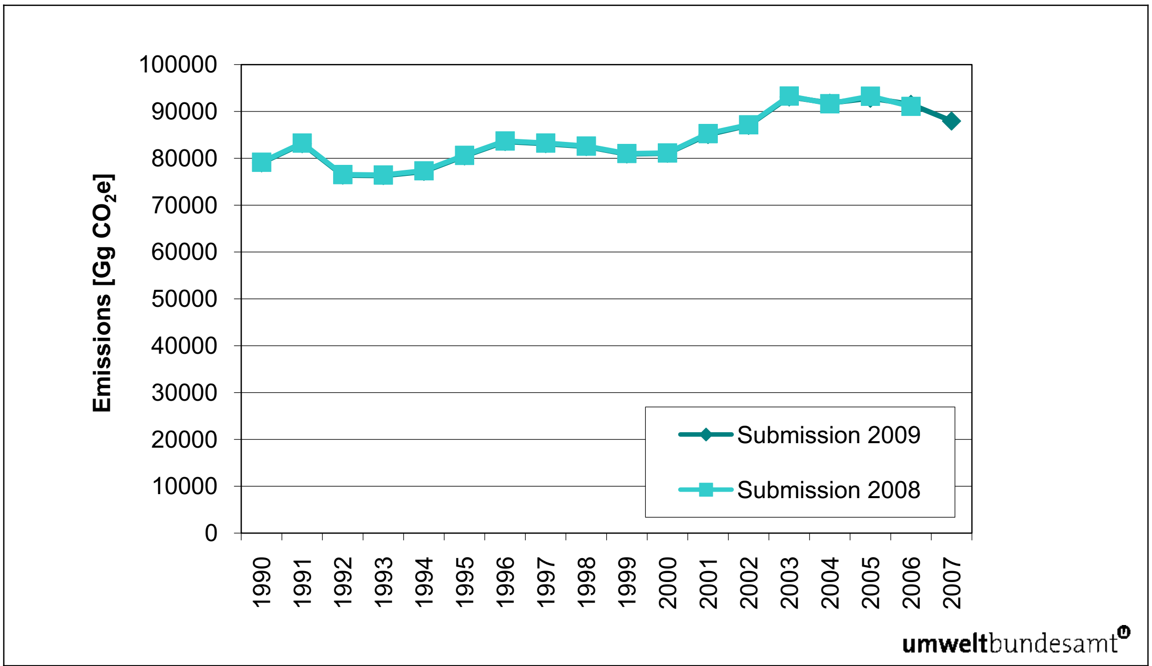


*Figure 32: Emission estimates of the submission 2007 and recalculated values of the submission 2008.*

## 9.4 Planned Improvements

Source specific planned improvements are presented in the respective subchapters of Chapters 3–8.

### Goals

The overall goal is to produce emission inventories which are fully consistent with the UNFCCC reporting guidelines and the IPCC Guidelines.

An improvement programme has been established to help meet this goal including implementation of the Good Practice Guidance to avoid any adjustments under the Kyoto Protocol.

### Linkages

The improvement programme is driven by the results of the various review processes, as e.g. the internal Austrian review, review under the European Union Monitoring Mechanism, and review under the UNFCCC and/or under the Kyoto Protocol. Improvement is triggered by the improvement programme that plans improvements sector by sector and also identifies actions outside the Umweltbundesamt.

The improvement programme is supported by the QA/QC programme based on the international standard ISO 17020.

**Updating**

The improvement programme is updated every year after the results from the UNFCCC review process become available.

**Responsibilities**

The Umweltbundesamt is responsible for the management of the improvement programme.

# ABBREVIATIONS

## General

AMA .................. Agrarmarkt Austria

BAWP ................ Bundes-Abfallwirtschaftsplan
Federal Waste Management Plan

BFW .................. Bundesamt und Forschungszentrum für Wald
Austrian Federal Office and Research Centre for Forest

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)

BMWA ................ Bundesministerium für Wirtschaft und Arbeit
Federal Ministry for Economic Affairs and Labour

BUWAL ............. Bundesamt für Umwelt, Wald und Landschaft, Bern
The Swiss Agency for the Environment, Forests and Landscape (SAEFL), Bern

COP .................. Conference of the Parties

CORINAIR ......... Core Inventory Air

CORINE ............ Coordination d´information Environmentale

CRF .................. Common Reporting Format

DKDB ................ Dampfkesseldatenbank
Austrian annual steam boiler inventory

DOC .................. Degradable Organic Carbon

EC ..................... European Community

EEA ................... European Environment Agency

EFTA ................. European Free Trade Association

EIONET ............. European Environment Information and Observation NETwork

EMEP ................ Cooperative Programme for Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe

EN ..................... European Norm

EPER ................ European Pollutant Emission Register

ETC/AE ............. European Topic Centre on Air Emissions

EU ..................... European Union

ERT ................... Expert Review Team (in context of the UNFCCC review process)

FAO .................. Food and Agricultural Organisation of the United Nations

GHG .................. Greenhouse Gas

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 [IPCC GPG, 2000]

GWP ................. Global Warming Potential

IPCC ................. Intergovernmental Panel on Climate Change

IEA.................... International Energy Agency

ISO.................... International Standards Organisation

LTO................... Landing/Take-Off cycle

LULUCF............ Land Use, Land-Use Change and Forestry – IPCC-CRF Category 5

NACE................ Nomenclature des activites economiques de la Communaute Europeenne

NAPFUE ........... Nomenclature for Air Pollution Fuels

NFI.................... National Forest Inventory

NFR .................. Nomenclature for Reporting (Format of Reporting under the UNECE/CLRTAP Convention)

NISA ................. National Inventory System Austria

OECD ............... Organisation for Economic Co-operation and Development

OLI.................... Österreichische Luftschadstoff Inventur
Austrian Air Emission Inventory

OMV.................. Österreichische Mineralölverwaltung
Austrian Mineraloil Company

PHARE ............. Phare is the acronym of the Programme's original name:
'**P**oland and **H**ungary: **A**ction for the **R**estructuring of the **E**conomy'.
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.)

QA/QC .............. Quality Assurance/Quality Control

QMS.................. Quality Management System

RWA ................. Raiffeisen Ware Austria (see www.rwa.at)

SNAP ................ Selected Nomenclature on Air Pollutants

UNECE/CLRTAP United Nations Economic Commission for Europe,
Convention on Long-range Transboundary Air Pollution

UNFCCC........... United Nations Framework Convention on Climate Change

**Notation Keys**

according to UNFCCC guidelines on reporting and review (FCCC/CP/2002/8)

| | |
|---|---|
| "NO"<br>(not occurring) | for activities or processes in a particular source or sink category that do not occur within a country; |
| "NE"<br>(not estimated) | for existing emissions by sources and removals by sinks of greenhouse gases which have not been estimated. Where "NE" is used in an inventory for emissions or removals of $CO_2$ , $CH_4$ , $N_2O$, HFCs, PFCs, or $SF_6$ , the Party should indicate in both the NIR and the CRF completeness table why emissions or removals have not been estimated |
| "NA"<br>(not applicable) | for activities in a given source/sink category that do not result in emissions or removals of a specific gas. If categories in the CRF for which "NA" is applicable are shaded, they do not need to be filled in |
| "IE"<br>(included elsewhere) | for emissions by sources and removals by sinks of greenhouse gases estimated but included elsewhere in the inventory instead of the expected source/sink category.<br>Where "IE" is used in an inventory, the Annex I Party should indicate, using the CRF completeness table, where in the inventory the emissions or removals from the displaced source/sink category have been included and the Annex I Party should explain such a deviation from the expected category |
| "C"<br>(confidential) | for emissions by sources and removals by sinks of greenhouse gases which could lead to the disclosure of confidential information, given the provisions of paragraph 27 of above |

## Chemical Symbols

Symbol................Name

### Greenhouse gases

$CH_4$ ................Methane
$CO_2$ ................Carbon Dioxide
$N_2O$ ................Nitrous Oxide
HFCs .............Hydroflurocarbons
PFCs .............Perfluorocarbons
$SF_6$ ................Sulphur hexafluoride

### Further chemical compounds

CO ................Carbon Monoxide
Cd ................Cadmium
$NH_3$ ................Ammonia
Hg ................Mercury
$NO_X$ ................Nitrogen Oxides (NO plus $NO_2$)
$NO_2$ ................Nitrogen Dioxide
NMVOC .........Non-Methane Volatile Organic Compounds
PAH ...............Polycyclic Aromatic Hydrocarbons
Pb ................Lead
POP ...............Persistent Organic Pollutants
$SO_2$ ................Sulfur Dioxide
$SO_X$ ................Sulfur Oxides

### Units and Metric Symbols

| UNIT | Name | Unit for |
|---|---|---|
| g | gram | mass |
| t | ton | mass |
| W | watt | power |
| J | joule | calorific value |
| m | meter | length |

| Mass Unit Conversion | | |
|---|---|---|
| 1g | | |
| 1kg | = 1 000 g | |
| 1t | = 1 000 kg | = 1 Mg |
| 1kt | = 1 000 t | = 1 Gg |
| 1Mt | = 1 Mio t | = 1 Tg |

| Metric Symbol | Prefix | Factor |
|---|---|---|
| P | peta | $10^{15}$ |
| T | tera | $10^{12}$ |
| G | giga | $10^{9}$ |
| M | mega | $10^{6}$ |
| k | kilo | $10^{3}$ |
| h | hecto | $10^{2}$ |
| da | deca | $10^{1}$ |
| d | deci | $10^{-1}$ |
| c | centi | $10^{-2}$ |
| m | milli | $10^{-3}$ |
| µ | micro | $10^{-6}$ |
| n | nano | $10^{-9}$ |

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# ANNEX 1: KEY CATEGORY ANALYSIS

The following tables present results from the key category analysis, the methodology of the analysis is presented in Chapter 1.5 of the NIR 2009.

Results are presented for the level assessments for the years 1990 and 2007, and for the trend assessment 1990-2007, both for the key category analysis excluding and including LULUCF. Furthermore, key categories identified including their ranking in the level and trend assessments and emission sources and removal sinks in the level of aggregation as used for the key category analysis together with emissions/removals from 1990 to 2007 for these categories are included.

*Table A 1: Level Assessment of the key category analysis excluding LULUCF for the base year 1990.*

| Rank | | IPCC Source Categories | GHG | Unit | BY | Level Assessment | Cumulative Total |
|---|---|---|---|---|---|---|---|
| 1 | 1 A gaseous | Fuel Combustion (stationary) | CO2 | Gg | 11 300.5 | 14.30% | 14.30% |
| 2 | 1 A 3 b gasoline | Road Transportation | CO2 | Gg | 7 941.7 | 10.05% | 24.35% |
| 3 | 1 A 4 stat-liquid | Other Sectors | CO2 | Gg | 7 319.1 | 9.26% | 33.61% |
| 4 | 1 A 1 a solid | Public Electricity and Heat Production | CO2 | Gg | 6 247.0 | 7.90% | 41.51% |
| 5 | 1 A 3 b diesel oil | Road Transportation | CO2 | Gg | 5 344.0 | 6.76% | 48.27% |
| 6 | 1 A 2 solid | Manufacturing Industries and Construction | CO2 | Gg | 5 016.3 | 6.35% | 54.62% |
| 7 | 4 A 1 | Cattle | CH4 | Gg CO2e | 3 560.9 | 4.51% | 59.12% |
| 8 | 2 C 1 | Iron and Steel Production | CO2 | Gg | 3 545.7 | 4.49% | 63.61% |
| 9 | 6 A | Solid Waste Disposal on Land | CH4 | Gg CO2e | 3 376.6 | 4.27% | 67.88% |
| 10 | 1 A 2 stat-liquid | Manufacturing Industries and Construction | CO2 | Gg | 2 883.6 | 3.65% | 71.53% |
| 11 | 1 A 4 solid | Other Sectors | CO2 | Gg | 2 654.1 | 3.36% | 74.89% |
| 12 | 2 A 1 | Cement Production | CO2 | Gg | 2 033.4 | 2.57% | 77.46% |
| 13 | 1 A 1 b liquid | Petroleum refining | CO2 | Gg | 1 957.7 | 2.48% | 79.94% |
| 14 | 4 D 1 | Direct Soil Emissions | N2O | Gg CO2e | 1 804.9 | 2.28% | 82.22% |
| 15 | 4 D 3 | Indirect Emissions | N2O | Gg CO2e | 1 309.7 | 1.66% | 83.88% |
| 16 | 1 A 1 a liquid | Public Electricity and Heat Production | CO2 | Gg | 1 228.7 | 1.55% | 85.43% |
| 17 | 2C3 | Aluminium production | PFCs | GgCO2e | 1 050.2 | 1.33% | 86.76% |
| 18 | 2 B 2 | Nitric Acid Production | N2O | Gg CO2e | 912.0 | 1.15% | 87.92% |
| 19 | 4 B 1 | Cattle | N2O | Gg CO2e | 908.1 | 1.15% | 89.07% |
| 20 | 1 A 4 mobile-diesel | Other Sectors | CO2 | Gg | 737.2 | 0.93% | 90.00% |
| 21 | 4 B 1 | Cattle | CH4 | Gg CO2e | 587.1 | 0.74% | 90.74% |
| 22 | 2 B 1 | Ammonia Production | CO2 | Gg | 516.6 | 0.65% | 91.39% |
| 23 | 2 A 7 b | Sinter Production | CO2 | Gg | 481.2 | 0.61% | 92.00% |
| 24 | 4 B 8 | Swine | CH4 | Gg CO2e | 447.7 | 0.57% | 92.57% |
| 25 | 2 A 2 | Lime Production | CO2 | Gg | 396.2 | 0.50% | 93.07% |
| 26 | 1 A 4 other | Other Sectors | CO2 | Gg | 349.6 | 0.44% | 93.51% |
| 27 | 1 A 4 biomass | Other Sectors | CH4 | Gg CO2e | 315.9 | 0.40% | 93.91% |
| 28 | 3 | Solvent and other Product Use | CO2 | Gg | 279.3 | 0.35% | 94.27% |
| 29 | 1 B 2 b | Natural gas | CH4 | Gg CO2e | 272.7 | 0.35% | 94.61% |
| 30 | 1 A 2 other | Manufacturing Industries and Construction | CO2 | Gg | 264.1 | 0.33% | 94.95% |
| 31 | 1 A 2 mobile-liquid | Manufacturing Industries and Construction | CO2 | Gg | 257.3 | 0.33% | 95.27% |

*Table A 2: Level Assessment of the key category analysis excluding LULUCF for the year 2007.*

| Rank | IPCC Source Categories | | GHG | Unit | 2007 | Level Assessment | Cumulative Total |
|---|---|---|---|---|---|---|---|
| 1 | 1 A 1 a biomass | Public Electricity and Heat Production | N2O | Gg CO2e | 43.7 | 0.05% | 0.05% |
| 2 | 1 A 1 a biomass | Public Electricity and Heat Production | CH4 | Gg CO2e | 1.7 | 0.00% | 0.05% |
| 3 | 1 A 1 a gaseous | Public Electricity and Heat Production | N2O | Gg CO2e | 12.5 | 0.01% | 0.07% |
| 4 | 1 A 1 a gaseous | Public Electricity and Heat Production | CH4 | Gg CO2e | 0.8 | 0.00% | 0.07% |
| 5 | 1 A 1 a liquid | Public Electricity and Heat Production | CO2 | Gg | 765.7 | 0.87% | 0.94% |
| 6 | 1 A 1 a liquid | Public Electricity and Heat Production | N2O | Gg CO2e | 3.9 | 0.00% | 0.94% |
| 7 | 1 A 1 a liquid | Public Electricity and Heat Production | CH4 | Gg CO2e | 0.2 | 0.00% | 0.94% |
| 8 | 1 A 1 a other | Public Electricity and Heat Production | CO2 | Gg | 655.4 | 0.75% | 1.69% |
| 9 | 1 A 1 a other | Public Electricity and Heat Production | N2O | Gg CO2e | 5.1 | 0.01% | 1.69% |
| 10 | 1 A 1 a other | Public Electricity and Heat Production | CH4 | Gg CO2e | 3.0 | 0.00% | 1.70% |
| 11 | 1 A 1 a solid | Public Electricity and Heat Production | CO2 | Gg | 5 066.5 | 5.76% | 7.46% |
| 12 | 1 A 1 a solid | Public Electricity and Heat Production | N2O | Gg CO2e | 8.6 | 0.01% | 7.47% |
| 13 | 1 A 1 a solid | Public Electricity and Heat Production | CH4 | Gg CO2e | 0.1 | 0.00% | 7.47% |
| 14 | 1 A 1 b gaseous | Petroleum refining | N2O | Gg CO2e | 0.1 | 0.00% | 7.47% |
| 15 | 1 A 1 b liquid | Petroleum refining | CO2 | Gg | 2 725.3 | 3.10% | 10.56% |
| 16 | 1 A 1 b liquid | Petroleum refining | N2O | Gg CO2e | 5.4 | 0.01% | 10.57% |
| 17 | 1 A 1 c gaseous | Manufacture of Solid fuels and Other Energy | CH4 | Gg CO2e | 0.4 | 0.00% | 10.57% |
| 18 | 1 A 1 c gaseous | Manufacture of Solid fuels and Other Energy | N2O | Gg CO2e | 0.4 | 0.00% | 10.57% |
| 19 | 1 A 1 c liquid | Manufacture of Solid fuels and Other Energy | CH4 | Gg CO2e | 0.0 | 0.00% | 10.57% |
| 20 | 1 A 1 c liquid | Manufacture of Solid fuels and Other Energy | CO2 | Gg | 0.0 | 0.00% | 10.57% |
| 21 | 1 A 1 c liquid | Manufacture of Solid fuels and Other Energy | N2O | Gg CO2e | 0.0 | 0.00% | 10.57% |
| 22 | 1 A 2 biomass | Manufacturing Industries and Construction | N2O | Gg CO2e | 48.5 | 0.06% | 10.63% |
| 23 | 1 A 2 biomass | Manufacturing Industries and Construction | CH4 | Gg CO2e | 2.4 | 0.00% | 10.63% |
| 24 | 1 A 2 gaseous | Manufacturing Industries and Construction | N2O | Gg CO2e | 3.6 | 0.00% | 10.63% |
| 25 | 1 A 2 gaseous | Manufacturing Industries and Construction | CH4 | Gg CO2e | 3.6 | 0.00% | 10.64% |
| 26 | 1 A 2 mobile-liquid | Manufacturing Industries and Construction | CO2 | Gg | 715.3 | 0.81% | 11.45% |
| 27 | 1 A 2 mobile-liquid | Manufacturing Industries and Construction | N2O | Gg CO2e | 53.8 | 0.06% | 11.51% |
| 28 | 1 A 2 mobile-liquid | Manufacturing Industries and Construction | CH4 | Gg CO2e | 0.4 | 0.00% | 11.51% |
| 29 | 1 A 2 other | Manufacturing Industries and Construction | CO2 | Gg | 943.6 | 1.07% | 12.59% |
| 30 | 1 A 2 other | Manufacturing Industries and Construction | N2O | Gg CO2e | 7.4 | 0.01% | 12.59% |

*Table A 3: Trend Assessment of the key category analysis excluding LULUCF for the trend 1990 - 2007*

| Rank | IPCC Source Categories | | GHG | Unit | BY | 2007 | Level Assessment | Trend Assessment | Contribution to Trend | Cumulative Total |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1 A 3 b diesel oil | Road Transportation | CO2 | Gg | 5 344.0 | 17 157.7 | 19.51% | 0.115 | 27.45% | 27.45% |
| 2 | 1 A 4 stat-liquid | Other Sectors | CO2 | Gg | 7 319.1 | 4 839.4 | 5.50% | 0.034 | 8.10% | 35.55% |
| 3 | 1 A gaseous | Fuel Combustion (stationary) | CO2 | Gg | 11 300.5 | 15 812.4 | 17.98% | 0.033 | 7.92% | 43.47% |
| 4 | 1 A 3 b gasoline | Road Transportation | CO2 | Gg | 7 941.7 | 6 009.5 | 6.83% | 0.029 | 6.93% | 50.40% |
| 5 | 1 A 4 solid | Other Sectors | CO2 | Gg | 2 654.1 | 496.4 | 0.56% | 0.025 | 6.02% | 56.41% |
| 6 | 6 A | Solid Waste Disposal on Land | CH4 | Gg CO2e | 3 376.6 | 1 744.2 | 1.98% | 0.021 | 4.93% | 61.35% |
| 7 | 1 A 1 a solid | Public Electricity and Heat Production | CO2 | Gg | 6 247.0 | 5 066.5 | 5.76% | 0.019 | 4.62% | 65.96% |
| 8 | 2 C 1 | Iron and Steel Production | CO2 | Gg | 3 545.7 | 5 482.0 | 6.23% | 0.016 | 3.76% | 69.72% |
| 9 | 2C3 | Aluminium production | PFCs | GgCO2e | 1 050.2 | 0.0 | 0.00% | 0.012 | 2.86% | 72.59% |
| 10 | 1 A 2 stat-liquid | Manufacturing Industries and Construction | CO2 | Gg | 2 883.6 | 2 114.2 | 2.40% | 0.011 | 2.68% | 75.27% |
| 11 | 4 A 1 | Cattle | CH4 | Gg CO2e | 3 560.9 | 3 000.8 | 3.41% | 0.010 | 2.36% | 77.62% |
| 12 | 2F1/2/3/4/5 | ODS Substitutes | HFCs | GgCO2e | 21.1 | 853.7 | 0.97% | 0.008 | 2.03% | 79.66% |
| 13 | 2 B 2 | Nitric Acid Production | N2O | Gg CO2e | 912.0 | 270.0 | 0.31% | 0.008 | 1.82% | 81.48% |
| 14 | 1 A 2 other | Manufacturing Industries and Construction | CO2 | Gg | 264.1 | 943.6 | 1.07% | 0.007 | 1.59% | 83.07% |
| 15 | 1 A 1 a liquid | Public Electricity and Heat Production | CO2 | Gg | 1 228.7 | 765.7 | 0.87% | 0.006 | 1.47% | 84.54% |
| 16 | 1 A 1 b liquid | Petroleum refining | CO2 | Gg | 1 957.7 | 2 725.3 | 3.10% | 0.006 | 1.34% | 85.88% |
| 17 | 1 A 1 a other | Public Electricity and Heat Production | CO2 | Gg | 118.0 | 655.4 | 0.75% | 0.005 | 1.28% | 87.17% |
| 18 | 1 A 2 mobile-liquid | Manufacturing Industries and Construction | CO2 | Gg | 257.3 | 715.3 | 0.81% | 0.004 | 1.05% | 88.22% |
| 19 | 4 D 1 | Direct Soil Emissions | N2O | Gg CO2e | 1 804.9 | 1 633.3 | 1.86% | 0.004 | 0.92% | 89.14% |
| 20 | 4 D 3 | Indirect Emissions | N2O | Gg CO2e | 1 309.7 | 1 104.8 | 1.26% | 0.004 | 0.86% | 90.00% |
| 21 | 2C4 | SF6 Used in Al and Mg Foundries | SF6 | GgCO2e | 253.3 | 0.0 | 0.00% | 0.003 | 0.69% | 90.69% |
| 22 | 1 B 2 b | Natural gas | CH4 | Gg CO2e | 272.7 | 581.7 | 0.66% | 0.003 | 0.68% | 91.37% |
| 23 | 1 A 4 other | Other Sectors | CO2 | Gg | 349.6 | 153.4 | 0.17% | 0.002 | 0.58% | 91.95% |
| 24 | 4 B 1 | Cattle | N2O | Gg CO2e | 908.1 | 788.5 | 0.90% | 0.002 | 0.54% | 92.49% |
| 25 | 2 A 7 b | Sinter Production | CO2 | Gg | 481.2 | 329.5 | 0.37% | 0.002 | 0.50% | 93.00% |
| 26 | 4 B 1 | Cattle | CH4 | Gg CO2e | 587.1 | 452.4 | 0.51% | 0.002 | 0.49% | 93.49% |
| 27 | 2 C 3 | Aluminium production | CO2 | Gg | 158.4 | 0.0 | 0.00% | 0.002 | 0.43% | 93.92% |
| 28 | 1 A 2 solid | Manufacturing Industries and Construction | CO2 | Gg | 5 016.3 | 5 410.1 | 6.15% | 0.002 | 0.42% | 94.34% |
| 29 | 6 B | Wastewater Handling | N2O | Gg CO2e | 108.4 | 279.4 | 0.32% | 0.002 | 0.39% | 94.73% |
| 30 | 2 A 2 | Lime Production | CO2 | Gg | 396.2 | 595.7 | 0.68% | 0.002 | 0.38% | 95.11% |

*Table A 4: Level Assessment of the key category analysis including LULUCF for thebase year 1990*

| Rank | | IPCC Source Categories | GHG | Unit | BY | BY ABS | Level Assessment | Cumulative Total |
|---|---|---|---|---|---|---|---|---|
| 1 | 5 A 1 | Forest land remaining forest land | CO2 | Gg | -11511 | 11 511.2 | 11.49% | 11.49% |
| 2 | 1 A gaseous | Fuel Combustion (stationary) | CO2 | Gg | 11 300.5 | 11 300.5 | 11.28% | 22.77% |
| 3 | 1 A 3 b gasoline | Road Transportation | CO2 | Gg | 7 941.7 | 7 941.7 | 7.93% | 30.70% |
| 4 | 1 A 4 stat-liquid | Other Sectors | CO2 | Gg | 7 319.1 | 7 319.1 | 7.31% | 38.01% |
| 5 | 1 A 1 a solid | Public Electricity and Heat Production | CO2 | Gg | 6 247.0 | 6 247.0 | 6.24% | 44.25% |
| 6 | 1 A 3 b diesel oil | Road Transportation | CO2 | Gg | 5 344.0 | 5 344.0 | 5.34% | 49.58% |
| 7 | 1 A 2 solid | Manufacturing Industries and Construction | CO2 | Gg | 5 016.3 | 5 016.3 | 5.01% | 54.59% |
| 8 | 5 A 2 | Land converted to forest land | CO2 | Gg | -4402 | 4 402.2 | 4.40% | 58.99% |
| 9 | 4 A 1 | Cattle | CH4 | Gg CO2e | 3 560.9 | 3 560.9 | 3.56% | 62.54% |
| 10 | 2 C 1 | Iron and Steel Production | CO2 | Gg | 3 545.7 | 3 545.7 | 3.54% | 66.08% |
| 11 | 6 A | Solid Waste Disposal on Land | CH4 | Gg CO2e | 3 376.6 | 3 376.6 | 3.37% | 69.45% |
| 12 | 1 A 2 stat-liquid | Manufacturing Industries and Construction | CO2 | Gg | 2 883.6 | 2 883.6 | 2.88% | 72.33% |
| 13 | 1 A 4 solid | Other Sectors | CO2 | Gg | 2 654.1 | 2 654.1 | 2.65% | 74.98% |
| 14 | 2 A 1 | Cement Production | CO2 | Gg | 2 033.4 | 2 033.4 | 2.03% | 77.01% |
| 15 | 1 A 1 b liquid | Petroleum refining | CO2 | Gg | 1 957.7 | 1 957.7 | 1.95% | 78.97% |
| 16 | 5 B 2 | Land converted to cropland | CO2 | Gg | 1823 | 1 822.9 | 1.82% | 80.79% |
| 17 | 4 D 1 | Direct Soil Emissions | N2O | Gg CO2e | 1 804.9 | 1 804.9 | 1.80% | 82.59% |
| 18 | 4 D 3 | Indirect Emissions | N2O | Gg CO2e | 1 309.7 | 1 309.7 | 1.31% | 83.90% |
| 19 | 1 A 1 a liquid | Public Electricity and Heat Production | CO2 | Gg | 1 228.7 | 1 228.7 | 1.23% | 85.12% |
| 20 | 5 C 2 | Land converted to grassland | CO2 | Gg | -1061 | 1 060.7 | 1.06% | 86.18% |
| 21 | 2C3 | Aluminium production | PFCs | GgCO2e | 1 050.2 | 1 050.2 | 1.05% | 87.23% |
| 22 | 2 B 2 | Nitric Acid Production | N2O | Gg CO2e | 912.0 | 912.0 | 0.91% | 88.14% |
| 23 | 4 B 1 | Cattle | N2O | Gg CO2e | 908.1 | 908.1 | 0.91% | 89.05% |
| 24 | 5 F 2 | Land converted to Other land | CO2 | Gg | 810 | 809.9 | 0.81% | 89.86% |
| 25 | 5 E 2 | Land converted to Settlements | CO2 | Gg | 760 | 759.7 | 0.76% | 90.61% |
| 26 | 1 A 4 mobile-diesel | Other Sectors | CO2 | Gg | 737.2 | 737.2 | 0.74% | 91.35% |
| 27 | 4 B 1 | Cattle | CH4 | Gg CO2e | 587.1 | 587.1 | 0.59% | 91.94% |
| 28 | 2 B 1 | Ammonia Production | CO2 | Gg | 516.6 | 516.6 | 0.52% | 92.45% |
| 29 | 2 A 7 b | Sinter Production | CO2 | Gg | 481.2 | 481.2 | 0.48% | 92.93% |
| 30 | 4 B 8 | Swine | CH4 | Gg CO2e | 447.7 | 447.7 | 0.45% | 93.38% |
| 31 | 2 A 2 | Lime Production | CO2 | Gg | 396.2 | 396.2 | 0.40% | 93.77% |
| 32 | 1 A 4 other | Other Sectors | CO2 | Gg | 349.6 | 349.6 | 0.35% | 94.12% |
| 33 | 1 A 4 biomass | Other Sectors | CH4 | Gg CO2e | 315.9 | 315.9 | 0.32% | 94.44% |
| 34 | 3 | Solvent and other Product Use | CO2 | Gg | 279.3 | 279.3 | 0.28% | 94.72% |
| 35 | 1 B 2 b | Natural gas | CH4 | Gg CO2e | 272.7 | 272.7 | 0.27% | 94.99% |
| 36 | 1 A 2 other | Manufacturing Industries and Construction | CO2 | Gg | 264.1 | 264.1 | 0.26% | 95.25% |

*Table A 5: Level Assessment of the key category analysis including LULUCF for the year 2007.*

| Rank | IPCC Source Categories | | GHG | Unit | 2007 | 2007 ABS | Level Assessment | Cumulative Total |
|---|---|---|---|---|---|---|---|---|
| 1 | 1 A 3 b diesel oil | Road Transportation | CO2 | Gg | 17 157.7 | 17 157.7 | 15.25% | 15.25% |
| 2 | 5 A 1 | Forest land remaining forest land | CO2 | Gg | -16967 | 16 966.8 | 15.08% | 30.32% |
| 3 | 1 A gaseous | Fuel Combustion (stationary) | CO2 | Gg | 15 812.4 | 15 812.4 | 14.05% | 44.37% |
| 4 | 1 A 3 b gasoline | Road Transportation | CO2 | Gg | 6 009.5 | 6 009.5 | 5.34% | 49.71% |
| 5 | 2 C 1 | Iron and Steel Production | CO2 | Gg | 5 482.0 | 5 482.0 | 4.87% | 54.59% |
| 6 | 1 A 2 solid | Manufacturing Industries and Construction | CO2 | Gg | 5 410.1 | 5 410.1 | 4.81% | 59.39% |
| 7 | 1 A 1 a solid | Public Electricity and Heat Production | CO2 | Gg | 5 066.5 | 5 066.5 | 4.50% | 63.90% |
| 8 | 1 A 4 stat-liquid | Other Sectors | CO2 | Gg | 4 839.4 | 4 839.4 | 4.30% | 68.20% |
| 9 | 4 A 1 | Cattle | CH4 | Gg CO2e | 3 000.8 | 3 000.8 | 2.67% | 70.86% |
| 10 | 1 A 1 b liquid | Petroleum refining | CO2 | Gg | 2 725.3 | 2 725.3 | 2.42% | 73.28% |
| 11 | 5 A 2 | Land converted to forest land | CO2 | Gg | -2572 | 2 572.3 | 2.29% | 75.57% |
| 12 | 2 A 1 | Cement Production | CO2 | Gg | 2 130.8 | 2 130.8 | 1.89% | 77.46% |
| 13 | 1 A 2 stat-liquid | Manufacturing Industries and Construction | CO2 | Gg | 2 114.2 | 2 114.2 | 1.88% | 79.34% |
| 14 | 5 B 2 | Land converted to cropland | CO2 | Gg | 1891 | 1 890.9 | 1.68% | 81.02% |
| 15 | 6 A | Solid Waste Disposal on Land | CH4 | Gg CO2e | 1 744.2 | 1 744.2 | 1.55% | 82.57% |
| 16 | 4 D 1 | Direct Soil Emissions | N2O | Gg CO2e | 1 633.3 | 1 633.3 | 1.45% | 84.02% |
| 17 | 5 C 2 | Land converted to grassland | CO2 | Gg | -1311 | 1 310.7 | 1.16% | 85.19% |
| 18 | 4 D 3 | Indirect Emissions | N2O | Gg CO2e | 1 104.8 | 1 104.8 | 0.98% | 86.17% |
| 19 | 1 A 2 other | Manufacturing Industries and Construction | CO2 | Gg | 943.6 | 943.6 | 0.84% | 87.01% |
| 20 | 2F1/2/3/4/5 | ODS Substitutes | HFCs | GgCO2e | 853.7 | 853.7 | 0.76% | 87.77% |
| 21 | 4 B 1 | Cattle | N2O | Gg CO2e | 788.5 | 788.5 | 0.70% | 88.47% |
| 22 | 1 A 1 a liquid | Public Electricity and Heat Production | CO2 | Gg | 765.7 | 765.7 | 0.68% | 89.15% |
| 23 | 1 A 4 mobile-diesel | Other Sectors | CO2 | Gg | 761.4 | 761.4 | 0.68% | 89.83% |
| 24 | 1 A 2 mobile-liquid | Manufacturing Industries and Construction | CO2 | Gg | 715.3 | 715.3 | 0.64% | 90.46% |
| 25 | 1 A 1 a other | Public Electricity and Heat Production | CO2 | Gg | 655.4 | 655.4 | 0.58% | 91.04% |
| 26 | 2 A 2 | Lime Production | CO2 | Gg | 595.7 | 595.7 | 0.53% | 91.57% |
| 27 | 1 B 2 b | Natural gas | CH4 | Gg CO2e | 581.7 | 581.7 | 0.52% | 92.09% |
| 28 | 5 E 2 | Land converted to Settlements | CO2 | Gg | 531 | 530.5 | 0.47% | 92.56% |
| 29 | 1 A 4 solid | Other Sectors | CO2 | Gg | 496.4 | 496.4 | 0.44% | 93.00% |
| 30 | 2 B 1 | Ammonia Production | CO2 | Gg | 473.4 | 473.4 | 0.42% | 93.42% |
| 31 | 5 F 2 | Land converted to Other land | CO2 | Gg | 470 | 470.4 | 0.42% | 93.84% |
| 32 | 4 B 1 | Cattle | CH4 | Gg CO2e | 452.4 | 452.4 | 0.40% | 94.24% |
| 33 | 4 B 8 | Swine | CH4 | Gg CO2e | 407.5 | 407.5 | 0.36% | 94.60% |
| 34 | 5 D 2 | Land converted to Wetlands | CO2 | Gg | 372 | 371.8 | 0.33% | 94.94% |

*Table A 6: Trend Assessment of the key category analysis including LULUCF for the trend 1990–2007.*

| Rank | IPCC Source Categories | | GHG | Unit | BY | 2007 | 2007 ABS | Level Assessment | Trend Assessment | Contribution to Trend | Cumulative Total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1 A 3 b diesel oil | Road Transportation | CO2 | Gg | 5 344.0 | 17 157.7 | 17 157.7 | 24.22% | 0.150 | 23.84% | 23.84% |
| 2 | 5 A 1 | Forest land remaining forest land | CO2 | Gg | -11511 | -16967 | 16 966.8 | 23.95% | 0.060 | 9.58% | 33.42% |
| 3 | 1 A gaseous | Fuel Combustion (stationary) | CO2 | Gg | 11 300.5 | 15 812.4 | 15 812.4 | 22.32% | 0.048 | 7.64% | 41.06% |
| 4 | 1 A 4 stat-liquid | Other Sectors | CO2 | Gg | 7 319.1 | 4 839.4 | 4 839.4 | 6.83% | 0.040 | 6.34% | 47.39% |
| 5 | 1 A 3 b gasoline | Road Transportation | CO2 | Gg | 7 941.7 | 6 009.5 | 6 009.5 | 8.48% | 0.033 | 5.29% | 52.68% |
| 6 | 1 A 4 solid | Other Sectors | CO2 | Gg | 2 654.1 | 496.4 | 496.4 | 0.70% | 0.031 | 4.93% | 57.61% |
| 7 | 5 A 2 | Land converted to forest land | CO2 | Gg | -4402 | -2572 | 2 572.3 | 3.63% | 0.028 | 4.52% | 62.13% |
| 8 | 6 A | Solid Waste Disposal on Land | CH4 | Gg CO2e | 3 376.6 | 1 744.2 | 1 744.2 | 2.46% | 0.025 | 3.94% | 66.07% |
| 9 | 2 C 1 | Iron and Steel Production | CO2 | Gg | 3 545.7 | 5 482.0 | 5 482.0 | 7.74% | 0.022 | 3.49% | 69.56% |
| 10 | 1 A 1 a solid | Public Electricity and Heat Production | CO2 | Gg | 6 247.0 | 5 066.5 | 5 066.5 | 7.15% | 0.022 | 3.45% | 73.01% |
| 11 | 2C3 | Aluminium production | PFCs | GgCO2e | 1 050.2 | 0.0 | 0.0 | 0.00% | 0.015 | 2.36% | 75.37% |
| 12 | 1 A 2 stat-liquid | Manufacturing Industries and Construction | CO2 | Gg | 2 883.6 | 2 114.2 | 2 114.2 | 2.98% | 0.013 | 2.06% | 77.43% |
| 13 | 2F1/2/3/4/5 | ODS Substitutes | HFCs | GgCO2e | 21.1 | 853.7 | 853.7 | 1.21% | 0.011 | 1.74% | 79.17% |
| 14 | 4 A 1 | Cattle | CH4 | Gg CO2e | 3 560.9 | 3 000.8 | 3 000.8 | 4.24% | 0.011 | 1.73% | 80.90% |
| 15 | 2 B 2 | Nitric Acid Production | N2O | Gg CO2e | 912.0 | 270.0 | 270.0 | 0.38% | 0.009 | 1.49% | 82.39% |
| 16 | 1 A 2 other | Manufacturing Industries and Construction | CO2 | Gg | 264.1 | 943.6 | 943.6 | 1.33% | 0.009 | 1.38% | 83.76% |
| 17 | 1 A 1 b liquid | Petroleum refining | CO2 | Gg | 1 957.7 | 2 725.3 | 2 725.3 | 3.85% | 0.008 | 1.29% | 85.06% |
| 18 | 1 A 1 a liquid | Public Electricity and Heat Production | CO2 | Gg | 1 228.7 | 765.7 | 765.7 | 1.08% | 0.007 | 1.16% | 86.22% |
| 19 | 1 A 1 a other | Public Electricity and Heat Production | CO2 | Gg | 118.0 | 655.4 | 655.4 | 0.93% | 0.007 | 1.10% | 87.32% |
| 20 | 1 A 2 mobile-liquid | Manufacturing Industries and Construction | CO2 | Gg | 257.3 | 715.3 | 715.3 | 1.01% | 0.006 | 0.92% | 88.24% |
| 21 | 5 F 2 | Land converted to Other land | CO2 | Gg | 810 | 470 | 470.4 | 0.66% | 0.005 | 0.84% | 89.08% |
| 22 | 4 D 1 | Direct Soil Emissions | N2O | Gg CO2e | 1 804.9 | 1 633.3 | 1 633.3 | 2.31% | 0.004 | 0.64% | 89.72% |
| 23 | 4 D 3 | Indirect Emissions | N2O | Gg CO2e | 1 309.7 | 1 104.8 | 1 104.8 | 1.56% | 0.004 | 0.63% | 90.36% |
| 24 | 1 B 2 b | Natural gas | CH4 | Gg CO2e | 272.7 | 581.7 | 581.7 | 0.82% | 0.004 | 0.60% | 90.96% |
| 25 | 5 E 2 | Land converted to Settlements | CO2 | Gg | 760 | 531 | 530.5 | 0.75% | 0.004 | 0.60% | 91.56% |
| 26 | 2C4 | SF6 Used in Al and Mg Foundries | SF6 | GgCO2e | 253.3 | 0.0 | 0.0 | 0.00% | 0.004 | 0.57% | 92.13% |
| 27 | 5 B 1 | Cropland remaining cropland | CO2 | Gg | -178 | 53 | 53.2 | 0.08% | 0.003 | 0.51% | 92.64% |
| 28 | 1 A 4 other | Other Sectors | CO2 | Gg | 349.6 | 153.4 | 153.4 | 0.22% | 0.003 | 0.47% | 93.10% |
| 29 | 4 B 1 | Cattle | N2O | Gg CO2e | 908.1 | 788.5 | 788.5 | 1.11% | 0.002 | 0.39% | 93.49% |
| 30 | 2 A 7 b | Sinter Production | CO2 | Gg | 481.2 | 329.5 | 329.5 | 0.47% | 0.002 | 0.39% | 93.89% |
| 31 | 4 B 1 | Cattle | CH4 | Gg CO2e | 587.1 | 452.4 | 452.4 | 0.64% | 0.002 | 0.37% | 94.26% |
| 32 | 2 C 3 | Aluminium production | CO2 | Gg | 158.4 | 0.0 | 0.0 | 0.00% | 0.002 | 0.36% | 94.62% |
| 33 | 5 C 2 | Land converted to grassland | CO2 | Gg | -1061 | -1311 | 1 310.7 | 1.85% | 0.002 | 0.35% | 94.97% |
| 34 | 2 A 2 | Lime Production | CO2 | Gg | 396.2 | 595.7 | 595.7 | 0.84% | 0.002 | 0.35% | 95.33% |

*Table A 7: Key categories identified including their ranking in the level and trend assessment for the KCA excluding LULUCF*

| IPCC Category | Description | Gas | LA90 | LA07 | TA07 | σ | Emi BY | Share BY | Emi 2007 | Share 2007 |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 A 1 a liquid | Public Electricity and Heat Production | CO2 | 16 | 18 | 15 | | 1 228.7 | 1.6% | 765.7 | 0.9% |
| 1 A 1 a other | Public Electricity and Heat Production | CO2 | | 21 | 17 | | 118.0 | 0.1% | 655.4 | 0.7% |
| 1 A 1 a solid | Public Electricity and Heat Production | CO2 | 4 | 6 | 7 | | 6 247.0 | 7.9% | 5 066.5 | 5.8% |
| 1 A 1 b liquid | Petroleum refining | CO2 | 13 | 9 | 16 | | 1 957.7 | 2.5% | 2 725.3 | 3.1% |
| 1 A 2 mobile-liquid | Manufacturing Industries and Construction | CO2 | 31 | 20 | 18 | | 257.3 | 0.3% | 715.3 | 0.8% |
| 1 A 2 other | Manufacturing Industries and Construction | CO2 | 30 | 15 | 14 | | 264.1 | 0.3% | 943.6 | 1.1% |
| 1 A 2 solid | Manufacturing Industries and Construction | CO2 | 6 | 5 | 28 | | 5 016.3 | 6.3% | 5 410.1 | 6.2% |
| 1 A 2 stat-liquid | Manufacturing Industries and Construction | CO2 | 10 | 11 | 10 | | 2 883.6 | 3.6% | 2 114.2 | 2.4% |
| 1 A 3 a jet kerosene | Civil Aviation | CO2 | | | | x | 24.2 | 0.0% | 64.7 | 0.1% |
| 1 A 3 b diesel oil | Road Transportation | CO2 | 5 | 1 | 1 | | 5 344.0 | 6.8% | 17 157.7 | 19.5% |
| 1 A 3 b gasoline | Road Transportation | CO2 | 2 | 3 | 4 | | 7 941.7 | 10.0% | 6 009.5 | 6.8% |
| 1 A 4 biomass | Other Sectors | CH4 | 27 | | | | 315.9 | 0.4% | 254.4 | 0.3% |
| 1 A 4 mobile-diesel | Other Sectors | CO2 | 20 | 19 | | | 737.2 | 0.9% | 761.4 | 0.9% |
| 1 A 4 other | Other Sectors | CO2 | 26 | | 23 | | 349.6 | 0.4% | 153.4 | 0.2% |
| 1 A 4 solid | Other Sectors | CO2 | 11 | 24 | 5 | | 2 654.1 | 3.4% | 496.4 | 0.6% |
| 1 A 4 stat-liquid | Other Sectors | CO2 | 3 | 7 | 2 | | 7 319.1 | 9.3% | 4 839.4 | 5.5% |
| 1 A gaseous | Fuel Combustion (stationary) | CO2 | 1 | 2 | 3 | | 11 300.5 | 14.3% | 15 812.4 | 18.0% |
| 1 B 2 b | Natural gas | CH4 | 29 | 23 | 22 | | 272.7 | 0.3% | 581.7 | 0.7% |
| 2 A 1 | Cement Production | CO2 | 12 | 10 | | | 2 033.4 | 2.6% | 2 130.8 | 2.4% |
| 2 A 2 | Lime Production | CO2 | 25 | 22 | 30 | | 396.2 | 0.5% | 595.7 | 0.7% |
| 2 A 3 | Limestone and Dolomite Use | CO2 | | 29 | | | 222.4 | 0.3% | 302.5 | 0.3% |
| 2 A 7 b | Sinter Production | CO2 | 23 | 28 | 25 | | 481.2 | 0.6% | 329.5 | 0.4% |
| 2 B 1 | Ammonia Production | CO2 | 22 | 25 | | | 516.6 | 0.7% | 473.4 | 0.5% |
| 2 B 2 | Nitric Acid Production | N2O | 18 | | 13 | | 912.0 | 1.2% | 270.0 | 0.3% |
| 2 C 1 | Iron and Steel Production | CO2 | 8 | 4 | 8 | | 3 545.7 | 4.5% | 5 482.0 | 6.2% |
| 2 C 3 | Aluminium production | PFCs | 17 | | 9 | | 1 050.2 | 1.3% | 0.0 | 0.0% |
| 2 C 3 | Aluminium production | CO2 | | | 27 | | 158.4 | 0.2% | 0.0 | 0.0% |
| 2 C 4 | SF6 Used in Al and Mg Foundries | SF6 | | | 21 | | 253.3 | 0.3% | 0.0 | 0.0% |
| 2 F 7 | Semiconductor Manufacture | FCs | | 30 | | | 133.1 | 0.2% | 288.7 | 0.3% |
| 2 F 9 | Other Sources of SF6 | SF6 | | | | x | 126.6 | 0.2% | 269.8 | 0.3% |
| 2F1/2/3/4/5 | ODS Substitutes | HFCs | | 16 | 12 | | 21.1 | 0.0% | 853.7 | 1.0% |
| 3 | Solvent and other Product Use | CO2 | 28 | | | | 279.3 | 0.4% | 248.5 | 0.3% |
| 4 A 1 | Cattle | CH4 | 7 | 8 | 11 | | 3 560.9 | 4.5% | 3 000.8 | 3.4% |
| 4 B 1 | Cattle | N2O | 19 | 17 | 24 | | 908.1 | 1.1% | 788.5 | 0.9% |
| 4 B 1 | Cattle | CH4 | 21 | 26 | 26 | | 587.1 | 0.7% | 452.4 | 0.5% |
| 4 B 8 | Swine | CH4 | 24 | 27 | | | 447.7 | 0.6% | 407.5 | 0.5% |
| 4 D 1 | Direct Soil Emissions | N2O | 14 | 13 | 19 | | 1 804.9 | 2.3% | 1 633.3 | 1.9% |
| 4 D 2 | Pasture, Range and Paddock Manure | N2O | | | | x | 218.5 | 0.3% | 223.0 | 0.3% |
| 4 D 3 | Indirect Emissions | N2O | 15 | 14 | 20 | | 1 309.7 | 1.7% | 1 104.8 | 1.3% |
| 6 A | Solid Waste Disposal on Land | CH4 | 9 | 12 | 6 | | 3 376.6 | 4.3% | 1 744.2 | 2.0% |
| 6 B | Wastewater Handling | N2O | | | 29 | | 108.4 | 0.1% | 279.4 | 0.3% |
| | | | | | | | | | | |
| | LA07= Level Assessment 2007 | | | | | | | | | |
| | TA07= Trend Assessment BY-2007 | | | | | | | | | |
| | | | 496 | 465 | 465 | | | 97.0% | | 97.1% |
| | | | 31 | 30 | 32 | | | | | |

*Table A 8: Key categories identified including their ranking in the level and trend assessment for the KCA including LULUCF*

| IPCC Category Description | | Gas | LA90 | LA07 | TA07 | Q | Emi BY | Emi 2007 |
|---|---|---|---|---|---|---|---|---|
| 1 A 1 a liquid | Public Electricity and Heat Production | CO2 | ***19*** | ***22*** | ***18*** | | 1 228.7 | 765.7 |
| 1 A 1 a other | Public Electricity and Heat Production | CO2 | ***5*** | ***25*** | ***19*** | | 118.0 | 655.4 |
| 1 A 1 a solid | Public Electricity and Heat Production | CO2 | | ***7*** | ***10*** | | 6 247.0 | 5 066.5 |
| 1 A 1 b liquid | Petroleum refining | CO2 | ***15*** | ***10*** | ***17*** | | 1 957.7 | 2 725.3 |
| 1 A 2 mobile-liquid | Manufacturing Industries and Construction | CO2 | | ***24*** | ***20*** | | 257.3 | 715.3 |
| 1 A 2 other | Manufacturing Industries and Construction | CO2 | ***36*** | ***19*** | ***16*** | | 264.1 | 943.6 |
| 1 A 2 solid | Manufacturing Industries and Construction | CO2 | ***7*** | ***6*** | | | 5 016.3 | 5 410.1 |
| 1 A 2 stat-liquid | Manufacturing Industries and Construction | CO2 | ***12*** | ***13*** | ***12*** | | 2 883.6 | 2 114.2 |
| 1 A 3 a jet kerosene | Civil Aviation | CO2 | | | | **x** | 24.2 | 64.7 |
| 1 A 3 b diesel oil | Road Transportation | CO2 | ***6*** | ***1*** | ***1*** | | 5 344.0 | 17 157.7 |
| 1 A 3 b gasoline | Road Transportation | CO2 | ***3*** | ***4*** | ***5*** | | 7 941.7 | 6 009.5 |
| 1 A 4 biomass | Other Sectors | CH4 | ***33*** | | | | 315.9 | 254.4 |
| 1 A 4 mobile-diesel | Other Sectors | CO2 | ***26*** | ***23*** | | | 737.2 | 761.4 |
| 1 A 4 other | Other Sectors | CO2 | ***32*** | | ***28*** | | 349.6 | 153.4 |
| 1 A 4 solid | Other Sectors | CO2 | ***13*** | ***29*** | ***6*** | | 2 654.1 | 496.4 |
| 1 A 4 stat-liquid | Other Sectors | CO2 | ***4*** | ***8*** | ***4*** | | 7 319.1 | 4 839.4 |
| 1 A gaseous | Fuel Combustion (stationary) | CO2 | ***2*** | ***3*** | ***3*** | | 11 300.5 | 15 812.4 |
| 1 B 2 b | Natural gas | CH4 | ***35*** | ***27*** | ***24*** | | 272.7 | 581.7 |
| 2 A 1 | Cement Production | CO2 | ***14*** | ***12*** | | | 2 033.4 | 2 130.8 |
| 2 A 2 | Lime Production | CO2 | ***31*** | ***26*** | ***34*** | | 396.2 | 595.7 |
| 2 A 3 | Limestone and Dolomite Use | CO2 | | | | | 222.4 | 302.5 |
| 2 A 7 b | Sinter Production | CO2 | ***29*** | ***35*** | ***30*** | | 481.2 | 329.5 |
| 2 B 1 | Ammonia Production | CO2 | ***28*** | ***30*** | | | 516.6 | 473.4 |
| 2 B 2 | Nitric Acid Production | N2O | ***22*** | | ***15*** | | 912.0 | 270.0 |
| 2 C 1 | Iron and Steel Production | CO2 | ***10*** | ***5*** | ***9*** | | 3 545.7 | 5 482.0 |
| 2 C 3 | Aluminium production | PFCs | ***21*** | | ***32*** | | 1 050.2 | 0.0 |
| 2 C 3 | Aluminium production | CO2 | | | ***26*** | | 158.4 | 0.0 |
| 2 C 4 | SF6 Used in Al and Mg Foundries | SF6 | | | ***11*** | | 253.3 | 0.0 |
| 2 F 7 | Semiconductor Manufacture | FCs | | | | | 133.1 | 288.7 |
| 2 F 9 | Other Sources of SF6 | SF6 | | | | **x** | 126.6 | 269.8 |
| 2F1/2/3/4/5 | ODS Substitutes | HFCs | | ***20*** | ***13*** | | 21.1 | 853.7 |
| 3 | Solvent and other Product Use | CO2 | ***34*** | | | | 279.3 | 248.5 |
| 4 A 1 | Cattle | CH4 | ***9*** | ***9*** | ***14*** | | 3 560.9 | 3 000.8 |
| 4 B 1 | Cattle | N2O | ***23*** | ***21*** | ***29*** | | 908.1 | 788.5 |
| 4 B 1 | Cattle | CH4 | ***27*** | ***32*** | ***31*** | | 587.1 | 452.4 |
| 4 B 8 | Swine | CH4 | ***30*** | ***33*** | | | 447.7 | 407.5 |
| 4 D 1 | Direct Soil Emissions | N2O | ***17*** | ***16*** | ***22*** | | 1 804.9 | 1 633.3 |
| 4 D 2 | Pasture, Range and Paddock Manure | N2O | | | | **x** | 218.5 | 223.0 |
| 4 D 3 | Indirect Emissions | N2O | ***18*** | ***18*** | ***23*** | | 1 309.7 | 1 104.8 |
| 5 A 1 | Forest land remaining forest land | CO2 | ***1*** | ***2*** | ***2*** | | -11 511.2 | -16 966.8 |
| 5 A 2 | Land converted to forest land | CO2 | ***8*** | ***11*** | ***7*** | | -4 402.2 | -2 572.3 |
| 5 B 1 | Cropland remaining cropland | CO2 | | | ***27*** | | -177.8 | 53.2 |
| 5 B 2 | Land converted to cropland | CO2 | ***16*** | ***14*** | | | 1 822.9 | 1 890.9 |
| 5 C 2 | Land converted to grassland | CO2 | ***20*** | ***17*** | ***33*** | | -1 060.7 | -1 310.7 |
| 5 D 2 | Land converted to Wetlands | CO2 | | ***34*** | | | 199.7 | 371.8 |
| 5 E 2 | Land converted to Settlements | CO2 | ***25*** | ***28*** | ***25*** | | 759.7 | 530.5 |
| 5 F 2 | Land converted to Other land | CO2 | ***24*** | ***31*** | ***21*** | | 809.9 | 470.4 |
| 6 A | Solid Waste Disposal on Land | CH4 | ***11*** | ***15*** | ***8*** | | 3 376.6 | 1 744.2 |
| 6 B | Wastewater Handling | N2O | | | | | 108.4 | 279.4 |
| | | | | | | | | |
| | LA07= Level Assessment 2007 | | | | | | | |
| | TA07= Trend Assessment BY-2007 | | | | | | | |

*Table A 9: Key categories identified including their ranking in the level and trend assessment for the KCA*

| IPCC 96 | Bezeichnung | Gas | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 A 1 a liquid | Public Electricity and Heat Produc | CH4 | 0.3 | 0.4 | 0.4 | 0.6 | 0.5 | 0.4 | 0.5 | 0.5 | 0.6 | 0.4 | 0.3 | 0.4 | 0.2 | 0.2 | 0.3 | 0.3 | 0.4 | 0.2 |
| 1 A 1 a solid | Public Electricity and Heat Produc | CH4 | 1.5 | 1.7 | 0.9 | 0.7 | 0.6 | 0.5 | 0.4 | 0.4 | 0.1 | 0.1 | 0.2 | 0.2 | 0.2 | 0.2 | 0.3 | 0.1 | 0.1 | 0.1 |
| 1 A 1 a gaseous | Public Electricity and Heat Produc | CH4 | 0.5 | 0.5 | 0.5 | 0.6 | 0.6 | 0.7 | 1.1 | 1.2 | 1.2 | 1.2 | 1.0 | 1.0 | 1.1 | 1.4 | 1.5 | 0.9 | 0.9 | 0.8 |
| 1 A 1 a biomass | Public Electricity and Heat Produc | CH4 | 0.2 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.4 | 0.4 | 0.6 | 0.5 | 0.6 | 1.0 | 0.8 | 0.9 | 1.0 | 1.1 | 1.4 | 1.7 |
| 1 A 1 a other | Public Electricity and Heat Produc | CH4 | 0.6 | 0.7 | 0.9 | 0.9 | 1.0 | 1.0 | 1.2 | 1.2 | 1.2 | 1.2 | 1.2 | 1.4 | 1.7 | 2.0 | 2.4 | 2.1 | 3.2 | 3.0 |
| 1 A 1 c liquid | Manufacture of Solid fuels and Ot | CH4 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| 1 A 1 c gaseous | Manufacture of Solid fuels and Ot | CH4 | 0.3 | 0.3 | 0.3 | 0.2 | 0.3 | 0.3 | 0.1 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.3 | 0.2 | 0.3 | 0.3 | 0.4 | 0.4 |
| 1 A 2 mobile-liquic | Manufacturing Industries and Con | CH4 | 0.3 | 0.3 | 0.3 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.5 | 0.4 | 0.5 | 0.5 | 0.5 | 0.4 | 0.5 | 0.4 | 0.4 | 0.4 |
| 1 A 2 stat-liquid | Manufacturing Industries and Con | CH4 | 1.0 | 1.1 | 0.8 | 0.9 | 0.9 | 0.8 | 0.7 | 0.9 | 0.8 | 0.6 | 0.6 | 0.5 | 0.5 | 0.6 | 0.7 | 0.8 | 0.8 | 0.8 |
| 1 A 2 solid | Manufacturing Industries and Con | CH4 | 1.6 | 1.7 | 1.7 | 1.6 | 1.4 | 1.4 | 1.5 | 1.7 | 1.7 | 1.5 | 1.7 | 1.5 | 1.5 | 2.0 | 2.1 | 2.4 | 2.7 | 2.5 |
| 1 A 2 gaseous | Manufacturing Industries and Con | CH4 | 2.2 | 2.3 | 2.3 | 2.2 | 2.8 | 2.9 | 3.0 | 3.1 | 3.0 | 2.9 | 3.2 | 3.1 | 3.3 | 3.5 | 3.3 | 3.7 | 3.7 | 3.6 |
| 1 A 2 biomass | Manufacturing Industries and Con | CH4 | 1.2 | 1.2 | 1.2 | 1.4 | 1.4 | 1.4 | 1.4 | 1.4 | 1.4 | 1.9 | 1.7 | 1.7 | 1.7 | 1.6 | 1.7 | 1.9 | 2.3 | 2.4 |
| 1 A 2 other | Manufacturing Industries and Con | CH4 | 0.8 | 1.1 | 1.3 | 1.1 | 1.2 | 1.3 | 1.6 | 1.4 | 1.5 | 1.3 | 1.6 | 2.1 | 2.2 | 2.5 | 3.0 | 2.8 | 3.9 | 4.3 |
| 1 A 3 a jet keroser | Civil Aviation | CH4 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 |
| 1 A 3 b gasoline | Road Transportation | CH4 | 62.1 | 68.0 | 68.1 | 68.0 | 64.5 | 59.9 | 53.4 | 48.1 | 46.0 | 40.3 | 36.3 | 33.3 | 31.8 | 29.2 | 25.8 | 22.6 | 19.5 | 17.2 |
| 1 A 3 b diesel oil | Road Transportation | CH4 | 2.4 | 2.5 | 2.5 | 2.6 | 2.6 | 2.6 | 3.2 | 2.7 | 3.0 | 2.7 | 2.8 | 2.9 | 3.1 | 3.3 | 3.3 | 3.3 | 3.1 | 3.1 |
| 1 A 3 c liquid | Railways | CH4 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 |
| 1 A 3 c solid | Railways | CH4 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 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 3 d gas/diesel | Navigation | CH4 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 |
| 1 A 3 d gasoline | Navigation | CH4 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 |
| 1 A 3 e gaseous | Other | CH4 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.2 | 0.2 | 0.3 | 0.3 | 0.2 | 0.2 | 0.3 | 0.3 | 0.3 | 0.3 |
| 1 A 4 mobile-liquic | Other Sectors | CH4 | 1.4 | 1.4 | 1.4 | 1.4 | 1.4 | 1.3 | 1.3 | 1.2 | 1.2 | 1.1 | 1.1 | 1.1 | 1.1 | 1.0 | 1.0 | 1.0 | 0.9 | 0.8 |
| 1 A 4 mobile-diese | Other Sectors | CH4 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 |
| 1 A 4 mobile-gaso | Other Sectors | CH4 | 0.7 | 0.5 | 0.6 | 0.6 | 0.6 | 0.6 | 0.6 | 0.6 | 0.6 | 0.6 | 0.5 | 0.5 | 0.6 | 0.6 | 0.6 | 0.6 | 0.6 | 0.6 |
| 1 A 4 stat-liquid | Other Sectors | CH4 | 0.8 | 0.8 | 0.8 | 0.8 | 0.7 | 0.7 | 0.7 | 0.6 | 0.7 | 0.7 | 0.6 | 0.6 | 0.7 | 0.8 | 0.7 | 0.6 | 0.6 | 0.5 |
| 1 A 4 solid | Other Sectors | CH4 | 61.8 | 66.7 | 54.9 | 49.1 | 44.8 | 43.4 | 42.3 | 27.6 | 24.0 | 22.7 | 20.5 | 20.3 | 16.6 | 15.4 | 13.3 | 13.0 | 11.5 | 10.5 |
| 1 A 4 gaseous | Other Sectors | CH4 | 4.0 | 4.0 | 3.5 | 3.0 | 1.9 | 1.3 | 1.2 | 1.2 | 1.2 | 1.3 | 1.2 | 1.5 | 1.4 | 1.6 | 1.5 | 1.4 | 1.4 | 1.3 |
| 1 A 4 biomass | Other Sectors | CH4 | 315.9 | 343.0 | 317.6 | 317.2 | 287.5 | 303.4 | 325.2 | 249.7 | 242.6 | 251.9 | 238.2 | 273.2 | 276.2 | 302.5 | 291.8 | 293.3 | 285.8 | 254.4 |
| 1 A 4 other | Other Sectors | CH4 | 0.8 | 0.7 | 0.8 | 0.5 | 0.5 | 0.4 | 0.7 | 0.6 | 0.4 | 0.4 | 0.3 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.4 |
| 1 A 5 liquid | Other | CH4 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 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 B 1 a | Coal Mining | CH4 | 11.0 | 9.4 | 7.8 | 7.6 | 6.2 | 5.8 | 5.0 | 5.1 | 5.1 | 5.1 | 5.6 | 5.4 | 6.3 | 5.2 | 1.1 | 0.0 | 0.0 | NO |
| 1 B 2 a | Oil | CH4 | 101.0 | 101.3 | 101.6 | 101.0 | 100.3 | 98.3 | 99.7 | 101.7 | 98.2 | 92.8 | 90.2 | 91.9 | 93.8 | 88.2 | 112.9 | 115.3 | 121.3 | 123.7 |
| 1 B 2 b | Natural gas | CH4 | 272.7 | 288.1 | 307.1 | 326.7 | 342.7 | 368.0 | 393.9 | 410.3 | 424.9 | 451.7 | 469.7 | 476.5 | 496.6 | 515.3 | 539.1 | 555.8 | 577.6 | 581.7 |
| 2 B | Chemical Industry | CH4 | 14.8 | 14.6 | 13.9 | 14.6 | 14.9 | 14.3 | 14.6 | 14.8 | 15.4 | 14.5 | 14.6 | 14.0 | 14.8 | 14.6 | 14.7 | 15.7 | 19.2 | 19.0 |
| 2 C | Metal Production | CH4 | 0.0 | 0.0 | 0.0 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 |
| 4 A 1 | Cattle | CH4 | 3 560.9 | 3 503.5 | 3 340.8 | 3 330.5 | 3 350.1 | 3 372.6 | 3 320.4 | 3 253.7 | 3 226.6 | 3 204.8 | 3 190.5 | 3 140.0 | 3 086.5 | 3 044.6 | 3 039.1 | 3 008.8 | 2 999.4 | 3 000.8 |
| 4 A 3 | Sheep | CH4 | 52.1 | 54.8 | 52.4 | 56.1 | 57.5 | 61.4 | 64.0 | 64.5 | 60.6 | 59.2 | 57.0 | 53.8 | 51.1 | 54.7 | 55.0 | 54.7 | 52.5 | 59.0 |
| 4 A 4 | Goats | CH4 | 3.9 | 4.3 | 4.1 | 5.0 | 5.2 | 5.7 | 5.7 | 6.1 | 5.7 | 6.1 | 5.9 | 6.2 | 6.1 | 5.7 | 5.8 | 5.8 | 5.6 | 6.4 |
| 4 A 6 | Horses | CH4 | 18.6 | 21.8 | 23.2 | 24.5 | 25.2 | 27.4 | 27.7 | 28.0 | 28.5 | 30.8 | 30.8 | 30.8 | 30.8 | 32.9 | 32.9 | 32.9 | 32.9 | 32.9 |
| 4 A 8 | Swine | CH4 | 116.2 | 114.6 | 117.2 | 120.3 | 117.5 | 116.7 | 115.4 | 115.9 | 120.0 | 108.1 | 105.5 | 108.4 | 104.1 | 102.2 | 98.4 | 99.8 | 98.9 | 103.5 |
| 4 A 9 | Poultry | CH4 | 5.6 | 5.8 | 5.5 | 5.9 | 5.7 | 5.6 | 5.2 | 6.0 | 5.8 | 5.9 | 4.8 | 5.1 | 5.1 | 5.3 | 5.3 | 5.3 | 5.3 | 5.3 |
| 4 A-10 | Other | CH4 | 6.2 | 6.2 | 6.2 | 6.2 | 6.3 | 6.8 | 7.0 | 9.4 | 8.5 | 6.6 | 6.5 | 6.5 | 6.5 | 6.9 | 6.9 | 6.9 | 6.9 | 6.9 |
| 4 B 1 | Cattle | CH4 | 587.1 | 576.9 | 552.0 | 546.3 | 542.2 | 532.8 | 525.7 | 520.5 | 517.0 | 510.4 | 501.3 | 486.6 | 476.4 | 470.3 | 467.2 | 457.8 | 454.4 | 452.4 |
| 4 B 3 | Sheep | CH4 | 1.2 | 1.3 | 1.2 | 1.3 | 1.4 | 1.5 | 1.5 | 1.5 | 1.4 | 1.4 | 1.4 | 1.3 | 1.2 | 1.3 | 1.3 | 1.3 | 1.2 | 1.4 |
| 4 B 4 | Goats | CH4 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.2 |
| 4 B 6 | Horses | CH4 | 1.4 | 1.7 | 1.8 | 1.9 | 1.9 | 2.1 | 2.1 | 2.2 | 2.2 | 2.4 | 2.4 | 2.4 | 2.4 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 |
| 4 B 8 | Swine | CH4 | 447.7 | 441.7 | 451.6 | 463.7 | 457.1 | 458.5 | 447.6 | 448.3 | 462.4 | 416.6 | 404.3 | 422.5 | 403.3 | 410.3 | 385.3 | 396.9 | 395.0 | 407.5 |
| 4 B 9 | Poultry | CH4 | 22.6 | 23.6 | 22.4 | 23.8 | 23.2 | 22.9 | 21.3 | 24.2 | 23.4 | 23.7 | 19.3 | 20.6 | 20.6 | 21.3 | 21.3 | 21.3 | 21.3 | 21.3 |
| 4 B-10 | Other | CH4 | 0.1 | 0.1 | 0.1 | 0.1 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 |
| 4 D | Agricultural Soils | CH4 | 6.9 | 6.9 | 6.6 | 9.8 | 8.4 | 9.3 | 9.4 | 9.4 | 9.4 | 9.4 | 9.4 | 9.1 | 7.9 | 8.6 | 7.7 | 7.8 | 8.6 | 8.9 |

| IPCC 96 | Bezeichnung | Gas | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 4 F | Field Burning of Agricultural Resid | CH4 | 1.4 | 1.4 | 1.4 | 1.4 | 1.4 | 1.4 | 1.4 | 1.5 | 1.4 | 1.5 | 1.4 | 1.4 | 1.4 | 1.3 | 2.0 | 1.3 | 1.2 | 1.2 |
| 6 A | Solid Waste Disposal on Land | CH4 | 3 376.6 | 3 370.0 | 3 281.7 | 3 235.8 | 3 061.1 | 2 893.6 | 2 737.5 | 2 607.5 | 2 511.8 | 2 406.7 | 2 303.3 | 2 218.1 | 2 178.4 | 2 229.4 | 2 084.4 | 1 957.3 | 1 864.8 | 1 744.2 |
| 6 B | Wastewater Handling | CH4 | 101.8 | 101.6 | 98.8 | 95.7 | 92.1 | 88.3 | 81.2 | 74.1 | 66.9 | 61.6 | 56.2 | 51.1 | 45.8 | 40.9 | 41.2 | 41.5 | 31.2 | 31.3 |
| 6 C | Waste Incineration | CH4 | 0.1 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 6 D | Other Waste | CH4 | 10.9 | 11.5 | 13.7 | 17.2 | 20.5 | 21.8 | 23.0 | 22.7 | 23.5 | 24.7 | 25.5 | 26.1 | 26.6 | 27.0 | 32.0 | 34.1 | 34.8 | 35.2 |
| 1 A 1 a liquid | Public Electricity and Heat Produc | CO2 | 1 228.7 | 1 498.0 | 1 481.6 | 2 052.0 | 1 901.8 | 1 557.5 | 1 550.5 | 1 936.5 | 2 212.4 | 1 763.6 | 1 185.4 | 1 476.8 | 831.4 | 1 139.3 | 1 173.1 | 1 090.0 | 1 169.2 | 765.7 |
| 1 A 1 a solid | Public Electricity and Heat Produc | CO2 | 6 247.0 | 6 817.0 | 4 009.5 | 3 088.9 | 3 279.1 | 4 529.8 | 4 695.9 | 5 002.2 | 3 498.0 | 3 789.2 | 4 824.4 | 5 873.0 | 5 510.1 | 6 916.2 | 6 674.2 | 5 844.0 | 5 642.5 | 5 066.5 |
| 1 A 1 a other | Public Electricity and Heat Produc | CO2 | 118.0 | 141.7 | 170.3 | 183.8 | 186.9 | 191.2 | 233.1 | 239.3 | 233.8 | 232.1 | 234.4 | 328.1 | 432.3 | 488.0 | 558.5 | 490.0 | 695.5 | 655.4 |
| 1 A 1 b liquid | Petroleum refining | CO2 | 1 957.7 | 1 908.5 | 1 916.8 | 2 184.4 | 2 325.5 | 2 169.0 | 2 182.1 | 2 155.9 | 2 172.2 | 2 056.5 | 1 991.6 | 2 014.2 | 2 157.5 | 2 303.6 | 2 515.1 | 2 148.7 | 2 687.6 | 2 725.3 |
| 1 A 1 c liquid | Manufacture of Solid fuels and Ot | CO2 | 3.9 | 2.6 | 0.0 | 0.1 | 0.1 | 0.5 | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| 1 A 2 mobile-liqui | Manufacturing Industries and Con | CO2 | 257.3 | 290.7 | 308.0 | 323.8 | 337.8 | 357.9 | 445.0 | 421.4 | 489.6 | 477.0 | 566.3 | 547.1 | 549.8 | 608.6 | 654.4 | 618.9 | 692.7 | 715.3 |
| 1 A 2 stat-liquid | Manufacturing Industries and Con | CO2 | 2 883.6 | 3 270.6 | 2 525.9 | 2 996.3 | 2 886.8 | 2 688.6 | 2 504.5 | 3 220.7 | 2 961.2 | 2 114.0 | 2 060.9 | 2 108.8 | 1 775.2 | 1 840.8 | 1 993.2 | 2 141.5 | 2 179.8 | 2 114.2 |
| 1 A 2 solid | Manufacturing Industries and Con | CO2 | 5 016.3 | 4 760.6 | 4 139.6 | 4 320.1 | 4 238.9 | 4 459.2 | 4 400.3 | 5 018.5 | 4 276.4 | 4 350.4 | 4 645.4 | 4 427.4 | 4 841.5 | 4 994.2 | 4 975.1 | 5 514.3 | 5 579.1 | 5 410.1 |
| 1 A 2 other | Manufacturing Industries and Con | CO2 | 264.1 | 390.0 | 447.1 | 299.6 | 427.0 | 466.8 | 538.5 | 513.4 | 416.6 | 434.5 | 454.1 | 561.5 | 627.2 | 705.3 | 754.2 | 750.1 | 990.0 | 943.6 |
| 1 A 3 a aviation ga | Civil Aviation | CO2 | 7.8 | 8.1 | 8.3 | 8.6 | 8.8 | 7.1 | 6.8 | 7.6 | 8.2 | 8.7 | 6.4 | 5.9 | 7.5 | 8.2 | 7.6 | 8.8 | 9.0 | 9.0 |
| 1 A 3 a jet kerose | Civil Aviation | CO2 | 24.2 | 29.4 | 34.7 | 40.0 | 45.3 | 50.5 | 56.7 | 62.9 | 69.1 | 72.4 | 60.8 | 54.2 | 54.7 | 54.4 | 56.8 | 58.0 | 62.7 | 64.7 |
| 1 A 3 b gasoline | Road Transportation | CO2 | 7 941.7 | 8 709.9 | 8 327.9 | 7 986.9 | 7 699.7 | 7 438.5 | 6 880.1 | 6 514.8 | 6 815.3 | 6 333.8 | 6 118.9 | 6 162.9 | 6 635.5 | 6 785.7 | 6 600.7 | 6 401.8 | 6 151.2 | 6 009.5 |
| 1 A 3 b diesel oil | Road Transportation | CO2 | 5 344.0 | 6 031.1 | 6 387.8 | 6 866.2 | 7 192.6 | 7 721.4 | 9 831.0 | 9 215.7 | 10 890.2 | 10 713.5 | 11 819.0 | 13 096.0 | 14 707.0 | 16 293.8 | 17 028.4 | 17 743.5 | 16 748.2 | 17 157.7 |
| 1 A 3 c liquid | Railways | CO2 | 167.3 | 174.2 | 173.5 | 169.6 | 171.2 | 159.2 | 143.5 | 145.0 | 143.1 | 177.1 | 176.9 | 174.3 | 170.8 | 166.9 | 139.4 | 161.2 | 163.1 | 162.7 |
| 1 A 3 c solid | Railways | CO2 | 6.6 | 6.0 | 6.3 | 5.7 | 5.6 | 5.8 | 5.8 | 3.3 | 2.9 | 2.8 | 2.5 | 2.4 | 2.2 | 2.1 | 2.2 | 0.6 | 0.5 | 0.5 |
| 1 A 3 d gas/diesel | Navigation | CO2 | 42.8 | 38.0 | 37.0 | 37.3 | 46.3 | 51.7 | 53.0 | 52.6 | 57.2 | 55.9 | 61.0 | 63.7 | 70.6 | 56.7 | 69.5 | 67.3 | 56.9 | 60.5 |
| 1 A 3 d gasoline | Navigation | CO2 | 10.1 | 10.0 | 10.0 | 10.0 | 10.0 | 9.9 | 9.8 | 9.8 | 9.7 | 9.7 | 9.6 | 9.6 | 9.5 | 9.4 | 9.3 | 9.2 | 9.1 | 8.9 |
| 1 A 4 mobile-liqui | Other Sectors | CO2 | 144.3 | 144.7 | 146.0 | 146.8 | 145.2 | 145.5 | 144.4 | 143.0 | 141.8 | 141.5 | 141.6 | 141.8 | 141.5 | 141.1 | 141.3 | 139.1 | 135.5 | 133.3 |
| 1 A 4 mobile-dies | Other Sectors | CO2 | 737.2 | 738.5 | 744.6 | 748.3 | 753.5 | 720.3 | 748.9 | 787.6 | 773.2 | 780.8 | 757.5 | 781.6 | 776.8 | 743.8 | 766.9 | 808.1 | 784.6 | 761.4 |
| 1 A 4 mobile-gasc | Other Sectors | CO2 | 33.2 | 28.9 | 29.7 | 29.8 | 32.0 | 31.4 | 32.6 | 32.3 | 31.6 | 31.6 | 30.7 | 30.8 | 32.0 | 33.9 | 33.1 | 32.8 | 35.1 | 32.8 |
| 1 A 4 stat-liquid | Other Sectors | CO2 | 7 319.1 | 7 694.4 | 7 183.5 | 7 118.8 | 6 528.7 | 7 194.0 | 8 322.2 | 7 407.4 | 7 457.1 | 7 839.1 | 6 834.6 | 7 410.0 | 7 341.1 | 8 178.4 | 7 215.0 | 6 609.9 | 6 741.7 | 4 839.4 |
| 1 A 4 solid | Other Sectors | CO2 | 2 654.1 | 2 934.3 | 2 510.7 | 2 080.0 | 1 855.6 | 1 746.4 | 1 657.7 | 1 294.5 | 1 127.3 | 1 065.2 | 965.6 | 957.5 | 782.0 | 727.9 | 622.1 | 613.6 | 543.1 | 496.4 |
| 1 A 4 other | Other Sectors | CO2 | 349.6 | 273.3 | 338.9 | 191.4 | 206.0 | 180.7 | 301.8 | 264.1 | 167.9 | 152.1 | 143.7 | 65.3 | 64.3 | 67.6 | 70.9 | 71.6 | 75.9 | 153.4 |
| 1 A 5 liquid | Other | CO2 | 35.0 | 37.1 | 33.7 | 39.4 | 41.6 | 32.6 | 38.9 | 37.1 | 42.4 | 41.6 | 40.8 | 41.4 | 41.9 | 42.5 | 43.0 | 43.6 | 44.1 | 44.6 |
| 1 A gaseous | Fuel Combustion (stationary) | CO2 | 11 300.5 | 11 940.3 | 12 000.1 | 12 453.3 | 13 111.3 | 14 339.2 | 15 287.3 | 14 720.1 | 15 135.5 | 15 406.0 | 14 683.6 | 15 628.8 | 15 792.4 | 17 069.8 | 16 917.1 | 18 508.0 | 16 792.1 | 15 812.4 |
| 1 B 2 a | Oil | CO2 | 43.0 | 43.0 | 40.0 | 37.0 | 47.5 | 38.0 | 41.0 | 31.1 | 61.0 | 90.0 | 72.0 | 88.0 | 84.0 | 133.0 | 122.0 | 122.0 | 140.0 | 142.0 |
| 1 B 2 b | Natural gas | CO2 | 59.0 | 68.0 | 80.0 | 75.0 | 80.0 | 89.0 | 30.0 | 89.4 | 80.8 | 80.5 | 92.5 | 94.7 | 83.0 | 100.0 | 88.0 | 83.0 | 92.0 | 95.0 |
| 2 A 1 | Cement Production | CO2 | 2 033.4 | 2 005.0 | 2 105.0 | 2 031.9 | 2 102.3 | 1 631.3 | 1 634.2 | 1 760.9 | 1 598.7 | 1 607.4 | 1 711.6 | 1 719.9 | 1 735.7 | 1 754.5 | 1 790.0 | 1 797.5 | 1 954.1 | 2 130.8 |
| 2 A 2 | Lime Production | CO2 | 396.2 | 361.3 | 355.1 | 365.2 | 390.5 | 394.6 | 382.7 | 412.5 | 453.8 | 453.1 | 497.5 | 506.6 | 546.6 | 576.9 | 601.1 | 578.7 | 585.7 | 595.7 |
| 2 A 3 | Limestone and Dolomite Use | CO2 | 222.4 | 225.2 | 205.2 | 205.0 | 220.0 | 251.2 | 227.1 | 254.2 | 264.1 | 247.4 | 275.6 | 271.1 | 290.4 | 295.6 | 297.5 | 290.7 | 295.8 | 302.5 |
| 2 A 4 | Soda Ash Production and use | CO2 | 19.4 | 22.3 | 19.7 | 19.8 | 21.1 | 21.2 | 21.2 | 19.7 | 19.7 | 21.6 | 18.2 | 21.4 | 18.9 | 18.8 | 11.9 | 15.3 | 16.1 | 17.2 |
| 2 A 7 a | Bricks and Tiles (decarbonizing) | CO2 | 116.5 | 121.9 | 126.0 | 135.4 | 139.7 | 148.8 | 148.8 | 137.1 | 133.6 | 121.5 | 115.9 | 123.7 | 120.3 | 115.8 | 133.7 | 128.0 | 129.9 | 129.9 |
| 2 A 7 b | Sinter Production | CO2 | 481.2 | 391.6 | 336.1 | 324.6 | 322.9 | 409.9 | 355.4 | 384.3 | 345.4 | 350.0 | 339.2 | 334.0 | 373.5 | 311.5 | 328.5 | 309.5 | 312.4 | 329.5 |
| 2 B 1 | Ammonia Production | CO2 | 516.6 | 545.7 | 552.8 | 538.8 | 507.0 | 537.1 | 538.7 | 532.1 | 525.3 | 530.4 | 518.0 | 472.5 | 486.1 | 526.4 | 467.7 | 503.1 | 541.8 | 473.4 |
| 2 B 2 | Nitric Acid Production | CO2 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 |
| 2 B 4 | Carbide Production | CO2 | 37.5 | 35.2 | 41.3 | 32.9 | 25.1 | 26.2 | 32.8 | 32.8 | 35.0 | 32.5 | 48.1 | 46.7 | 40.8 | 41.5 | 35.8 | 35.9 | 30.5 | 36.3 |
| 2 B 5 | Other | CO2 | 30.5 | 28.0 | 38.0 | 33.8 | 22.6 | 20.0 | 18.4 | 17.6 | 19.0 | 19.9 | 20.8 | 20.0 | 24.0 | 24.2 | 24.2 | 24.1 | 26.5 | 20.6 |
| 2 C 1 | Iron and Steel Production | CO2 | 3 545.7 | 3 509.5 | 3 074.9 | 3 144.7 | 3 411.1 | 3 921.0 | 3 702.9 | 4 099.9 | 3 900.4 | 3 759.3 | 4 201.8 | 4 159.4 | 4 606.8 | 4 523.1 | 4 446.2 | 4 995.0 | 5 192.9 | 5 482.0 |
| 2 C 2 | Ferroalloys Production | CO2 | 20.8 | 20.8 | 20.8 | 20.8 | 20.8 | 20.8 | 18.8 | 19.3 | 19.2 | 18.9 | 18.9 | 18.1 | 17.1 | 16.7 | 16.9 | 18.7 | 18.7 | 17.0 |
| 2 C 3 | Aluminium production | CO2 | 158.4 | 158.4 | 63.0 | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| 3 | Solvent and other Product Use | CO2 | 279.3 | 233.5 | 185.1 | 186.0 | 170.8 | 190.0 | 173.2 | 191.9 | 173.8 | 159.8 | 192.6 | 204.1 | 220.0 | 226.2 | 193.7 | 219.9 | 247.9 | 248.5 |
| 6 C | Waste Incineration | CO2 | 26.9 | 23.4 | 10.9 | 10.6 | 10.7 | 11.0 | 11.3 | 11.6 | 11.9 | 12.3 | 12.3 | 12.3 | 12.3 | 12.3 | 12.3 | 12.3 | 12.3 | 12.3 |
| 1 A 1 a liquid | Public Electricity and Heat Produc | N2O | 6.7 | 7.8 | 7.0 | 9.9 | 9.5 | 7.5 | 7.7 | 10.1 | 11.5 | 9.9 | 5.9 | 6.9 | 4.1 | 6.0 | 6.1 | 5.9 | 6.2 | 3.9 |
| 1 A 1 a solid | Public Electricity and Heat Produc | N2O | 23.0 | 27.3 | 17.4 | 15.0 | 14.9 | 19.6 | 15.4 | 14.2 | 14.9 | 16.6 | 21.2 | 23.7 | 22.9 | 27.4 | 29.2 | 9.6 | 9.3 | 8.6 |
| 1 A 1 a gaseous | Public Electricity and Heat Produc | N2O | 10.2 | 10.0 | 9.2 | 9.2 | 10.6 | 11.2 | 12.0 | 8.6 | 11.2 | 11.0 | 9.2 | 10.4 | 10.3 | 11.7 | 11.6 | 17.0 | 14.1 | 12.5 |
| 1 A 1 a biomass | Public Electricity and Heat Produc | N2O | 2.0 | 3.2 | 3.7 | 3.7 | 4.0 | 4.8 | 6.9 | 7.0 | 8.0 | 7.6 | 9.7 | 11.8 | 16.0 | 16.9 | 21.8 | 25.0 | 34.7 | 43.7 |

| IPCC 96 | Bezeichnung | Gas | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 A 1 a other | Public Electricity and Heat Produc | N2O | 1.0 | 1.3 | 1.5 | 1.6 | 1.7 | 1.7 | 2.1 | 2.1 | 2.1 | 2.1 | 2.0 | 2.4 | 2.9 | 3.4 | 4.1 | 3.7 | 5.4 | 5.1 |
| 1 A 1 b liquid | Petroleum refining | N2O | 4.4 | 4.7 | 4.7 | 5.4 | 5.3 | 5.2 | 5.1 | 5.1 | 5.2 | 5.0 | 4.7 | 5.0 | 5.6 | 5.1 | 5.6 | 5.2 | 4.9 | 5.4 |
| 1 A 1 b gaseous | Petroleum refining | N2O | 0.2 | 0.3 | 0.3 | 0.3 | 0.2 | 0.2 | 0.3 | 0.3 | 0.3 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.4 | 0.1 | 0.1 |
| 1 A 1 c liquid | Manufacture of Solid fuels and Otl | N2O | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| 1 A 1 c gaseous | Manufacture of Solid fuels and Otl | N2O | 0.3 | 0.3 | 0.3 | 0.2 | 0.3 | 0.3 | 0.1 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.3 | 0.2 | 0.3 | 0.3 | 0.4 | 0.4 |
| 1 A 2 mobile-liquid | Manufacturing Industries and Con | N2O | 28.1 | 31.8 | 33.7 | 35.4 | 38.1 | 41.2 | 53.4 | 50.3 | 60.2 | 58.8 | 71.0 | 68.6 | 66.7 | 67.7 | 64.1 | 64.0 | 56.9 | 53.8 |
| 1 A 2 stat-liquid | Manufacturing Industries and Con | N2O | 10.8 | 12.3 | 9.5 | 10.8 | 10.4 | 9.6 | 8.8 | 11.2 | 10.7 | 8.3 | 8.1 | 8.2 | 7.9 | 8.0 | 9.0 | 9.1 | 8.7 | 8.6 |
| 1 A 2 solid | Manufacturing Industries and Con | N2O | 16.4 | 16.8 | 15.0 | 15.0 | 14.8 | 16.3 | 15.9 | 18.3 | 17.6 | 17.2 | 19.0 | 17.2 | 17.8 | 18.2 | 17.8 | 19.3 | 21.0 | 20.8 |
| 1 A 2 gaseous | Manufacturing Industries and Con | N2O | 2.4 | 2.4 | 2.4 | 2.4 | 3.0 | 3.1 | 3.3 | 3.4 | 3.3 | 3.2 | 3.4 | 3.3 | 3.5 | 3.5 | 3.4 | 3.7 | 3.7 | 3.6 |
| 1 A 2 biomass | Manufacturing Industries and Con | N2O | 20.6 | 21.1 | 21.7 | 25.0 | 25.5 | 24.7 | 23.2 | 24.6 | 21.7 | 37.3 | 30.7 | 30.4 | 30.4 | 29.8 | 29.3 | 34.5 | 45.8 | 48.5 |
| 1 A 2 other | Manufacturing Industries and Con | N2O | 1.4 | 2.0 | 2.3 | 1.8 | 2.1 | 2.3 | 2.8 | 2.5 | 2.6 | 2.3 | 2.7 | 3.5 | 3.9 | 4.3 | 5.2 | 4.9 | 6.7 | 7.4 |
| 1 A 3 a jet keroser | Civil Aviation | N2O | 0.3 | 0.4 | 0.5 | 0.5 | 0.6 | 0.6 | 0.7 | 0.8 | 0.9 | 0.9 | 1.1 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.1 | 1.1 |
| 1 A 3 b gasoline | Road Transportation | N2O | 136.7 | 170.3 | 175.3 | 180.4 | 187.5 | 188.1 | 180.8 | 177.2 | 196.1 | 186.1 | 181.3 | 181.0 | 191.7 | 189.4 | 175.1 | 159.0 | 139.3 | 124.8 |
| 1 A 3 b diesel oil | Road Transportation | N2O | 41.1 | 46.4 | 48.9 | 52.3 | 54.7 | 58.0 | 72.7 | 71.1 | 84.6 | 85.9 | 95.2 | 105.6 | 120.3 | 133.6 | 140.6 | 145.7 | 142.4 | 143.2 |
| 1 A 3 c liquid | Railways | N2O | 6.6 | 6.9 | 6.7 | 6.5 | 6.4 | 5.9 | 5.2 | 5.2 | 5.1 | 6.2 | 6.1 | 5.9 | 5.7 | 5.5 | 5.6 | 4.7 | 4.7 | 4.6 |
| 1 A 3 c solid | Railways | N2O | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.0 | 0.1 | 0.0 | 0.0 | 0.0 |
| 1 A 3 d gas/diesel | Navigation | N2O | 4.6 | 4.1 | 4.0 | 4.0 | 5.0 | 5.7 | 5.8 | 5.8 | 6.3 | 6.2 | 6.8 | 7.2 | 7.9 | 6.4 | 7.7 | 7.5 | 6.5 | 6.8 |
| 1 A 3 d gasoline | Navigation | N2O | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 |
| 1 A 3 e gaseous | Other | N2O | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.2 | 0.2 | 0.3 | 0.3 | 0.2 | 0.2 | 0.2 | 0.3 | 0.3 | 0.3 |
| 1 A 4 mobile-liquid | Other Sectors | N2O | 7.4 | 7.4 | 7.5 | 7.6 | 7.8 | 8.0 | 7.9 | 7.9 | 7.9 | 7.9 | 8.0 | 8.1 | 7.2 | 7.1 | 6.2 | 5.9 | 5.7 | 5.2 |
| 1 A 4 mobile-diese | Other Sectors | N2O | 78.4 | 78.7 | 79.4 | 80.0 | 81.1 | 78.7 | 83.1 | 88.8 | 88.4 | 90.5 | 88.9 | 92.6 | 92.0 | 86.4 | 87.0 | 89.5 | 86.8 | 81.2 |
| 1 A 4 mobile-gaso | Other Sectors | N2O | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.2 | 0.1 |
| 1 A 4 stat-liquid | Other Sectors | N2O | 25.8 | 28.3 | 26.5 | 27.2 | 25.3 | 27.5 | 31.6 | 29.0 | 29.2 | 30.0 | 26.3 | 28.5 | 28.3 | 31.6 | 28.2 | 26.2 | 27.0 | 19.5 |
| 1 A 4 solid | Other Sectors | N2O | 20.6 | 22.8 | 19.6 | 16.1 | 14.3 | 13.4 | 12.7 | 10.0 | 8.6 | 8.2 | 7.6 | 7.6 | 5.9 | 5.6 | 4.8 | 4.6 | 4.2 | 3.8 |
| 1 A 4 gaseous | Other Sectors | N2O | 14.4 | 17.3 | 19.7 | 22.2 | 19.5 | 23.1 | 22.9 | 21.7 | 22.7 | 24.0 | 22.5 | 27.1 | 25.1 | 28.8 | 27.9 | 26.8 | 25.0 | 23.3 |
| 1 A 4 biomass | Other Sectors | N2O | 86.0 | 94.8 | 89.2 | 90.7 | 83.2 | 89.8 | 97.7 | 91.5 | 88.5 | 91.5 | 86.6 | 103.2 | 107.8 | 121.1 | 121.7 | 125.2 | 123.5 | 113.1 |
| 1 A 4 other | Other Sectors | N2O | 1.5 | 1.1 | 1.4 | 0.8 | 0.9 | 0.8 | 1.3 | 1.1 | 0.7 | 0.6 | 0.6 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.6 |
| 1 A 5 liquid | Other | N2O | 0.9 | 0.9 | 0.9 | 1.0 | 1.0 | 0.8 | 1.0 | 0.9 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 |
| 2 B 2 | Nitric Acid Production | N2O | 912.0 | 927.3 | 837.5 | 878.7 | 825.2 | 857.2 | 874.2 | 862.6 | 896.7 | 923.5 | 951.6 | 786.5 | 807.2 | 883.4 | 280.9 | 274.2 | 280.1 | 270.0 |
| 3 | Solvent and other Product Use | N2O | 232.5 | 232.5 | 232.5 | 232.5 | 232.5 | 232.5 | 232.5 | 232.5 | 232.5 | 232.5 | 232.5 | 220.7 | 208.9 | 197.2 | 185.4 | 173.6 | 164.3 | 160.3 |
| 4 B 1 | Cattle | N2O | 908.1 | 896.1 | 858.5 | 857.4 | 858.1 | 879.2 | 865.0 | 851.4 | 848.1 | 843.6 | 836.6 | 824.5 | 809.0 | 799.8 | 800.7 | 789.1 | 787.8 | 788.5 |
| 4 B 3 | Sheep | N2O | 1.9 | 2.0 | 1.9 | 2.0 | 2.1 | 2.2 | 2.3 | 2.3 | 2.2 | 2.1 | 2.1 | 1.9 | 1.8 | 2.0 | 2.0 | 2.0 | 1.9 | 2.1 |
| 4 B 4 | Goats | N2O | 0.0 | 0.0 | 0.0 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 |
| 4 B 6 | Horses | N2O | 0.2 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 |
| 4 B 8 | Swine | N2O | 77.9 | 76.9 | 78.6 | 80.7 | 79.6 | 79.9 | 78.0 | 78.1 | 80.4 | 72.4 | 70.3 | 73.5 | 70.2 | 71.3 | 67.0 | 68.9 | 68.6 | 70.7 |
| 4 B 9 | Poultry | N2O | 16.7 | 17.7 | 16.7 | 17.8 | 17.4 | 17.0 | 15.9 | 18.0 | 17.4 | 17.5 | 14.4 | 15.3 | 15.3 | 15.8 | 15.8 | 15.8 | 15.8 | 15.8 |
| 4 B-10 | Other | N2O | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.1 | 0.1 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 |
| 4 D 1 | Direct Soil Emissions | N2O | 1 804.9 | 1 978.2 | 1 832.4 | 1 672.4 | 2 004.7 | 2 034.4 | 1 765.2 | 1 809.0 | 1 834.4 | 1 806.9 | 1 699.5 | 1 711.5 | 1 710.6 | 1 603.5 | 1 552.5 | 1 562.0 | 1 610.3 | 1 633.3 |
| 4 D 2 | Pasture, Range and Paddock Mar | N2O | 218.5 | 222.9 | 216.1 | 228.3 | 230.9 | 239.4 | 237.5 | 237.3 | 232.1 | 231.6 | 226.0 | 222.1 | 218.1 | 220.1 | 220.0 | 219.3 | 217.3 | 223.0 |
| 4 D 3 | Indirect Emissions | N2O | 1 309.7 | 1 394.3 | 1 276.6 | 1 180.0 | 1 339.4 | 1 364.1 | 1 252.3 | 1 256.7 | 1 259.8 | 1 222.8 | 1 196.1 | 1 187.0 | 1 181.7 | 1 138.5 | 1 082.7 | 1 086.7 | 1 091.9 | 1 104.8 |
| 4 F | Field Burning of Agricultural Resid | N2O | 0.4 | 0.4 | 0.3 | 0.3 | 0.4 | 0.4 | 0.3 | 0.4 | 0.4 | 0.4 | 0.3 | 0.4 | 0.4 | 0.3 | 0.5 | 0.3 | 0.3 | 0.3 |
| 6 B | Wastewater Handling | N2O | 108.4 | 107.9 | 102.1 | 97.1 | 109.4 | 123.4 | 139.3 | 149.2 | 162.2 | 177.2 | 201.9 | 228.6 | 229.4 | 229.9 | 246.1 | 262.3 | 278.3 | 279.4 |
| 6 C | Waste Incineration | N2O | 0.1 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 6 D | Other Waste | N2O | 23.6 | 24.7 | 29.2 | 36.0 | 42.6 | 44.8 | 46.9 | 46.2 | 47.8 | 50.2 | 51.7 | 52.8 | 53.9 | 54.6 | 66.0 | 70.9 | 72.7 | 73.5 |
| 2C3 | Aluminium production | PFCs | 1 050.2 | 1 050.2 | 417.6 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 2C4 | SF6 Used in Al and Mg Foundries | SF6 | 253.3 | 277.2 | 253.3 | 277.2 | 372.8 | 443.1 | 610.6 | 349.2 | 164.2 | 22.2 | 7.6 | 7.6 | 7.6 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 2F8 | Electrical Equipment | SF6 | 20.6 | 21.7 | 22.8 | 23.9 | 25.0 | 26.1 | 26.9 | 27.1 | 27.2 | 28.9 | 29.1 | 29.4 | 30.0 | 31.5 | 33.7 | 36.3 | 38.1 | 40.7 |
| 2F7 | Semiconductor Manufacture | FCs | 133.1 | 215.2 | 287.8 | 360.4 | 430.9 | 505.7 | 403.9 | 593.8 | 477.8 | 453.9 | 407.1 | 416.9 | 425.8 | 483.0 | 508.9 | 297.6 | 308.7 | 288.7 |
| 2F1/2/3/4/5 | ODS Substitutes | HFCs | 21.1 | 42.1 | 44.6 | 151.9 | 200.0 | 259.1 | 337.4 | 418.3 | 492.2 | 539.2 | 592.7 | 690.9 | 777.2 | 859.3 | 892.8 | 904.1 | 855.9 | 853.7 |
| 2F9 | Other Sources of SF6 | SF6 | 126.6 | 179.2 | 183.1 | 190.6 | 222.5 | 241.2 | 252.2 | 256.1 | 286.1 | 246.4 | 265.2 | 268.3 | 268.0 | 185.1 | 100.1 | 81.7 | 274.0 | 269.8 |

# ANNEX 2: SECTOR 1.A FUEL COMBUSTION

This annex includes detailed information about category 1.A (trend information by sub-category), a description of the national energy balance (including fuel and fuel categories) and a description of the methodology applied to extract activity data from the energy balance for the calculation of emissions for Sector 1.A Fuel Combustion (e.g. correspondence of categories of the energy balance to IPCC categories). Activity data used for estimating emissions in the sectoral approach as taken from the energy balance is also presented.

Furthermore, the revision of the national energy balance as well as the implication of this revision on activity data is described.

## Trend information by sub category

### 1.A.1.a Public Electricity and Heat Production

*Table A 10: Greenhouse gas emissions from Category 1.A.1.a*

| | $CO_2$ [Gg] | $CH_4$ [Gg] | $N_2O$ [Gg] | $CO_2$ equiv. [Gg] |
|---|---|---|---|---|
| 1990 | 10 888 | 0.15 | 0.14 | 10 934 |
| 1991 | 11 645 | 0.17 | 0.16 | 11 698 |
| 1992 | 8 570 | 0.14 | 0.13 | 8 612 |
| 1993 | 8 310 | 0.15 | 0.13 | 8 353 |
| 1994 | 8 600 | 0.14 | 0.13 | 8 643 |
| 1995 | 9 717 | 0.14 | 0.14 | 9 765 |
| 1996 | 10 897 | 0.17 | 0.14 | 10 945 |
| 1997 | 10 968 | 0.18 | 0.14 | 11 014 |
| 1998 | 10 018 | 0.18 | 0.15 | 10 069 |
| 1999 | 9 983 | 0.16 | 0.15 | 10 033 |
| 2000 | 9 679 | 0.15 | 0.15 | 9 730 |
| 2001 | 11 365 | 0.19 | 0.18 | 11 424 |
| 2002 | 10 586 | 0.19 | 0.18 | 10 647 |
| 2003 | 13 001 | 0.23 | 0.21 | 13 071 |
| 2004 | 12 932 | 0.26 | 0.23 | 13 010 |
| 2005 | 12 743 | 0.22 | 0.20 | 12 809 |
| 2006 | 12 048 | 0.28 | 0.23 | 12 123 |
| 2007 | 10 434 | 0.28 | 0.24 | 10 514 |
| *Trend 1990-2007* | *-4.2%* | *85.3%* | *71.5%* | *-3.8%* |

During the last three years solid fossil fuels and natural gas were dominant compared to other fuel types. Since 2000 liquid fossil fuels became less important. The share in $CO_2$ emissions from waste incineration in district heating plants which are reported as 'other fuels' increased from 1% in 1990 to 6% in 2007.

*Table A 11: Share of fuel types on total $CO_2$ emissions from Category 1.A.1.a*

| | Liquid | Solid | Gaseous | Other |
|---|---|---|---|---|
| 1990 | 11% | 57% | 30% | 1% |
| 1991 | 13% | 59% | 27% | 1% |
| 1992 | 17% | 47% | 34% | 2% |
| 1993 | 25% | 37% | 36% | 2% |
| 1994 | 22% | 38% | 38% | 2% |
| 1995 | 16% | 47% | 35% | 2% |
| 1996 | 14% | 43% | 41% | 2% |
| 1997 | 18% | 46% | 35% | 2% |
| 1998 | 22% | 35% | 41% | 2% |
| 1999 | 18% | 38% | 42% | 2% |
| 2000 | 12% | 50% | 35% | 2% |
| 2001 | 13% | 52% | 32% | 3% |
| 2002 | 8% | 52% | 36% | 4% |
| 2003 | 9% | 53% | 34% | 4% |
| 2004 | 9% | 52% | 35% | 4% |
| 2005 | 9% | 46% | 42% | 4% |
| 2006 | 10% | 47% | 38% | 6% |
| 2007 | 7% | 49% | 38% | 6% |

## 1.A.1.b Petroleum Refining

*Table A 12: Greenhouse gas emissions from Category 1.A.1.b.*

| | $CO_2$ [Gg] | $N_2O$ [Gg] | $CO_2$ equiv. [Gg] |
|---|---|---|---|
| 1990 | 2 394 | IE | 0.015 |
| 1991 | 2 428 | IE | 0.016 |
| 1992 | 2 389 | IE | 0.016 |
| 1993 | 2 732 | IE | 0.018 |
| 1994 | 2 709 | IE | 0.018 |
| 1995 | 2 590 | IE | 0.017 |
| 1996 | 2 647 | IE | 0.017 |
| 1997 | 2 640 | IE | 0.017 |
| 1998 | 2 633 | IE | 0.017 |
| 1999 | 2 463 | IE | 0.017 |
| 2000 | 2 344 | IE | 0.016 |
| 2001 | 2 423 | IE | 0.017 |
| 2002 | 2 565 | IE | 0.019 |
| 2003 | 2 687 | IE | 0.017 |
| 2004 | 2 844 | IE | 0.019 |
| 2005 | 2 827 | IE | 0.018 |
| 2006 | 2 830 | IE | 0.016 |
| 2007 | 2 868 | IE | 0.018 |
| *Trend 1990-2007* | *19.8%* | - | *18.4%* |

Table A 13 presents the share of $CO_2$ emissions on the different fuel types.

*Table A 13: Share of fuel types on total $CO_2$ emissions from Category 1.A.1.b.*

| | Liquid | Gaseous |
|---|---|---|
| 1990 | 82% | 18% |
| 1991 | 79% | 21% |
| 1992 | 80% | 20% |
| 1993 | 80% | 20% |
| 1994 | 86% | 14% |
| 1995 | 84% | 16% |
| 1996 | 82% | 18% |
| 1997 | 82% | 18% |
| 1998 | 82% | 18% |
| 1999 | 83% | 17% |
| 2000 | 85% | 15% |
| 2001 | 83% | 17% |
| 2002 | 84% | 16% |
| 2003 | 86% | 14% |
| 2004 | 88% | 12% |
| 2005 | 76% | 24% |
| 2006 | 95% | 5% |
| 2007 | 95% | 5% |

## 1.A.1.c Manufacture of Solid Fuels and Other Energy Industries

*Table A 14: Greenhouse gas emissions from Category 1.A.1.c.*

| | $CO_2$ [Gg] | $CH_4$ [Gg] | $N_2O$ [Gg] | $CO_2$ equiv. [Gg] |
|---|---|---|---|---|
| 1990 | 510 | 0.014 | 0.0010 | 511 |
| 1991 | 549 | 0.015 | 0.0010 | 550 |
| 1992 | 522 | 0.014 | 0.0009 | 523 |
| 1993 | 424 | 0.011 | 0.0008 | 425 |
| 1994 | 453 | 0.012 | 0.0008 | 453 |
| 1995 | 611 | 0.017 | 0.0011 | 612 |
| 1996 | 261 | 0.007 | 0.0005 | 261 |
| 1997 | 277 | 0.008 | 0.0005 | 278 |
| 1998 | 343 | 0.009 | 0.0006 | 343 |
| 1999 | 396 | 0.011 | 0.0007 | 396 |
| 2000 | 330 | 0.009 | 0.0006 | 331 |
| 2001 | 340 | 0.009 | 0.0006 | 340 |
| 2002 | 519 | 0.014 | 0.0009 | 520 |
| 2003 | 429 | 0.012 | 0.0008 | 429 |
| 2004 | 576 | 0.016 | 0.0010 | 577 |
| 2005 | 525 | 0.014 | 0.0009 | 526 |
| 2006 | 668 | 0.018 | 0.0012 | 668 |
| 2007 | 627 | 0.017 | 0.0011 | 628 |
| *Trend 1990-2007* | *22.9%* | *23.7%* | *16.0%* | *22.9%* |

Almost all emissions of category 1.A.1.c originated from natural gas combustion.

*Table A 15: Share of fuel types on total $CO_2$ emissions from Category 1.A.1.c.*

| | Liquid | Gaseous |
|---|---|---|
| 1990 | 1% | 99% |
| 1991 | 0% | 100% |
| 1992 | 0% | 100% |
| 1993 | 0% | 100% |
| 1994 | 0% | 100% |
| 1995 | 0% | 100% |
| 1996 | NO | 100% |
| 1997 | NO | 100% |
| 1998 | NO | 100% |
| 1999 | NO | 100% |
| 2000 | NO | 100% |
| 2001 | NO | 100% |
| 2002 | NO | 100% |
| 2003 | NO | 100% |
| 2004 | NO | 100% |
| 2005 | NO | 100% |
| 2006 | NO | 100% |
| 2007 | NO | 100% |

## 1.A.2.a Iron and Steel

*Table A 16: Greenhouse gas emissions from Category 1.A.2.a.*

| | $CO_2$ [Gg] | $CH_4$ [Gg] | $N_2O$ [Gg] | $CO_2$ equiv. [Gg] |
|---|---|---|---|---|
| 1990 | 4 944 | 0.025 | 0.043 | 4 958 |
| 1991 | 4 615 | 0.023 | 0.043 | 4 628 |
| 1992 | 3 933 | 0.020 | 0.036 | 3 944 |
| 1993 | 4 191 | 0.022 | 0.038 | 4 203 |
| 1994 | 4 441 | 0.026 | 0.041 | 4 455 |
| 1995 | 4 774 | 0.026 | 0.047 | 4 789 |
| 1996 | 4 666 | 0.030 | 0.043 | 4 680 |
| 1997 | 5 287 | 0.035 | 0.048 | 5 303 |
| 1998 | 4 715 | 0.033 | 0.048 | 4 731 |
| 1999 | 4 837 | 0.030 | 0.049 | 4 853 |
| 2000 | 5 217 | 0.038 | 0.055 | 5 234 |
| 2001 | 5 191 | 0.035 | 0.053 | 5 208 |
| 2002 | 5 508 | 0.038 | 0.053 | 5 525 |
| 2003 | 5 624 | 0.077 | 0.054 | 5 643 |
| 2004 | 5 718 | 0.085 | 0.054 | 5 737 |
| 2005 | 6 450 | 0.100 | 0.059 | 6 470 |
| 2006 | 6 349 | 0.109 | 0.062 | 6 371 |
| 2007 | 6 225 | 0.101 | 0.063 | 6 247 |
| *Trend 1990-2007* | *25.9%* | *297.9%* | *47.7%* | *26.0%* |

$CO_2$ emissions from category *1.A.2.a* mainly arise from solid fossil fuels (coke oven coke for blast furnaces). See Table A 17.

*Table A 17: Share of fuel types in total $CO_2$ emissions from Category 1.A.2.a.*

| | Liquid | Solid | Gaseous |
|---|---|---|---|
| 1990 | 9.1% | 77.8% | 13.1% |
| 1991 | 9.7% | 75.7% | 14.5% |
| 1992 | 11.1% | 72.7% | 16.2% |
| 1993 | 10.9% | 74.5% | 14.6% |
| 1994 | 10.9% | 73.8% | 15.3% |
| 1995 | 11.7% | 72.5% | 15.9% |
| 1996 | 9.9% | 70.1% | 20.0% |
| 1997 | 9.8% | 69.7% | 20.5% |
| 1998 | 14.1% | 63.3% | 22.6% |
| 1999 | 13.5% | 65.7% | 20.8% |
| 2000 | 15.8% | 65.5% | 18.7% |
| 2001 | 16.9% | 64.7% | 18.5% |
| 2002 | 12.0% | 69.4% | 18.7% |
| 2003 | 9.9% | 72.1% | 18.0% |
| 2004 | 12.3% | 70.5% | 17.3% |
| 2005 | 12.3% | 69.6% | 18.1% |
| 2006 | 12.1% | 69.6% | 18.3% |
| 2007 | 13.8% | 68.8% | 17.4% |

## 1.A.2.b Non-Ferrous Metals

*Table A 18: Greenhouse gas emissions from Category 1.A.2.b.*

| | $CO_2$ [Gg] | $CH_4$ [Gg] | $N_2O$ [Gg] | $CO_2$ equiv. [Gg] |
|---|---|---|---|---|
| 1990 | 132 | 0.003 | 0.0009 | 132 |
| 1991 | 119 | 0.003 | 0.0008 | 119 |
| 1992 | 127 | 0.003 | 0.0007 | 127 |
| 1993 | 158 | 0.004 | 0.0008 | 158 |
| 1994 | 261 | 0.007 | 0.0011 | 262 |
| 1995 | 255 | 0.006 | 0.0010 | 255 |
| 1996 | 177 | 0.004 | 0.0009 | 177 |
| 1997 | 221 | 0.005 | 0.0012 | 222 |
| 1998 | 205 | 0.004 | 0.0011 | 206 |
| 1999 | 192 | 0.004 | 0.0011 | 192 |
| 2000 | 194 | 0.004 | 0.0010 | 195 |
| 2001 | 199 | 0.005 | 0.0009 | 200 |
| 2002 | 207 | 0.005 | 0.0010 | 207 |
| 2003 | 218 | 0.005 | 0.0010 | 219 |
| 2004 | 216 | 0.005 | 0.0009 | 216 |
| 2005 | 220 | 0.005 | 0.0009 | 220 |
| 2006 | 224 | 0.005 | 0.0009 | 225 |
| 2007 | 254 | 0.006 | 0.0009 | 255 |
| *Trend 1990-2007* | *92.7%* | *107.0%* | *2.5%* | *92.5%* |

$CO_2$ emissions arise from combustion of natural gas and residual fuel oil.

*Table A 19: Share of fuel types in total CO2 emissions from Category 1.A.2.b*

| | Liquid | Solid | Gaseous |
|---|---|---|---|
| 1990 | 27% | 17% | 57% |
| 1991 | 29% | 15% | 56% |
| 1992 | 25% | 6% | 69% |
| 1993 | 21% | 12% | 67% |
| 1994 | 15% | 6% | 79% |
| 1995 | 16% | 4% | 80% |
| 1996 | 28% | 9% | 63% |
| 1997 | 32% | 9% | 59% |
| 1998 | 30% | 8% | 62% |
| 1999 | 25% | 12% | 62% |
| 2000 | 24% | 10% | 66% |
| 2001 | 23% | 5% | 72% |
| 2002 | 21% | 8% | 71% |
| 2003 | 19% | 7% | 74% |
| 2004 | 17% | 8% | 75% |
| 2005 | 15% | 6% | 79% |
| 2006 | 14% | 6% | 80% |
| 2007 | 12% | 6% | 83% |

## 1.A.2.c Chemicals

*Table A 20: Greenhouse gas emissions from Category 1.A.2.c.*

| | $CO_2$ [Gg] | $CH_4$ [Gg] | $N_2O$ [Gg] | $CO_2$ equiv. [Gg] |
|---|---|---|---|---|
| 1990 | 883 | 0.045 | 0.017 | 889 |
| 1991 | 905 | 0.051 | 0.018 | 912 |
| 1992 | 986 | 0.059 | 0.021 | 994 |
| 1993 | 1 034 | 0.049 | 0.015 | 1 040 |
| 1994 | 984 | 0.048 | 0.014 | 989 |
| 1995 | 1 033 | 0.053 | 0.014 | 1 039 |
| 1996 | 1 125 | 0.062 | 0.019 | 1 132 |
| 1997 | 1 200 | 0.060 | 0.020 | 1 207 |
| 1998 | 1 117 | 0.053 | 0.017 | 1 123 |
| 1999 | 1 353 | 0.065 | 0.028 | 1 363 |
| 2000 | 1 380 | 0.071 | 0.024 | 1 389 |
| 2001 | 1 440 | 0.073 | 0.017 | 1 447 |
| 2002 | 1 457 | 0.079 | 0.016 | 1 463 |
| 2003 | 1 505 | 0.086 | 0.017 | 1 512 |
| 2004 | 1 459 | 0.103 | 0.019 | 1 467 |
| 2005 | 1 583 | 0.096 | 0.019 | 1 591 |
| 2006 | 1 696 | 0.129 | 0.022 | 1 705 |
| 2007 | 1 528 | 0.141 | 0.023 | 1 538 |
| *Trend 1990-2007* | *73.2%* | *214.2%* | *37.0%* | *73.1%* |

In 2007 natural gas was still the main source of $CO_2$ emissions from category *1.A.2.c*. $CO_2$ emissions from solid and liquid fossil fuel combustion got less important while $CO_2$ emissions from industrial waste (reported as "other fuels") strongly increased since 2000. See Table A 21.

*Table A 21: Share of fuel types in total $CO_2$ emissions from Category 1.A.2.c*

| | Liquid | Solid | Gaseous | Other |
|---|---|---|---|---|
| 1990 | 9% | 12% | 59% | 20% |
| 1991 | 10% | 15% | 51% | 24% |
| 1992 | 6% | 19% | 50% | 26% |
| 1993 | 7% | 18% | 58% | 16% |
| 1994 | 9% | 15% | 56% | 19% |
| 1995 | 9% | 15% | 55% | 22% |
| 1996 | 8% | 17% | 51% | 24% |
| 1997 | 11% | 21% | 50% | 18% |
| 1998 | 10% | 22% | 52% | 16% |
| 1999 | 5% | 23% | 60% | 12% |
| 2000 | 4% | 18% | 62% | 17% |
| 2001 | 5% | 17% | 60% | 19% |
| 2002 | 4% | 16% | 58% | 22% |
| 2003 | 4% | 16% | 56% | 24% |
| 2004 | 3% | 14% | 52% | 32% |
| 2005 | 3% | 9% | 58% | 29% |
| 2006 | 3% | 7% | 58% | 32% |

## 1.A.2.d Pulp, Paper and Print

*Table A 22: Greenhouse gas emissions from Category 1.A.2.d.*

| | $CO_2$ [Gg] | $CH_4$ [Gg] | $N_2O$ [Gg] | $CO_2$ equiv.[Gg] |
|---|---|---|---|---|
| 1990 | 2 213 | 0.12 | 0.06 | 2 234 |
| 1991 | 2 676 | 0.13 | 0.06 | 2 698 |
| 1992 | 2 167 | 0.12 | 0.06 | 2 188 |
| 1993 | 2 024 | 0.12 | 0.08 | 2 050 |
| 1994 | 2 555 | 0.14 | 0.08 | 2 582 |
| 1995 | 2 315 | 0.14 | 0.08 | 2 342 |
| 1996 | 2 417 | 0.14 | 0.07 | 2 440 |
| 1997 | 2 821 | 0.15 | 0.08 | 2 849 |
| 1998 | 2 635 | 0.14 | 0.07 | 2 658 |
| 1999 | 2 194 | 0.13 | 0.08 | 2 220 |
| 2000 | 2 349 | 0.13 | 0.06 | 2 371 |
| 2001 | 2 113 | 0.13 | 0.07 | 2 136 |
| 2002 | 2 204 | 0.13 | 0.07 | 2 228 |
| 2003 | 2 365 | 0.13 | 0.07 | 2 388 |
| 2004 | 2 223 | 0.13 | 0.07 | 2 247 |
| 2005 | 2 286 | 0.14 | 0.07 | 2 311 |
| 2006 | 2 189 | 0.14 | 0.08 | 2 216 |
| 2007 | 2 191 | 0.14 | 0.07 | 2 217 |
| *Trend 1990-2007* | *-1.0%* | *18.4%* | *26.0%* | *-0.7%* |

Natural gas combustion is the main source of $CO_2$ emissions from category 1.A.2.d. Liquid fuel consumption decreased since 1990 whereas the share of solid fuels in total $CO_2$ emissions is quite constant.

*Table A 23: Share of fuel types in total $CO_2$ emissions from Category 1.A.2.d.*

| | Liquid | Solid | Gaseous | Other |
|---|---|---|---|---|
| 1990 | 39% | 18% | 43% | 1% |
| 1991 | 41% | 20% | 38% | 1% |
| 1992 | 31% | 21% | 47% | 1% |
| 1993 | 34% | 21% | 44% | 1% |
| 1994 | 26% | 14% | 59% | 1% |
| 1995 | 23% | 16% | 59% | 2% |
| 1996 | 17% | 15% | 65% | 3% |
| 1997 | 18% | 16% | 66% | 0% |
| 1998 | 17% | 17% | 66% | 0% |
| 1999 | 10% | 15% | 75% | 1% |
| 2000 | 7% | 18% | 75% | NO |
| 2001 | 8% | 16% | 76% | 1% |
| 2002 | 7% | 19% | 74% | 1% |
| 2003 | 7% | 16% | 77% | 1% |
| 2004 | 6% | 18% | 75% | 1% |
| 2005 | 6% | 19% | 74% | 1% |
| 2006 | 6% | 19% | 74% | 1% |
| 2007 | 6% | 21% | 73% | 0% |

## 1.A.2.e Food Processing, Beverages and Tobacco

*Table A 24: Greenhouse gas emissions from Category 1 A 2 e.*

| | $CO_2$ [Gg] | $CH_4$ [Gg] | $N_2O$ [Gg] | $CO_2$ equiv. [Gg] |
|---|---|---|---|---|
| 1990 | 870 | 0.018 | 0.005 | 872 |
| 1991 | 933 | 0.020 | 0.006 | 935 |
| 1992 | 854 | 0.018 | 0.005 | 856 |
| 1993 | 886 | 0.016 | 0.005 | 888 |
| 1994 | 916 | 0.019 | 0.005 | 918 |
| 1995 | 931 | 0.019 | 0.005 | 933 |
| 1996 | 888 | 0.019 | 0.004 | 889 |
| 1997 | 1 042 | 0.022 | 0.004 | 1 043 |
| 1998 | 943 | 0.021 | 0.004 | 944 |
| 1999 | 828 | 0.020 | 0.004 | 830 |
| 2000 | 888 | 0.022 | 0.004 | 890 |
| 2001 | 880 | 0.021 | 0.004 | 882 |
| 2002 | 1 097 | 0.028 | 0.005 | 1 099 |
| 2003 | 896 | 0.022 | 0.004 | 897 |
| 2004 | 823 | 0.019 | 0.003 | 825 |
| 2005 | 904 | 0.022 | 0.005 | 906 |
| 2006 | 941 | 0.022 | 0.006 | 943 |
| 2007 | 899 | 0.022 | 0.005 | 901 |
| *Trend 1990-2007* | *3.4%* | *21.2%* | *3.2%* | *3.4%* |

The share of natural gas consumption is increasing and is the main source of $CO_2$ emissions from category *1.A.2.e*. The share of liquid fossil fuel combustion in total $CO_2$ emissions decreased since 1990.

*Table A 25: Share of fuel types in total $CO_2$ emissions from Category 1 A 2 e.*

| | Liquid | Solid | Gaseous | Other |
|---|---|---|---|---|
| 1990 | 40% | 2% | 58% | NO |
| 1991 | 42% | 2% | 55% | NO |
| 1992 | 40% | 1% | 59% | NO |
| 1993 | 44% | 2% | 54% | NO |
| 1994 | 38% | 2% | 59% | NO |
| 1995 | 37% | 1% | 63% | NO |
| 1996 | 29% | 1% | 70% | 0.1% |
| 1997 | 30% | 1% | 69% | 0.1% |
| 1998 | 26% | 1% | 72% | 0.1% |
| 1999 | 20% | 1% | 79% | NO |
| 2000 | 19% | 3% | 79% | NO |
| 2001 | 22% | 1% | 77% | NO |
| 2002 | 16% | 1% | 82% | NO |
| 2003 | 19% | 4% | 77% | NO |
| 2004 | 20% | 2% | 79% | NO |
| 2005 | 21% | 1% | 77% | NO |
| 2006 | 26% | 1% | 73% | NO |
| 2007 | 23% | 1% | 75% | NO |

## 1.A.2.f Manufacturing Industries and Construction – Other

*Table A 26: Greenhouse gas emissions from Category 1.A.2.f.*

| | $CO_2$ [Gg] | $CH_4$ [Gg] | $N_2O$ [Gg] | $CO_2$ equiv. [Gg] |
|---|---|---|---|---|
| 1990 | 3 645 | 0.127 | 0.132 | 3 689 |
| 1991 | 3 829 | 0.140 | 0.146 | 3 877 |
| 1992 | 3 718 | 0.146 | 0.150 | 3 767 |
| 1993 | 3 956 | 0.143 | 0.157 | 4 008 |
| 1994 | 4 080 | 0.146 | 0.162 | 4 133 |
| 1995 | 4 180 | 0.150 | 0.169 | 4 236 |
| 1996 | 4 431 | 0.162 | 0.214 | 4 500 |
| 1997 | 4 661 | 0.163 | 0.201 | 4 726 |
| 1998 | 4 372 | 0.171 | 0.238 | 4 450 |
| 1999 | 3 661 | 0.160 | 0.254 | 3 743 |
| 2000 | 3 714 | 0.171 | 0.289 | 3 807 |
| 2001 | 3 717 | 0.185 | 0.282 | 3 808 |
| 2002 | 3 609 | 0.181 | 0.276 | 3 698 |
| 2003 | 3 821 | 0.183 | 0.280 | 3 912 |
| 2004 | 3 991 | 0.191 | 0.271 | 4 079 |
| 2005 | 4 242 | 0.207 | 0.280 | 4 333 |
| 2006 | 4 567 | 0.247 | 0.294 | 4 663 |
| 2007 | 4 570 | 0.258 | 0.293 | 4 667 |
| *Trend 1990-2007* | *25.4%* | *102.1%* | *121.8%* | *26.5%* |

Natural gas and liquid fossil fuel combustion is the main source of $CO_2$ emissions from category *1 A 2 f*. The share of fossil fuel types on total $CO_2$ emissions is quite constant over the years.

*Table A 27: Share of fuel types in total $CO_2$ emissions from category 1 A 2 f.*

| | Liquid | Solid | Gaseous | Other |
|---|---|---|---|---|
| 1990 | 38% | 17% | 43% | 2% |
| 1991 | 39% | 15% | 43% | 4% |
| 1992 | 35% | 17% | 44% | 5% |
| 1993 | 43% | 14% | 41% | 3% |
| 1994 | 39% | 10% | 46% | 5% |
| 1995 | 36% | 11% | 49% | 5% |
| 1996 | 38% | 12% | 45% | 4% |
| 1997 | 45% | 13% | 36% | 6% |
| 1998 | 44% | 13% | 37% | 5% |
| 1999 | 39% | 13% | 41% | 7% |
| 2000 | 37% | 14% | 42% | 7% |
| 2001 | 35% | 12% | 44% | 9% |
| 2002 | 34% | 9% | 47% | 10% |
| 2003 | 38% | 7% | 44% | 11% |
| 2004 | 39% | 7% | 42% | 12% |
| 2005 | 37% | 10% | 45% | 9% |
| 2006 | 36% | 12% | 43% | 9% |
| 2007 | 34% | 15% | 42% | 9% |

## 1.A.2.f Manufacturing Industries and Construction - Other - stationary sources

*Table A 28: Greenhouse gas emissions from Category 1.A.2.f stationary sources.*

| | $CO_2$ [Gg] | $CH_4$ [Gg] | $N_2O$ [Gg] | $CO_2$ equiv. [Gg] |
|---|---|---|---|---|
| 1990 | 3 388 | 0.11 | 0.04 | 3 403 |
| 1991 | 3 538 | 0.13 | 0.04 | 3 554 |
| 1992 | 3 410 | 0.13 | 0.04 | 3 425 |
| 1993 | 3 632 | 0.13 | 0.04 | 3 648 |
| 1994 | 3 742 | 0.13 | 0.04 | 3 757 |
| 1995 | 3 822 | 0.13 | 0.04 | 3 836 |
| 1996 | 3 986 | 0.14 | 0.04 | 4 002 |
| 1997 | 4 239 | 0.14 | 0.04 | 4 254 |
| 1998 | 3 883 | 0.15 | 0.04 | 3 899 |
| 1999 | 3 184 | 0.14 | 0.06 | 3 207 |
| 2000 | 3 148 | 0.15 | 0.06 | 3 169 |
| 2001 | 3 170 | 0.16 | 0.06 | 3 192 |
| 2002 | 3 059 | 0.16 | 0.06 | 3 081 |
| 2003 | 3 212 | 0.16 | 0.06 | 3 235 |
| 2004 | 3 336 | 0.17 | 0.06 | 3 360 |
| 2005 | 3 623 | 0.19 | 0.07 | 3 649 |
| 2006 | 3 874 | 0.23 | 0.11 | 3 913 |
| 2007 | 3 855 | 0.24 | 0.12 | 3 897 |
| *Trend 1990-2007* | *13.8%* | *108.7%* | *187.8%* | *14.5%* |

Natural gas and liquid fossil fuel combustion is the main stationary source of $CO_2$ emissions from category *1 A 2 f*. Solid and liquid fuels got less important but $CO_2$ emissions from combustion of natural gas and industrial waste are increasing.

*Table A 29: Share of fuel types on total $CO_2$ emissions from Category 1.A.2.f stationary sources.*

| | Liquid | Solid | Gaseous | Other |
|---|---|---|---|---|
| 1990 | 33% | 18% | 46% | 2% |
| 1991 | 34% | 16% | 46% | 4% |
| 1992 | 29% | 18% | 48% | 5% |
| 1993 | 37% | 15% | 45% | 3% |
| 1994 | 34% | 11% | 50% | 6% |
| 1995 | 30% | 12% | 53% | 5% |
| 1996 | 31% | 14% | 50% | 5% |
| 1997 | 39% | 14% | 39% | 7% |
| 1998 | 37% | 15% | 42% | 6% |
| 1999 | 30% | 15% | 47% | 8% |
| 2000 | 26% | 16% | 50% | 8% |
| 2001 | 24% | 14% | 52% | 10% |
| 2002 | 22% | 11% | 55% | 12% |
| 2003 | 26% | 8% | 52% | 13% |
| 2004 | 27% | 8% | 51% | 14% |
| 2005 | 26% | 11% | 53% | 10% |
| 2006 | 25% | 15% | 50% | 10% |
| 2007 | 22% | 17% | 49% | 11% |

## 1.A.2.f Manufacturing Industries and Construction - Cement Clinker Production (NACE 26.51)

*Table A 30: Greenhouse gas emissions from Category 1.A.2.f - cement clinker production.*

| | $CO_2$ [Gg] | $CH_4$ [Gg] | $N_2O$ [Gg] | $CO_2$ equiv. [Gg] |
|---|---|---|---|---|
| 1990 | 1 055 | 0.06 | 0.02 | 1 061 |
| 1991 | 1 038 | 0.06 | 0.02 | 1 044 |
| 1992 | 1 107 | 0.06 | 0.02 | 1 114 |
| 1993 | 1 038 | 0.06 | 0.02 | 1 045 |
| 1994 | 1 089 | 0.06 | 0.02 | 1 095 |
| 1995 | 867 | 0.05 | 0.01 | 872 |
| 1996 | 848 | 0.06 | 0.01 | 853 |
| 1997 | 932 | 0.06 | 0.01 | 938 |
| 1998 | 853 | 0.07 | 0.02 | 859 |
| 1999 | 826 | 0.06 | 0.01 | 832 |
| 2000 | 866 | 0.07 | 0.02 | 872 |
| 2001 | 807 | 0.08 | 0.02 | 813 |
| 2002 | 830 | 0.08 | 0.02 | 837 |
| 2003 | 821 | 0.08 | 0.02 | 828 |
| 2004 | 920 | 0.09 | 0.02 | 928 |
| 2005 | 884 | 0.09 | 0.02 | 892 |
| 2006 | 1 012 | 0.11 | 0.02 | 1 021 |
| 2007 | 1 110 | 0.11 | 0.02 | 1 119 |
| *Trend 1990-2007* | *5.2%* | *103.0%* | *32.9%* | *5.5%* |

## *1 A 2 f Manufacturing Industries and Construction – Other – mobile sources*

*Table A 31: Greenhouse gas emissions from Category 1 A 2 f mobile sources.*

| | $CO_2$ [Gg] | $CH_4$ [Gg] | $N_2O$ [Gg] | $CO_2$ equiv. [Gg] |
|---|---|---|---|---|
| 1990 | 257 | 0.01 | 0.09 | 286 |
| 1991 | 291 | 0.02 | 0.10 | 323 |
| 1992 | 308 | 0.02 | 0.11 | 342 |
| 1993 | 324 | 0.02 | 0.11 | 360 |
| 1994 | 338 | 0.02 | 0.12 | 376 |
| 1995 | 358 | 0.02 | 0.13 | 399 |
| 1996 | 445 | 0.02 | 0.17 | 499 |
| 1997 | 421 | 0.02 | 0.16 | 472 |
| 1998 | 490 | 0.02 | 0.19 | 550 |
| 1999 | 477 | 0.02 | 0.19 | 536 |
| 2000 | 566 | 0.02 | 0.23 | 638 |
| 2001 | 547 | 0.02 | 0.22 | 616 |
| 2002 | 550 | 0.02 | 0.22 | 617 |
| 2003 | 609 | 0.02 | 0.22 | 677 |
| 2004 | 654 | 0.02 | 0.21 | 719 |
| 2005 | 619 | 0.02 | 0.21 | 683 |
| 2006 | 693 | 0.02 | 0.18 | 750 |
| 2007 | 715 | 0.02 | 0.17 | 769 |
| *Trend 1990-2007* | *178.0%* | *47.1%* | *91.5%* | *169.4%* |

All emissions from mobile machinery of industry arise from liquid fuels.

## 1.A.3.e Other Transportation – Pipeline Compressors

*Table A 32: Greenhouse gas emissions from Category 1.A.3.e.*

| | $CO_2$ [Gg] | $CH_4$ [Gg] | $N_2O$ [Gg] | $CO_2$ equiv. [Gg] |
|---|---|---|---|---|
| 1990 | 224 | 0.006 | 0.0004 | 225 |
| 1991 | 225 | 0.006 | 0.0004 | 226 |
| 1992 | 220 | 0.006 | 0.0004 | 220 |
| 1993 | 214 | 0.006 | 0.0004 | 214 |
| 1994 | 209 | 0.006 | 0.0004 | 210 |
| 1995 | 227 | 0.006 | 0.0004 | 227 |
| 1996 | 234 | 0.006 | 0.0004 | 234 |
| 1997 | 233 | 0.006 | 0.0004 | 233 |
| 1998 | 351 | 0.010 | 0.0006 | 352 |
| 1999 | 434 | 0.012 | 0.0008 | 435 |
| 2000 | 538 | 0.015 | 0.0010 | 538 |
| 2001 | 456 | 0.012 | 0.0008 | 457 |
| 2002 | 275 | 0.007 | 0.0005 | 275 |
| 2003 | 367 | 0.010 | 0.0007 | 368 |
| 2004 | 441 | 0.012 | 0.0008 | 442 |
| 2005 | 545 | 0.015 | 0.0010 | 546 |
| 2006 | 452 | 0.012 | 0.0008 | 452 |
| 2007 | 449 | 0.012 | 0.0008 | 450 |
| *Trend 1990-2007* | *100.1%* | *100.1%* | *100.1%* | *100.1%* |

Combustion of natural gas is the only source of $CO_2$ emissions from category *1.A.3.e*.

## 1.A.4 Other sectors

*Table A 33: Greenhouse gas emissions from Category 1.A.4.*

| | $CO_2$ [Gg] | $CH_4$ [Gg] | $N_2O$ [Gg] | $CO_2$ equiv. [Gg] |
|---|---|---|---|---|
| 1990 | 13 811 | 18.40 | 0.76 | 14 432 |
| 1991 | 14 911 | 19.90 | 0.81 | 15 579 |
| 1992 | 14 468 | 18.12 | 0.79 | 15 092 |
| 1993 | 14 288 | 17.78 | 0.79 | 14 906 |
| 1994 | 13 008 | 16.10 | 0.75 | 13 579 |
| 1995 | 14 144 | 16.76 | 0.78 | 14 737 |
| 1996 | 15 303 | 17.76 | 0.83 | 15 934 |
| 1997 | 13 807 | 13.45 | 0.81 | 14 340 |
| 1998 | 13 762 | 12.93 | 0.79 | 14 280 |
| 1999 | 14 293 | 13.31 | 0.82 | 14 825 |
| 2000 | 12 887 | 12.54 | 0.78 | 13 391 |
| 2001 | 14 229 | 14.20 | 0.86 | 14 795 |
| 2002 | 13 629 | 14.16 | 0.86 | 14 193 |
| 2003 | 15 046 | 15.37 | 0.91 | 15 650 |
| 2004 | 13 841 | 14.75 | 0.89 | 14 427 |
| 2005 | 13 056 | 14.80 | 0.90 | 13 646 |
| 2006 | 12 782 | 14.36 | 0.88 | 13 356 |
| 2007 | 10 580 | 12.81 | 0.80 | 11 096 |
| *Trend 1990-2007* | *-23.4%* | *-30.4%* | *5.4%* | *-23.1%* |

As can be seen from Table A 34, liquid fossil fuels are the main source of $CO_2$ emissions from category *1.A.4* with a quite constant share over the time series. Since 1990 solid fossil fuels became less important whereas the share of $CO_2$ emissions from natural gas combustion almost doubled.

*Table A 34: Share of fuel types on total $CO_2$ emissions from Category 1.A.4.*

| | Liquid | Solid | Gaseous | Other |
|---|---|---|---|---|
| 1990 | 60% | 19% | 19% | 3% |
| 1991 | 58% | 20% | 21% | 2% |
| 1992 | 56% | 17% | 24% | 2% |
| 1993 | 56% | 15% | 28% | 1% |
| 1994 | 57% | 14% | 27% | 2% |
| 1995 | 57% | 12% | 29% | 1% |
| 1996 | 60% | 11% | 27% | 2% |
| 1997 | 61% | 9% | 28% | 2% |
| 1998 | 61% | 8% | 30% | 1% |
| 1999 | 62% | 7% | 30% | 1% |
| 2000 | 60% | 7% | 31% | 1% |
| 2001 | 59% | 7% | 34% | 0% |
| 2002 | 61% | 6% | 33% | 0% |
| 2003 | 60% | 5% | 34% | 0% |
| 2004 | 59% | 4% | 36% | 1% |
| 2005 | 58% | 5% | 37% | 1% |
| 2006 | 60% | 4% | 35% | 1% |
| 2007 | 55% | 5% | 39% | 1% |

## 1.A.4 Other sectors – stationary sources

The following table presents greenhouse gas emissions from *1.A.4 Other sectors –stationary sources* and heating degree days.

*Table A 35: Greenhouse gas emissions from Category 1.A.4 stationary sources.*

| | $CO_2$ [Gg] | $CH_4$ [Gg] | $N_2O$ [Gg] | $CO_2$ equiv. [Gg] | Heating degree days[(1)] |
|---|---|---|---|---|---|
| 1990 | 12 897 | 18.26 | 0.48 | 13 428 | 3 237 |
| 1991 | 13 998 | 19.77 | 0.53 | 14 578 | 3 612 |
| 1992 | 13 548 | 17.98 | 0.50 | 14 082 | 3 356 |
| 1993 | 13 363 | 17.65 | 0.51 | 13 890 | 3 414 |
| 1994 | 12 078 | 15.97 | 0.46 | 12 556 | 3 138 |
| 1995 | 13 246 | 16.63 | 0.50 | 13 750 | 3 415 |
| 1996 | 14 377 | 17.63 | 0.54 | 14 914 | 3 820 |
| 1997 | 12 844 | 13.32 | 0.49 | 13 277 | 3 485 |
| 1998 | 12 816 | 12.81 | 0.48 | 13 234 | 3 309 |
| 1999 | 13 339 | 13.19 | 0.50 | 13 770 | 3 253 |
| 2000 | 11 958 | 12.42 | 0.46 | 12 362 | 2 958 |
| 2001 | 13 275 | 14.08 | 0.54 | 13 737 | 3 294 |
| 2002 | 13 275 | 14.08 | 0.54 | 13 737 | 3 191 |
| 2003 | 14 128 | 15.26 | 0.60 | 14 636 | 3 463 |
| 2004 | 12 900 | 14.64 | 0.59 | 13 390 | 3 322 |
| 2005 | 12 076 | 14.69 | 0.59 | 12 568 | 3 527 |
| 2006 | 11 826 | 14.26 | 0.58 | 12 306 | 3 315 |
| 2007 | 9 652 | 12.71 | 0.52 | 10 080 | 3 025 |
| *Trend 1990-2007* | *-25.2%* | *-30.4%* | *8.2%* | *-24.9%* | *-6.5%* |

[(1)] *Source: STATISTIK AUSTRIA*

As can be seen in Table A 36, liquid fossil fuels are the main stationary source of $CO_2$ emissions from category 1.A.4 with a quite constant share over time. Since 1990 solid fossil fuels became less important whereas the share of $CO_2$ emissions from natural gas combustion almost doubled.

*Table A 36: Share of fuel types in total $CO_2$ emissions from Category 1.A.4 stationary sources.*

| | Liquid | Solid | Gaseous | Other |
|---|---|---|---|---|
| 1990 | 57% | 21% | 20% | 2.7% |
| 1991 | 55% | 21% | 22% | 2.0% |
| 1992 | 53% | 19% | 26% | 2.5% |
| 1993 | 53% | 16% | 30% | 1.4% |
| 1994 | 54% | 15% | 29% | 1.7% |
| 1995 | 54% | 13% | 31% | 1.4% |
| 1996 | 58% | 12% | 28% | 2.1% |
| 1997 | 58% | 10% | 30% | 2.1% |
| 1998 | 58% | 9% | 32% | 1.3% |
| 1999 | 59% | 8% | 32% | 1.1% |
| 2000 | 57% | 8% | 34% | 1.2% |
| 2001 | 56% | 7% | 36% | 0.5% |
| 2002 | 55% | 6% | 34% | 0.5% |
| 2003 | 58% | 5% | 36% | 0.5% |
| 2004 | 56% | 5% | 39% | 0.5% |
| 2005 | 55% | 5% | 40% | 0.6% |
| 2006 | 57% | 5% | 38% | 0.6% |
| 2007 | 50% | 5% | 43% | 1.6% |

## Activity Data Recalculations

Recalculations of activity data are due to the revised energy balance (IEA JQ 2008).

*Table A 37: Activity data recalculations by sub categories with respect to previous submission [PJ absolut values].*

| | Fuel Consumption [PJ] | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 1990 | | | 2005 | | | 2006 | | |
| **IPCC Category/ Fuel Group** | **Subm. 2008** | **Subm. 2009** | **Differ-ence** | **Subm. 2008** | **Subm. 2009** | **Differ-ence** | **Subm. 2008** | **Subm. 2009** | **Differ-ence** |
| **1 A FUEL COMBUSTION ACTIVITIES** | **824.43** | **824.76** | **0.34** | **1 145.86** | **1 153.44** | **7.58** | **1 132.91** | **1 148.55** | **15.64** |
| 1 A liquid | 377.04 | 377.04 | 0.00 | 526.01 | 518.80 | -7.20 | 526.29 | 521.62 | -4.67 |
| 1 A solid | 139.85 | 139.89 | 0.04 | 122.40 | 123.40 | 0.99 | 122.52 | 121.60 | -0.91 |
| 1 A gaseous | 203.98 | 203.98 | - | 334.17 | 334.17 | 0.00 | 303.20 | 303.20 | 0.00 |
| 1 A biomass | 94.56 | 94.86 | 0.30 | 142.98 | 156.66 | 13.68 | 155.42 | 173.51 | 18.09 |
| 1 A other | 8.99 | 8.99 | - | 20.29 | 20.40 | 0.11 | 25.48 | 28.61 | 3.13 |
| **1 A 1 Energy Industries** | **188.78** | **188.78** | **-** | **253.92** | **253.91** | **-0.01** | **255.35** | **247.85** | **-7.49** |
| 1 A 1 liquid | 46.45 | 46.45 | - | 45.08 | 45.07 | -0.01 | 49.46 | 49.55 | 0.09 |
| 1 A 1 solid | 61.40 | 61.40 | - | 61.63 | 61.63 | - | 60.20 | 60.20 | - |
| 1 A 1 gaseous | 76.48 | 76.48 | - | 117.74 | 117.74 | 0.00 | 104.05 | 96.58 | -7.47 |
| 1 A 1 biomass | 2.04 | 2.04 | - | 20.97 | 20.97 | 0.00 | 29.08 | 28.97 | -0.11 |
| 1 A 1 other | 2.41 | 2.41 | - | 8.51 | 8.51 | 0.00 | 12.55 | 12.55 | - |
| **1 A 1 a Public Electricity and Heat Production** | **140.95** | **140.95** | **-** | **200.93** | **200.92** | **-0.01** | **198.67** | **198.54** | **-0.13** |
| 1 A 1 a liquid | 15.63 | 15.63 | - | 13.81 | 13.80 | -0.01 | 14.87 | 14.86 | -0.02 |
| 1 A 1 a solid | 61.40 | 61.40 | - | 61.63 | 61.63 | - | 60.20 | 60.20 | - |
| 1 A 1 a gaseous | 59.46 | 59.46 | - | 96.02 | 96.02 | 0.00 | 81.96 | 81.96 | 0.00 |
| 1 A 1 a biomass | 2.04 | 2.04 | - | 20.97 | 20.97 | 0.00 | 29.08 | 28.97 | -0.11 |
| 1 A 1 a other | 2.41 | 2.41 | - | 8.51 | 8.51 | 0.00 | 12.55 | 12.55 | - |
| **1 A 1 b Petroleum refining** | **38.63** | **38.63** | **-** | **43.51** | **43.51** | **0.00** | **46.80** | **37.27** | **-9.53** |
| 1 A 1 b liquid | 30.75 | 30.75 | - | 31.27 | 31.27 | 0.00 | 34.59 | 34.70 | 0.11 |
| 1 A 1 b solid | NO | NO | - | NO | NO | - | NO | NO | - |
| 1 A 1 b gaseous | 7.88 | 7.88 | - | 12.24 | 12.24 | - | 12.21 | 2.57 | -9.64 |
| 1 A 1 b biomass | NO | NO | - | NO | NO | - | NO | NO | - |
| 1 A 1 b other | NO | NO | - | NO | NO | - | NO | NO | - |
| **1 A 1 c Manufacture of Solid fuels and Other Energy Industries** | **9.20** | **9.20** | **-** | **9.48** | **9.48** | **0.00** | **9.88** | **12.05** | **2.17** |
| 1 A 1 c liquid | 0.06 | 0.06 | - | NO | NO | - | NO | NO | - |
| 1 A 1 c solid | NO | NO | - | NO | NO | - | NO | NO | - |
| 1 A 1 c gaseous | 9.13 | 9.13 | - | 9.48 | 9.48 | 0.00 | 9.88 | 12.05 | 2.17 |
| 1 A 1 c biomass | NO | NO | - | NO | NO | - | NO | NO | - |
| 1 A 1 c other | NO | NO | - | NO | NO | - | NO | NO | - |

| | Fuel Consumption [PJ] | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 1990 | | | 2005 | | | 2006 | | |
| IPCC Category/ Fuel Group | Subm. 2008 | Subm. 2009 | Differ-ence | Subm. 2008 | Subm. 2009 | Differ-ence | Subm. 2008 | Subm. 2009 | Differ-ence |
| **1 A 2 Manufac-turing Indus-tries and Con-struction** | **209.52** | **199.50** | **-10.03** | **267.33** | **268.60** | **1.27** | **272.49** | **282.54** | **10.05** |
| 1 A 2 liquid | 50.95 | 40.70 | -10.25 | 40.91 | 36.00 | -4.91 | 40.24 | 38.15 | -2.09 |
| 1 A 2 solid | 50.25 | 50.28 | 0.04 | 54.62 | 55.23 | 0.61 | 56.31 | 55.64 | -0.67 |
| 1 A 2 gaseous | 76.99 | 76.99 | - | 116.89 | 120.30 | 3.42 | 113.53 | 117.86 | 4.33 |
| 1 A 2 biomass | 28.11 | 28.30 | 0.19 | 43.81 | 45.86 | 2.05 | 50.22 | 55.57 | 5.36 |
| 1 A 2 other | 3.22 | 3.22 | - | 11.10 | 11.21 | 0.11 | 12.20 | 15.33 | 3.13 |
| **1 A 2 a Iron and Steel** | **55.59** | **55.63** | **0.04** | **75.41** | **75.46** | **0.05** | **74.90** | **74.09** | **-0.81** |
| 1 A 2 a liquid | 5.79 | 5.79 | - | 10.17 | 10.17 | 0.00 | 9.85 | 9.85 | 0.00 |
| 1 A 2 a solid | 38.07 | 38.11 | 0.04 | 44.15 | 44.15 | 0.00 | 44.01 | 43.15 | -0.87 |
| 1 A 2 a gaseous | 11.73 | 11.73 | - | 21.09 | 21.14 | 0.05 | 21.04 | 21.10 | 0.06 |
| 1 A 2 a biomass | NO | NO | - | NO | NO | - | NO | NO | - |
| 1 A 2 a other | NO | NO | - | NO | NO | - | NO | NO | - |
| **1 A 2 b Non-ferrous Metals** | **2.08** | **2.08** | **-** | **3.70** | **3.72** | **0.02** | **3.85** | **3.80** | **-0.05** |
| 1 A 2 b liquid | 0.51 | 0.51 | - | 0.44 | 0.45 | 0.01 | 0.47 | 0.45 | -0.02 |
| 1 A 2 b solid | 0.21 | 0.21 | - | 0.13 | 0.13 | - | 0.12 | 0.12 | - |
| 1 A 2 b gaseous | 1.35 | 1.35 | - | 3.13 | 3.14 | 0.01 | 3.27 | 3.23 | -0.03 |
| 1 A 2 b biomass | NO | NO | - | NO | NO | - | NO | NO | - |
| 1 A 2 b other | NO | NO | - | NO | NO | - | NO | NO | - |
| **1 A 2 c Chemi-cals** | **16.09** | **16.09** | **-** | **25.75** | **27.56** | **1.80** | **23.52** | **29.04** | **5.52** |
| 1 A 2 c liquid | 1.06 | 1.06 | - | 0.65 | 0.67 | 0.02 | 0.59 | 0.65 | 0.07 |
| 1 A 2 c solid | 1.10 | 1.10 | - | 1.57 | 1.57 | - | 1.12 | 1.12 | - |
| 1 A 2 c gaseous | 9.36 | 9.36 | - | 16.69 | 18.36 | 1.67 | 14.97 | 17.35 | 2.39 |
| 1 A 2 c biomass | 2.90 | 2.90 | - | 2.26 | 2.26 | 0.00 | 2.24 | 2.19 | -0.06 |
| 1 A 2 c other | 1.67 | 1.67 | - | 4.57 | 4.68 | 0.11 | 4.61 | 7.73 | 3.12 |
| **1 A 2 d Pulp, Paper and Print** | **54.15** | **54.15** | **-** | **70.13** | **70.43** | **0.30** | **69.99** | **69.91** | **-0.08** |
| 1 A 2 d liquid | 10.94 | 10.94 | - | 1.76 | 1.79 | 0.03 | 1.59 | 1.65 | 0.06 |
| 1 A 2 d solid | 4.12 | 4.12 | - | 4.72 | 4.98 | 0.26 | 5.19 | 5.23 | 0.05 |
| 1 A 2 d gaseous | 17.01 | 17.01 | - | 30.58 | 30.58 | - | 28.65 | 28.65 | - |
| 1 A 2 d biomass | 21.88 | 21.88 | - | 32.89 | 32.89 | 0.01 | 34.42 | 34.21 | -0.20 |
| 1 A 2 d other | 0.19 | 0.19 | - | 0.18 | 0.18 | - | 0.15 | 0.17 | 0.01 |
| **1 A 2 e Food Processing, Beverages and Tobacco** | **13.91** | **13.91** | **-** | **14.68** | **15.73** | **1.05** | **14.77** | **16.22** | **1.45** |
| 1 A 2 e liquid | 4.45 | 4.45 | - | 1.81 | 2.54 | 0.73 | 1.90 | 3.23 | 1.33 |
| 1 A 2 e solid | 0.18 | 0.18 | - | 0.13 | 0.13 | - | 0.10 | 0.10 | - |
| 1 A 2 e gaseous | 9.15 | 9.15 | - | 12.28 | 12.59 | 0.31 | 12.40 | 12.37 | -0.02 |
| 1 A 2 e biomass | 0.13 | 0.13 | - | 0.46 | 0.47 | 0.01 | 0.37 | 0.52 | 0.14 |
| 1 A 2 e other | NO | NO | - | NO | NO | - | NO | NO | - |

| | Fuel Consumption [PJ] | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 1990 | | | 2005 | | | 2006 | | |
| IPCC Category/ Fuel Group | Subm. 2008 | Subm. 2009 | Differ-ence | Subm. 2008 | Subm. 2009 | Differ-ence | Subm. 2008 | Subm. 2009 | Differ-ence |
| **1 A 2 f Other** | **67.71** | **57.65** | **-10.06** | **77.66** | **75.70** | **-1.96** | **85.46** | **89.48** | **4.02** |
| 1 A 2 f liquid | 28.20 | 17.95 | -10.25 | 26.09 | 20.37 | -5.71 | 25.85 | 22.32 | -3.53 |
| 1 A 2 f solid | 6.56 | 6.56 | - | 3.92 | 4.26 | 0.34 | 5.76 | 5.91 | 0.15 |
| 1 A 2 f gaseous | 28.38 | 28.38 | - | 33.10 | 34.48 | 1.38 | 33.22 | 35.15 | 1.94 |
| 1 A 2 f biomass | 3.21 | 3.39 | 0.19 | 8.21 | 10.24 | 2.03 | 13.19 | 18.66 | 5.47 |
| 1 A 2 f other | 1.36 | 1.36 | - | 6.34 | 6.34 | - | 7.44 | 7.44 | - |
| **1 A 3 Transport** | **166.12** | **184.26** | **18.14** | **331.37** | **344.74** | **13.36** | **324.66** | **337.27** | **12.61** |
| 1 A 3 liquid | 162.00 | 180.14 | 18.14 | 321.51 | 334.89 | 13.38 | 316.48 | 329.11 | 12.63 |
| 1 A 3 solid | 0.07 | 0.07 | - | 0.02 | 0.01 | -0.02 | 0.02 | 0.01 | -0.02 |
| 1 A 3 gaseous | 4.05 | 4.05 | - | 9.84 | 9.84 | - | 8.16 | 8.16 | 0.00 |
| 1 A 3 biomass | NO | NO | - | NO | NO | - | NO | NO | - |
| 1 A 3 other | NO | NO | - | NO | NO | - | NO | NO | - |
| **1 A 3 a Civil Aviation** | **0.44** | **0.44** | **-** | **2.99** | **0.92** | **-2.07** | **3.12** | **0.99** | **-2.14** |
| 1 A 3 a aviation gasoline | 0.11 | 0.11 | - | 0.12 | 0.12 | - | 0.12 | 0.12 | - |
| 1 A 3 a jet kero-sene | 0.33 | 0.33 | - | 2.87 | 0.80 | -2.07 | 3.00 | 0.86 | -2.14 |
| **1 A 3 b Road Transportation** | **158.60** | **176.73** | **18.13** | **315.79** | **330.70** | **14.91** | **310.58** | **324.84** | **14.26** |
| 1 A 3 b gasoline | 104.38 | 104.53 | 0.15 | 86.14 | 86.26 | 0.12 | 84.19 | 84.30 | 0.11 |
| 1 A 3 b diesel oil | 54.22 | 72.20 | 17.98 | 229.65 | 244.44 | 14.79 | 226.39 | 240.54 | 14.15 |
| 1 A 3 b LPG | NO | NO | - | NO | NO | - | NO | NO | - |
| 1 A 3 b other liq-uid | NO | NO | - | NO | NO | - | NO | NO | - |
| 1 A 3 b gaseous | NO | NO | - | NO | NO | - | NO | NO | - |
| 1 A 3 b biomass | NO | NO | - | NO | NO | - | NO | NO | - |
| 1 A 3 b other | NO | NO | - | NO | NO | - | NO | NO | - |
| **1 A 3 c Railways** | **2.33** | **2.33** | **-** | **2.04** | **2.23** | **0.19** | **2.06** | **2.35** | **0.29** |
| 1 A 3 c solid | 2.26 | 2.26 | - | 2.02 | 2.22 | 0.20 | 2.04 | 2.34 | 0.31 |
| 1 A 3 c liquid | 0.07 | 0.07 | - | 0.02 | 0.01 | -0.02 | 0.02 | 0.01 | -0.02 |
| 1 A 3 c gaseous | NO | NO | - | NO | NO | - | NO | NO | - |
| 1 A 3 c other | NO | NO | - | NO | NO | - | NO | NO | - |
| **1 A 3 d Naviga-tion** | **0.70** | **0.71** | **0.01** | **0.71** | **1.05** | **0.34** | **0.75** | **0.94** | **0.20** |
| 1 A 3 d residual oil | NO | NO | - | NO | NO | - | NO | NO | - |
| 1 A 3 d gas/diesel oil | 0.58 | 0.58 | 0.00 | 0.60 | 0.93 | 0.33 | 0.63 | 0.82 | 0.19 |
| 1 A 3 d gasoline | 0.12 | 0.13 | 0.01 | 0.12 | 0.12 | 0.01 | 0.12 | 0.12 | 0.00 |
| 1 A 3 d other liq-uid | NO | NO | - | NO | NO | - | NO | NO | - |
| 1 A 3 d solid | NO | NO | - | NO | NO | - | NO | NO | - |
| 1 A 3 d gaseous | NO | NO | - | NO | NO | - | NO | NO | - |
| 1 A 3 d other | NO | NO | - | NO | NO | - | NO | NO | - |
| **1 A 3 e Other** | **4.05** | **4.05** | **-** | **9.84** | **9.84** | **-** | **8.16** | **8.16** | **0.00** |
| 1 A 3 e liquid | NO | NO | - | NO | NO | - | NO | NO | - |

| | Fuel Consumption [PJ] | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 1990 | | | 2005 | | | 2006 | | |
| **IPCC Category/ Fuel Group** | **Subm. 2008** | **Subm. 2009** | **Differ-ence** | **Subm. 2008** | **Subm. 2009** | **Differ-ence** | **Subm. 2008** | **Subm. 2009** | **Differ-ence** |
| 1 A 3 e solid | NO | NO | - | NO | NO | - | NO | NO | - |
| 1 A 3 e gaseous | 4.05 | 4.05 | - | 9.84 | 9.84 | - | 8.16 | 8.16 | 0.00 |
| 1 A 3 e biomass | NO | NO | - | NO | NO | - | NO | NO | - |
| 1 A 3 e other | NO | NO | - | NO | NO | - | NO | NO | - |
| **1 A 4 Other Sectors** | **259.52** | **251.74** | **-7.78** | **291.58** | **285.59** | **-5.99** | **278.68** | **280.27** | **1.59** |
| 1 A 4 liquid | 117.16 | 109.27 | -7.89 | 116.85 | 102.24 | -14.61 | 118.38 | 104.20 | -14.17 |
| 1 A 4 solid | 28.14 | 28.14 | - | 6.12 | 6.53 | 0.41 | 5.99 | 5.76 | -0.23 |
| 1 A 4 gaseous | 46.46 | 46.46 | - | 89.71 | 86.30 | -3.42 | 77.46 | 80.61 | 3.15 |
| 1 A 4 biomass | 64.40 | 64.52 | 0.11 | 78.20 | 89.84 | 11.63 | 76.12 | 88.97 | 12.84 |
| 1 A 4 other | 3.36 | 3.36 | - | 0.69 | 0.69 | - | 0.73 | 0.73 | - |
| **1 A 4 a Commecial/Institutional** | **39.35** | **39.22** | **-0.13** | **57.00** | **40.75** | **-16.25** | **56.68** | **50.11** | **-6.56** |
| 1 A 4 a liquid | 19.10 | 19.10 | - | 22.17 | 13.16 | -9.01 | 27.74 | 21.92 | -5.82 |
| 1 A 4 a solid | 0.95 | 0.95 | - | 0.53 | 0.72 | 0.19 | 0.67 | 0.68 | 0.00 |
| 1 A 4 a gaseous | 13.77 | 13.77 | - | 28.04 | 20.69 | -7.35 | 22.07 | 21.33 | -0.74 |
| 1 A 4 a biomass | 2.17 | 2.05 | -0.13 | 5.58 | 5.49 | -0.08 | 5.47 | 5.46 | -0.01 |
| 1 A 4 a other | 3.36 | 3.36 | - | 0.69 | 0.69 | - | 0.73 | 0.73 | - |
| **1 A 4 b Residential** | **191.41** | **191.66** | **0.25** | **204.78** | **221.66** | **16.87** | **192.69** | **207.16** | **14.47** |
| 1 A 4 b liquid | 74.40 | 74.43 | 0.03 | 72.93 | 75.95 | 3.02 | 68.84 | 69.27 | 0.43 |
| 1 A 4 b solid | 26.64 | 26.64 | - | 5.49 | 5.72 | 0.23 | 5.21 | 5.01 | -0.21 |
| 1 A 4 b gaseous | 32.33 | 32.33 | - | 60.98 | 64.95 | 3.97 | 54.77 | 58.68 | 3.91 |
| 1 A 4 b biomass | 58.05 | 58.27 | 0.22 | 65.39 | 75.04 | 9.65 | 63.86 | 74.21 | 10.35 |
| 1 A 4 b other | NO | NO | - | NO | NO | - | NO | NO | - |
| **1 A 4 c Agriculture/Forestry/Fisheries** | **28.76** | **20.85** | **-7.91** | **29.80** | **23.19** | **-6.61** | **29.32** | **22.99** | **-6.32** |
| 1 A 4 c liquid | 23.67 | 15.74 | -7.92 | 21.76 | 13.13 | -8.63 | 21.80 | 13.01 | -8.79 |
| 1 A 4 c solid | 0.55 | 0.55 | - | 0.11 | 0.10 | -0.01 | 0.10 | 0.08 | -0.02 |
| 1 A 4 c gaseous | 0.37 | 0.37 | - | 0.69 | 0.66 | -0.03 | 0.62 | 0.60 | -0.02 |
| 1 A 4 c biomass | 4.18 | 4.20 | 0.02 | 7.24 | 9.30 | 2.06 | 6.80 | 9.30 | 2.51 |
| 1 A 4 c other | NO | NO | - | NO | NO | - | NO | NO | - |
| **1 A 5 Other** | **0.48** | **0.48** | **0.00** | **1.65** | **0.60** | **-1.05** | **1.73** | **0.61** | **-1.12** |
| 1 A 5 liquid | 0.48 | 0.48 | 0.00 | 1.65 | 0.60 | -1.05 | 1.73 | 0.61 | -1.12 |
| 1 A 5 solid | NO | NO | - | NO | NO | - | NO | NO | - |
| 1 A 5 gaseous | NO | NO | - | NO | NO | - | NO | NO | - |
| 1 A 5 biomass | NO | NO | - | NO | NO | - | NO | NO | - |
| 1 A 5 other | NO | NO | - | NO | NO | - | NO | NO | - |
| **International Bunkers** | **12.26** | **12.26** | **-** | **23.79** | **26.92** | **3.12** | **24.88** | **28.14** | **3.26** |

*A "-" indicates that no recalculations were carried out or recalculations are lower than ± 0.001 PJ (mostly due to rounding) .*

## Methodology

For calculations of emissions from *1 A Fuel Combustion* CORINAIR methodology was applied. The fuel consumption based on the energy balance is multiplied with source specific emission factors for $CO_2$, $CH_4$ and $N_2O$. Sector specific considerations and emission factors are described in the related sub chapters of Chapter *3 Energy* of the NIR.

Activity data is taken from the national energy balance as described in the following sub chapters. Data of the national energy balance is presented in Annex 4.

## The National Energy Balance

The new time series is consistent to the *IEA/EUROSTAT Joint Questionnaire* format. The new energy balance for 2007 has been submitted to IEA and EUROSTAT in December 2008 by STATISTIK AUSTRIA.

There are five different IEA questionnaires for each of: oil; natural gas; coal; renewable fuels; electricity and heat. Table A 38 shows the unified categories of the IEA questionnaires with ISIC codes and the corresponding SNAP and IPCC categories to which the fuel consumption is assigned to.

Data of the national energy balance is presented in Annex 4.

*Table A 38: Categories of the national energy balance (JQ 2008) and their correspondence to IPCC categories.*

| IEA-Category and ISIC Codes[(2)] | Comments | SNAP | IPCC-Category |
|---|---|---|---|
| Production | | | Reference Approach: Production |
| Imports | | | Reference Approach: Import |
| Exports | | | Reference Approach: Export |
| Bunkers | No consumption [(1)] | | |
| Stock Changes | | | Reference Approach: Stock Change |
| Refinery Fuel | | 0103 | 1 A 1 b Petroleum Refining |
| **Transformation Sector, of which:** | | | |
| Public Electricity plants | In the inventory plant specific data are considered. | 0101<br>0102 | 1 A 1 a Public Electricity and Heat Production |
| Public CHP plants | | | |
| Public Heat plants | | | |
| Auto Producer Electricity plants | For autoproducers by sectors see table below. | | |
| Auto Producer CHP plants | | | |
| Auto Producer Heat plants | | | |
| Coke Ovens | Transformation from *Coking Coal* to *Coke Oven Coke* . | | |
| Blast furnaces | Coke Oven Coke. | 030326 | 1 A 2 a Iron and Steel |
| Gas Works | Transformation of *Other Oil Products* to *Gas Works Gas* . | | |
| Petrochemical Industry | No consumption [(1)] | | |
| Patent Fuel Plants | No consumption [(1)] | | |
| Not Elsewhere Specified | No consumption [(1)] | | |

| IEA-Category and ISIC Codes[2] | Comments | SNAP | IPCC-Category |
|---|---|---|---|
| **Energy Sector, of which (ISIC 10, 11, 12, 23, 40):** | | | |
| Coal Mines | No consumption [1] | | |
| Oil and Gas Extraction | | 0105 | 1 A 1 c Manufacture of Solid fuels and Other Energy Industries |
| Inputs to oil refineries | | 0103 | 1 A 1 b Petroleum Refining |
| Coke Ovens | *Coke Oven Gas* and *Blast Furnace Gas*. | 0301 | 1 A 2 a Iron and Steel |
| Blast furnaces | *Coke Oven Coke*. | 030326 | 1 A 2 a Iron and Steel |
| Gas Works | *Natural Gas*. | 0201 | 1 A 4 a Commercial/ Institutional |
| Electricity, CHP and Heat Plants | | 0101 | 1 A 1 a Public Electricity and Heat Production |
| Liquefaction Plants | No consumption [1] | | |
| Not Elsewhere Specified | No consumption [1] | | |
| Distribution Losses | Includes statistical differences and therefore it may be less than zero. | | |
| **Final Energy Consumption** | | | |
| **Total Transport, of which (ISIC 60, 61, 62):** | | | |
| Domestic Air Transport<br>Road<br>Rail<br>Inland Waterways | Division to SNAP categories is performed by means of studies. | 07<br>08<br>0201 | 1 A 2 f Manuf. Ind. and Constr. - Other<br>1 A 3 Transport<br>1 A 4 b Residential<br>1 A 4 c Agriculture/ Forestry/ Fisheries |
| Pipeline Transport | *Natural Gas*. | 010506 | 1 A 3 e Transport-Other |
| Non Specified | *Other biofuels* and *Lubricants*. | 0201 | 1 A 4 a Commercial/ Institutional |
| **Total Industry, of which:** | | | |
| Iron and Steel (ISIC 271, 2731) | | 0301<br>030301<br>030326 | 1 A 2 a Iron and Steel |
| Chemical incl.Petro-Chemical (ISIC 24) | | 0301 | 1 A 2 c Chemicals |
| Non ferrous Metals (ISIC 272, 2732) | | 0301 | 1 A 2 b Non-ferrous Metals |
| Non metallic Mineral Products (ISIC 26) | | 0301<br>030311<br>030317<br>030319 | 1 A 2 f Manuf. Ind. and Constr. - Other |
| Transportation Equipment (ISIC 34, 35) | | 0301 | 1 A 2 f Manuf. Ind. and Constr. - Other |
| Machinery (ISIC 28, 29, 30, 31, 32) | | 0301 | 1 A 2 f Manuf. Ind. and Constr. - Other |
| Mining and Quarrying (ISIC 13, 14) | | 0105 | 1 A 1 c Manufacture of Solid fuels and Other Energy Industries |
| Food, Beverages and Tobacco (ISIC 15, 16) | | 0301 | 1 A 2 e Food Processing, Beverages and Tobacco |
| Pulp, Paper and Printing (ISIC 21, 22) | | 0301 | 1 A 2 d Pulp, Paper and Print |
| Wood and Wood Products | | 0301 | 1 A 2 f Manuf. Ind. and Constr. - |

| IEA-Category and ISIC Codes[2] | Comments | SNAP | IPCC-Category |
|---|---|---|---|
| (ISIC 20) | | | Other |
| Construction<br>(ISIC 45) | | 0301 | 1 A 2 f Manuf. Ind. and Constr. - Other |
| Textiles and Leather<br>(ISIC 17, 18, 19) | | 0301 | 1 A 2 f Manuf. Ind. and Constr. - Other |
| Non Specified<br>(ISIC 25, 33, 36, 37) | | 0301 | 1 A 2 f Manuf. Ind. and Constr. - Other |
| **Total Other sectors, of which:** | | | |
| Commercial and Public Services<br>(ISIC 41, 50, 51, 52, 55, 63, 64, 65, 66, 67, 70, 71, 72, 73, 74, 75, 80, 85, 90, 91, 92, 93, 99) | | 0201 | 1 A 4 a Commercial/ Institutional |
| Residential<br>(ISIC 95) | | 0202 | 1 A 4 b Residential |
| Agriculture<br>(ISIC 01, 02, 05) | | 0203 | 1 A 4 c Agriculture/Forestry/ Fisheries |
| Non Specified | No consumption [1] | | |

*(1) Indicates that no fuel consumption is reported in the energy balance for the specific category. In some cases this may be interpreted as "included elsewhere" if the energy statistic has lack of detailed sectoral data.*

*(2) Sector names may differ to original IEA questionnaire naming convention. Note that the ISIC codes cited in this table are consistent with the NACE nomenclature.*

*Table A 39: Categories of the national energy balance (IEA-JQ, 2006) and their correspondence to IPCC categories: Autoproducers by sector.*

| | | | |
|---|---|---|---|
| **Auto Producers (Electricity + CHP + Heat), of which:** | | | |
| **Energy Sector, of which:** | | | |
| Coal Mines | No consumption [1] | | |
| Oil and Gas Extraction | | 0105 | 1 A 1 c Manufacture of Solid fuels and Other Energy Industries |
| Inputs to oil refineries | | 0103 | 1 A 1 b Petroleum Refining |
| Coke Ovens | No consumption [1] | | |
| Gas Works | No consumption [1] | | |
| Liquefaction Plants | No consumption [1] | | |
| Not Elsewhere Specified | No consumption [1] | | |
| **Industrie, of which:** | | | |
| Iron and Steel | | 030326 | 1 A 2 a Iron and Steel |
| Chemical (incl.Petro-Chemical) | | 0301 | 1 A 2 c Chemicals |
| Non ferrous Metals | | 0301 | 1 A 2 b Non-ferrous Metals |
| Non metallic Mineral Products | | 0301 | 1 A 2 f Manuf. Ind. and Constr. -Other |
| Transportation Equipment | | 0301 | 1 A 2 f Manuf. Ind. and Constr. -Other |
| Machinery | | 0301 | 1 A 2 f Manuf. Ind. and Constr. -Other |
| Mining and Quarrying | | 0301 | 1 A 1 c Manufacture of Solid fuels and Other Energy Industries |
| Food, Beverages and Tobacco | | 0301 | 1 A 2 e Food Processing, Beverages |

| | | | |
|---|---|---|---|
| | | | and Tobacco |
| Pulp, Paper and Printing | | 0301 | 1 A 2 d Pulp, Paper and Print |
| Wood and Wood Products | | 0301 | 1 A 2 f Manuf. Ind. and Constr. -Other |
| Construction | | 0301 | 1 A 2 f Manuf. Ind. and Constr. -Other |
| Textiles and Leather | | 0301 | 1 A 2 f Manuf. Ind. and Constr. -Other |
| Non Specified (Industry) | | 0301 | 1 A 2 f Manuf. Ind. and Constr. -Other |
| **Total Transport, of which** | | | |
| Pipeline Transport | No consumption (1) | | |
| Non Specified | No consumption (1) | | |
| **Other Sectors, of which** | | | |
| Commercial and Public Services | | 0201 | 1 A 4 a Commercial/ Institutional |
| Residential | No consumption (1) | | |
| Agriculture | No consumption (1) | | |
| Non Specified | No consumption (1) | | |

*(1) Indicates that no fuel consumption is reported in the energy balance for the specific category. In some cases this may be interpreted as "included elsewhere" if the energy statistic has lack of detailed sectoral data.*

## Fuels and Fuel Categories

The units used in the national fuel statistics are: *ton* for solid or liquid fuels and *cubic meter* for gaseous fuels. To convert these units into the caloric unit *Joule* the calorific value of each fuel category has to be quantified. These calorific values are specified in the unit *Joule per Mass or Volume Unit,* e.g. MJ/kg, MJ/m³ gas.

Each fuel has chemical and physical characteristics which influence its burning performance e.g. calorific value or carbon and sulphur content. Fuel categories are formed to pool fuels of the same characteristics in fuel groups. Limitations are given by the fuel categories of the energy balance. A list of the inventory fuel categories and their correspondence to IPCC-fuel categories is shown in Table A 40.

*Table A 40: Fuel categories used for the inventory and correspondence to IPCC fuel categories.*

| **Inventory Fuel Category** | | **IEA Fuel Category** | | **IPCC Fuel Category (3)** |
|---|---|---|---|---|
| **Code (1)** | **Category** | **Category** | **Average Net Calorific Value(2)** | |
| 102 A | Hard Coal | Bituminous Coal and Anthracite | 27.88 | Solid (coal) |
| 104 A | Hard Coal Briquettes | Patent Fuel | 31.00 | Solid (coal) |
| 105 A | Brown Coal | Lignite/Brown Coal | 20.45 | Solid (coal) |
| 106 A | Brown Coal Briquettes | BKB/PB | 19.30 | Solid (coal) |
| 107 A | Coke | Coke Oven Coke | 29.00 | Solid (coal) |
| 113 A | Peat | Peat | 8.80 | Solid |
| 304 A | Coke Oven Gas | Coke Oven Gas | 17.36 | Solid |
| 305 A | Blast Furnace Gas | Blast Furnace Gas | 39.88 | Solid |
| 110 A | Petrol Coke | Petrol Coke | 31.54 | Liquid |

| Inventory Fuel Category Code [(1)] | Inventory Fuel Category Category | IEA Fuel Category Category | Average Net Calorific Value[(2)] | IPCC Fuel Category [(3)] |
|---|---|---|---|---|
| 203 B | Light Fuel Oil Sulphur Content < 0,2 % | Residual Fuel Oil | 41.89 | Liquid (residual oil) |
| 203 C | Medium Fuel Oil Sulphur Content < 0,4% | | | |
| 203 D | Heavy Fuel Oil Sulphur Content >= 1% | | | |
| 204 A | Gasoil | Heating and other Gasoil | 42.80 | Liquid (gas/diesel oil) |
| 205 0 | Diesel | Transport Diesel | 42.80 | Liquid (diesel oil; gas/diesel oil) |
| 206 A | Petroleum | Other Kerosene | 43.30 | Liquid |
| 206 B | Kerosene | Kerosene Type Jet Fuel | 43.30 | Liquid (jet kerosene) |
| 207 A | Aviation Gasoline | Gasoline Type Jet Fuel | 43.18 | Liquid (aviation gasoline) |
| 208 0 | Motor Gasoline | Motor Gasoline | 43.18 | Liquid (gasoline) |
| 224 A | Other Petroleum Products | Other Products | 31.54 | Liquid |
| 303 A | Liquified Petroleum Gas (LPG) | LPG | 46.00 | Liquid |
| 308 A | Refinery Gas | Refinery Gas | 43.93 | Liquid |
| 301 A | Natural Gas | Natural Gas | 36.36 | Gaseous (natural gas) |
| 114 B | Municipal Waste | Municipal Solid Waste Renewable | 9.96 | Other Fuels |
| | | Municipal Solid Waste Non Renewable | 9.89 | Other Fuels |
| 115 A | Industrial Waste | Industrial Wastes | 15.76 | Other Fuels |
| 111 A | Fuel Wood | *Wood/Wood wastes/Other Solid Wastes, of which:* Wood | 14.35 | Biomass |
| 116 A | Wood Wastes, Wood Chips, Pellets, Straw. | *Wood/Wood wastes/Other Solid Wastes, of which:* Other vegetal materials and waste (including straw, sawdust, wood chips) | 10.93 | Biomass |
| 118 A | Sewage Sludge (dry substance) | *Wood/Wood wastes/Other Solid Wastes, of which:* Other vegetal materials and waste (including straw, sawdust, wood chips) | 12.00 | Biomass |
| 215 A | Black Liquor | *Wood/Wood wastes/Other Solid Wastes, of which:* Black Liquor | 8.17 | Biomass |
| 309 A | Biogas | Biogas | 20.86 | Biomass |
| 309 B | Sewage Sludge Gas | Sewage Sludge Gas | 16.80 | Biomass |
| 310 A | Landfill Gas | Landfill Gas | 19.39 | Biomass |

(1) *First three digits are based on CORINAIR / NAPFUE 94–Code*

(2) *Units: [MJ / kg] or [MJ / $m^3$ Gas] respectively, for the Year 2007 Note that for some fuels sector specific calorific values are taken. The energy balance reports some fuels (e.g. renewables) in [TJ] so that unit conversion by means of calorific values is not necessary.*

(3) *Fuel subcategories are shown in parenthesis*

**Specific remark to natural gas NCV**

Natural gas NCV is calculated by GCV / 1.1 (=GCV*0.909) whereas the IEA calculates it by GCV*0.9. This follows the methodology used by the Austrian energy statistics agency and leads to different apparent consumption (1%) between the national and IEA reference approach.

## Energy Consumption and $CO_2$ Emissions by Sectors and Fuel Types

Table *A* 41 to Table A 58 show detailed data on fuel consumption and $CO_2$ emissions for each fuel type according to Table A 40 and each sector of *1 A Fuel Combustion* are provided for the period from 1990 to 2007 For information on completeness, in particular on $CO_2$ emissions included elsewhere, please refer to the documentation boxes of the CRF and to Chapter 3.2.1 subchapter *Completeness* of the NIR.

*Table A 41: 2007 energy consumption and $CO_2$ emissions from category 1 A Fuel Combustion by fuel type and sector.*

| | | Consumption (PJ) | | | | | $CO_2$ emissions (Tg) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 A 1 | 1 A 2 | 1 A 3 + 1 A 5 | 1 A 4 | 1 A | 1 A 1 | 1 A 2 | 1 A 3 + 1 A 5 | 1 A 4 | 1 A |
| | | Energy Ind. | Industry | Trans-port | Other Sectors | Total | Energy Ind. | Industry | Trans-port | Other Sectors | Total |
| | **Total Solid** | **54.46** | **53.75** | **0.01** | **5.27** | **113.49** | **5.07** | **5.41** | **0.00** | **0.50** | **10.97** |
| 102A | Hard Coal | 54.46 | 9.53 | 0.01 | 1.24 | 65.24 | 5.07 | 0.88 | 0.00 | 0.12 | 6.06 |
| 104A | Hard Coal Briquettes | | | | 0.27 | 0.27 | | | | 0.03 | 0.03 |
| 105A | Brown Coal | 0.00 | 1.95 | | 0.37 | 2.32 | 0.00 | 0.19 | | 0.04 | 0.23 |
| 106A | Brown Coal Briquettes | | | | 0.89 | 0.89 | | | | 0.09 | 0.09 |
| 107A | Coke | | 36.45 | | 2.49 | 38.94 | | 3.79 | | 0.23 | 4.02 |
| 113A | Peat | | | | 0.00 | 0.00 | | | | 0.00 | 0.00 |
| 304A | Coke Oven Gas | | 5.83 | | | 5.83 | | 0.55 | | | 0.55 |
| | **Total Liquid** | **46.16** | **37.64** | **336.12** | **78.51** | **498.43** | **3.49** | **2.83** | **23.47** | **5.77** | **35.61** |
| 110A | Petrol Coke | 2.31 | 1.23 | | | 3.54 | 0.23 | 0.12 | | | 0.35 |
| 203B | Light Fuel Oil | 0.21 | 5.20 | | 5.72 | 11.13 | 0.02 | 0.41 | | 0.44 | 0.86 |
| 203C | Medium Fuel Oil | 1.88 | | | | 1.88 | 0.15 | | | | 0.15 |
| 203D | Heavy Fuel Oil | 9.11 | 15.00 | | | 24.11 | 0.72 | 1.17 | | | 1.89 |
| 204A | Gasoil | 0.15 | 4.09 | | 53.86 | 58.10 | 0.01 | 0.31 | | 4.04 | 4.36 |
| 2050 | Diesel | 0.01 | 10.20 | 251.23 | 11.86 | 273.30 | 0.00 | 0.71 | 17.38 | 0.82 | 18.91 |
| 206A | Other Kerosene | | 0.01 | | 0.11 | 0.13 | | 0.00 | | 0.01 | 0.01 |
| 206B | Jet Kerosene | | | 1.48 | | 1.48 | | | 0.06 | | 0.11 |
| 207A | Aviation Gasoline | | | 0.12 | | 0.12 | | | 0.01 | | 0.01 |
| 2080 | Motor Gasoline | | 0.13 | 83.29 | 1.48 | 84.90 | | 0.01 | 6.02 | 0.11 | 6.14 |
| 224A | Other Petroleum Prod-ucts | 10.57 | | | | 10.57 | 0.82 | | | | 0.82 |
| 303A | Liquified Petroleum Gas (LPG) | 1.04 | 1.77 | | 5.49 | 8.30 | 0.07 | 0.11 | | 0.35 | 0.53 |
| 308A | Refinery Gas | 20.87 | | | | 20.87 | 1.47 | | | | 1.47 |
| **301A** | **Total Gaseous** (Natu-ral Gas) | **85.12** | **117.13** | **8.10** | **75.15** | **285.50** | **4.72** | **6.48** | **0.45** | **4.16** | **15.81** |
| | **Total Other Fuel** | **11.80** | **17.00** | | **1.47** | **30.27** | **0.66** | **0.94** | | **0.15** | **1.75** |
| 114B | Municipal Waste | 10.37 | | | | 10.37 | 0.51 | | | | 0.51 |
| 115A | Industrial Waste | 1.43 | 17.00 | | 1.47 | 19.90 | 0.15 | 0.94 | | 0.15 | 1.25 |
| | **Total Biomass**(1) | **36.35** | **57.67** | | **81.44** | **175.46** | **(4)** | **(6.31)** | | **(8.35)** | **(18.66)** |
| 111A | Fuel Wood | 0.03 | 3.40 | | 61.03 | 64.46 | 0.00 | 0.34 | | 6.10 | 6.45 |
| 116A | Wood Wastes | 34.70 | 25.90 | | 20.10 | 80.69 | 3.82 | 2.85 | | 2.21 | 8.88 |
| 118A | Sewage Sludge | 0.77 | 0.03 | | | 0.80 | 0.08 | 0.00 | | | 0.09 |
| 215A | Black Liquor | | 27.36 | | | 27.36 | | 3.01 | | | 3.01 |
| 309A | Biogas | 0.76 | 0.37 | | 0.12 | 1.25 | 0.09 | 0.04 | | 0.01 | 0.14 |
| 309B | Sewage Sludge Gas | 0.04 | 0.61 | | 0.04 | 0.69 | 0.00 | 0.07 | | 0.00 | 0.08 |
| 310A | Landfill Gas | 0.05 | | | 0.15 | 0.20 | 0.01 | | | 0.02 | 0.02 |
| | **Total**(1) | **233.89** | **283.19** | **344.23** | **241.84** | **1 103.15** | **13.93** | **15.67** | **23.92** | **10.58** | **64.14** |

*(1) $CO_2$ emissions of Biomass are not included in Total.*

*Table A 42: 2006 energy consumption and $CO_2$ emissions from category 1 A Fuel Combustion by fuel type and sector.*

| | | Consumption (PJ) | | | | | $CO_2$ emissions (Tg) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 A 1 | 1 A 2 | 1 A 3 + 1 A 5 | 1 A 4 | 1 A | 1 A 1 | 1 A 2 | 1 A 3 + 1 A 5 | 1 A 4 | 1 A |
| | | **Energy Ind.** | **Indus-try** | **Trans-port** | **Other Sectors** | **Total** | **Energy Ind.** | **Industry** | **Trans-port** | **Other Sectors** | **Total** |
| | **Total Solid** | **60.20** | **55.64** | **0.01** | **5.76** | **121.60** | **5.64** | **5.58** | **0.00** | **0.54** | **11.77** |
| 102A | Hard Coal | 53.98 | 10.26 | 0.01 | 1.62 | 65.87 | 5.01 | 0.94 | 0.00 | 0.15 | 6.10 |
| 104A | Hard Coal Briquettes | | | | 0.02 | 0.02 | | | | 0.00 | 0.00 |
| 105A | Brown Coal | 6.22 | 1.81 | | 0.39 | 8.42 | 0.63 | 0.17 | | 0.04 | 0.85 |
| 106A | Brown Coal Briquettes | | 0.00 | | 0.99 | 0.99 | | 0.00 | | 0.10 | 0.10 |
| 107A | Coke | | 36.21 | | 2.73 | 38.94 | | 3.77 | | 0.25 | 4.02 |
| 113A | Peat | | | | 0.00 | 0.00 | | | | 0.00 | 0.00 |
| 304A | Coke Oven Gas | | 7.36 | | | 7.36 | | 0.70 | | | 0.70 |
| | **Total Liquid** | **49.55** | **38.15** | **329.72** | **104.20** | **521.62** | **3.86** | **2.87** | **23.20** | **7.70** | **37.67** |
| 110A | Petrol Coke | 2.02 | 1.30 | | | 3.32 | 0.20 | 0.12 | | | 0.33 |
| 203B | Light Fuel Oil | 0.25 | 6.51 | | 8.44 | 15.19 | 0.02 | 0.51 | | 0.65 | 1.18 |
| 203C | Medium Fuel Oil | 2.30 | | | | 2.30 | 0.18 | | | | 0.18 |
| 203D | Heavy Fuel Oil | 12.35 | 13.70 | | | 26.05 | 0.98 | 1.07 | | | 2.04 |
| 204A | Gasoil | 0.19 | 4.58 | | 75.85 | 80.62 | 0.01 | 0.34 | | 5.69 | 6.05 |
| 2050 | Diesel | 0.01 | 9.82 | 243.73 | 12.12 | 265.68 | 0.00 | 0.68 | 16.97 | 0.84 | 18.50 |
| 206A | Other Kerosene | | 0.02 | | 0.14 | 0.16 | | 0.00 | | 0.01 | 0.01 |
| 206B | Jet Kerosene | | | 1.44 | | 1.44 | | | 0.06 | | 0.10 |
| 207A | Aviation Gasoline | | | 0.12 | | 0.12 | | | 0.01 | | 0.01 |
| 2080 | Motor Gasoline | | 0.13 | 84.42 | 1.53 | 86.08 | | 0.01 | 6.16 | 0.11 | 6.28 |
| 224A | Other Petroleum Prod-ucts | 12.56 | | | | 12.56 | 0.98 | | | | 0.98 |
| 303A | Liquified Petroleum Gas (LPG) | 0.16 | 2.10 | | 6.13 | 8.39 | 0.01 | 0.13 | | 0.39 | 0.54 |
| 308A | Refinery Gas | 19.71 | | | | 19.71 | 1.47 | | | | 1.47 |
| **301A** | **Total Gaseous** (Natu-ral Gas) | **96.58** | **117.86** | **8.16** | **80.61** | **303.20** | **5.35** | **6.52** | **0.45** | **4.47** | **16.79** |
| | **Total Other Fuel** | **12.55** | **15.33** | | **0.73** | **28.61** | **0.70** | **0.99** | | **0.08** | **1.76** |
| 114B | Municipal Waste | 11.07 | | | | 11.07 | 0.54 | | | | 0.54 |
| 115A | Industrial Waste | 1.48 | 15.33 | | 0.73 | 17.54 | 0.15 | 0.99 | | 0.08 | 1.22 |
| | **Total Biomass**(1) | **28.97** | **55.57** | | **88.97** | **173.51** | **(3.19)** | **(6.09)** | | **(9.11)** | **(18.39)** |
| 111A | Fuel Wood | 0.05 | 2.32 | | 67.26 | 69.63 | 0.00 | 0.23 | | 6.73 | 6.96 |
| 116A | Wood Wastes | 27.51 | 24.76 | | 21.34 | 73.60 | 3.03 | 2.72 | | 2.35 | 8.10 |
| 118A | Sewage Sludge | 0.77 | 0.06 | | | 0.83 | 0.08 | 0.01 | | | 0.09 |
| 215A | Black Liquor | | 27.35 | | | 27.35 | | 3.01 | | | 3.01 |
| 309A | Biogas | 0.57 | 0.46 | | 0.02 | 1.06 | 0.06 | 0.05 | | 0.00 | 0.12 |
| 309B | Sewage Sludge Gas | 0.04 | 0.62 | | | 0.66 | 0.00 | 0.07 | | | 0.07 |
| 310A | Landfill Gas | 0.04 | | | 0.34 | 0.38 | 0.00 | | | 0.04 | 0.04 |
| | **Total**(1) | **247.85** | **282.54** | **337.88** | **280.27** | **1 148.55** | **15.55** | **15.97** | **23.65** | **12.78** | **67.99** |

*(1) $CO_2$ emissions of Biomass are not included in Total.*

*Table A 43: 2005 energy consumption and $CO_2$ emissions from category 1 A Fuel Combustion by fuel type and sector.*

| | | Consumption (PJ) | | | | | $CO_2$ emissions (Tg) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **1 A 1** | **1 A 2** | **1 A 3 + 1 A 5** | **1 A 4** | **1 A** | **1 A 1** | **1 A 2** | **1 A 3 + 1 A 5** | **1 A 4** | **1 A** |
| | | **Energy Ind.** | **Industry** | **Trans-port** | **Other Sectors** | **Total** | **Energy Ind.** | **Industry** | **Trans-port** | **Other Sectors** | **Total** |
| | **Total Solid** | **61.63** | **55.23** | **0.01** | **6.53** | **123.40** | **5.84** | **5.51** | **0.00** | **0.61** | **11.97** |
| 102A | Hard Coal | 51.51 | 7.65 | 0.01 | 1.70 | 60.87 | 4.81 | 0.71 | 0.00 | 0.16 | 5.67 |
| 104A | Hard Coal Briquettes | | | | 0.03 | 0.03 | | | | 0.00 | 0.00 |
| 105A | Brown Coal | 10.12 | 2.50 | | 0.38 | 13.00 | 1.04 | 0.22 | | 0.04 | 1.30 |
| 106A | Brown Coal Briquettes | | 0.00 | | 0.98 | 0.98 | | 0.00 | | 0.09 | 0.09 |
| 107A | Coke | | 34.35 | | 3.44 | 37.79 | | 3.57 | | 0.32 | 3.89 |
| 113A | Peat | | | | 0.00 | 0.00 | | | | 0.00 | 0.00 |
| 304A | Coke Oven Gas | | 10.72 | | | 10.72 | | 1.01 | | | 1.01 |
| | **Total Liquid** | **45.07** | **36.00** | **335.49** | **102.24** | **518.80** | **3.24** | **2.76** | **24.45** | **7.59** | **38.08** |
| 110A | Petrol Coke | 2.07 | 2.05 | | | 4.12 | 0.21 | 0.19 | | | 0.40 |
| 203B | Light Fuel Oil | 0.17 | 5.80 | | 10.12 | 16.09 | 0.01 | 0.45 | | 0.78 | 1.24 |
| 203C | Medium Fuel Oil | 2.29 | 0.00 | | | 2.29 | 0.18 | 0.00 | | | 0.18 |
| 203D | Heavy Fuel Oil | 12.23 | 14.11 | | | 26.34 | 0.97 | 1.10 | | | 2.07 |
| 204A | Gasoil | 0.19 | 3.85 | | 72.28 | 76.32 | 0.01 | 0.29 | | 5.42 | 5.72 |
| 2050 | Diesel | 0.02 | 8.42 | 247.62 | 11.98 | 268.03 | 0.00 | 0.61 | 17.97 | 0.87 | 19.46 |
| 206A | Other Kerosene | | 0.02 | | 0.13 | 0.15 | | 0.00 | | 0.01 | 0.01 |
| 206B | Jet Kerosene | | | 1.37 | | 1.37 | | | 0.06 | | 0.10 |
| 207A | Aviation Gasoline | | | 0.12 | | 0.12 | | | 0.01 | | 0.01 |
| 2080 | Motor Gasoline | | 0.11 | 86.39 | 1.49 | 87.99 | | 0.01 | 6.41 | 0.11 | 6.53 |
| 224A | Other Petroleum Prod-ucts | 10.08 | | | | 10.08 | 0.79 | | | | 0.79 |
| 303A | Liquified Petroleum Gas (LPG) | 2.29 | 1.64 | | 6.24 | 10.17 | 0.15 | 0.10 | | 0.40 | 0.65 |
| 308A | Refinery Gas | 15.75 | | | | 15.75 | 0.92 | | | | 0.92 |
| **301A** | **Total Gaseous** (Natu-ral Gas) | **117.74** | **120.30** | **9.84** | **86.30** | **334.17** | **6.52** | **6.66** | **0.54** | **4.78** | **18.51** |
| | **Total Other Fuel** | **8.51** | **11.21** | | **0.69** | **20.40** | **0.49** | **0.75** | | **0.07** | **1.31** |
| 114B | Municipal Waste | 7.17 | | | | 7.17 | 0.35 | | | | 0.35 |
| 115A | Industrial Waste | 1.34 | 11.21 | | 0.69 | 13.24 | 0.14 | 0.75 | | 0.07 | 0.96 |
| | **Total Biomass**(1) | **20.97** | **45.86** | | **89.84** | **156.66** | **(2.31)** | **(5.03)** | | **(9.17)** | **(16.51)** |
| 111A | Fuel Wood | 0.05 | 1.35 | | 71.14 | 72.54 | 0.01 | 0.13 | | 7.11 | 7.25 |
| 116A | Wood Wastes | 19.74 | 16.87 | | 18.33 | 54.95 | 2.17 | 1.86 | | 2.02 | 6.04 |
| 118A | Sewage Sludge | 0.75 | 0.04 | | | 0.79 | 0.08 | 0.00 | | | 0.09 |
| 215A | Black Liquor | | 26.66 | | | 26.66 | | 2.93 | | | 2.93 |
| 309A | Biogas | 0.33 | 0.35 | | | 0.68 | 0.04 | 0.04 | | | 0.08 |
| 309B | Sewage Sludge Gas | 0.05 | 0.59 | | 0.06 | 0.70 | 0.01 | 0.07 | | 0.01 | 0.08 |
| 310A | Landfill Gas | 0.04 | | | 0.30 | 0.35 | 0.00 | | | 0.03 | 0.04 |
| | **Total**(1) | **253.91** | **268.60** | **345.34** | **285.59** | **1 153.44** | **16.10** | **15.68** | **25.00** | **13.06** | **69.87** |

*(1) $CO_2$ emissions of Biomass are not included in Total.*

*Table A 44: 2004 energy consumption and $CO_2$ emissions from category 1 A Fuel Combustion by fuel type and Sector.*

| | | Consumption (PJ) | | | | | $CO_2$ emissions (Tg) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **1 A 1** | **1 A 2** | **1 A 3 + 1 A 5** | **1 A 4** | **1 A** | **1 A 1** | **1 A 2** | **1 A 3 + 1 A 5** | **1 A 4** | **1 A** |
| | | **Energy Ind.** | **Industry** | **Trans-port** | **Other Sectors** | **Total** | **Energy Ind.** | **Industry** | **Trans-port** | **Other Sectors** | **Total** |
| | **Total Solid** | **69.07** | **49.43** | **0.02** | **6.63** | **125.15** | **6.67** | **4.98** | **0.00** | **0.62** | **12.27** |
| 102A | Hard Coal | 59.70 | 7.50 | 0.02 | 1.69 | 68.92 | 5.64 | 0.71 | 0.00 | 0.16 | 6.51 |
| 104A | Hard Coal Briquettes | | | | 0.04 | 0.04 | | | | 0.00 | 0.00 |
| 105A | Brown Coal | 9.37 | 1.72 | | 0.29 | 11.38 | 1.03 | 0.17 | | 0.03 | 1.23 |
| 106A | Brown Coal Briquettes | | 0.00 | | 1.13 | 1.13 | | 0.00 | | 0.11 | 0.11 |
| 107A | Coke | | 31.89 | | 3.48 | 35.37 | | 3.32 | | 0.32 | 3.64 |
| 113A | Peat | | | | 0.00 | 0.00 | | | | 0.00 | 0.00 |
| 304A | Coke Oven Gas | | 8.31 | | | 8.31 | | 0.79 | | | 0.79 |
| | **Total Liquid** | **48.21** | **33.94** | **324.46** | **109.46** | **516.07** | **3.69** | **2.65** | **23.91** | **8.16** | **38.45** |
| 110A | Petrol Coke | 1.97 | 3.11 | | | 5.08 | 0.20 | 0.31 | | | 0.51 |
| 203B | Light Fuel Oil | 1.39 | 5.94 | | 13.89 | 21.21 | 0.11 | 0.46 | | 1.07 | 1.64 |
| 203C | Medium Fuel Oil | | | | 2.29 | 2.29 | | | | 0.18 | 0.18 |
| 203D | Heavy Fuel Oil | 13.59 | 11.78 | | | 25.37 | 1.08 | 0.92 | | | 2.00 |
| 204A | Gasoil | 0.06 | 2.79 | | 73.78 | 76.64 | 0.00 | 0.21 | | 5.53 | 5.75 |
| 2050 | Diesel | 0.03 | 8.77 | 234.01 | 11.25 | 254.06 | 0.00 | 0.65 | 17.24 | 0.83 | 18.72 |
| 206A | Other Kerosene | | 0.01 | | 0.15 | 0.17 | | 0.00 | | 0.01 | 0.01 |
| 206B | Jet Kerosene | | | 1.34 | | 1.34 | | | 0.06 | | 0.10 |
| 207A | Aviation Gasoline | | | 0.10 | | 0.10 | | | 0.01 | | 0.01 |
| 2080 | Motor Gasoline | | 0.11 | 89.00 | 1.51 | 90.63 | | 0.01 | 6.61 | 0.11 | 6.73 |
| 224A | Other Petroleum Prod-ucts | 17.57 | | | | 17.57 | 1.37 | | | | 1.37 |
| 303A | Liquified Petroleum Gas (LPG) | 0.15 | 1.42 | | 6.59 | 8.15 | 0.01 | 0.09 | | 0.42 | 0.52 |
| 308A | Refinery Gas | 13.46 | | | | 13.46 | 0.91 | | | | 0.91 |
| **301A** | **Total Gaseous** (Natu-ral Gas) | **98.03** | **109.27** | **7.96** | **90.10** | **305.36** | **5.43** | **6.05** | **0.44** | **4.99** | **16.92** |
| | **Total Other Fuel** | **9.38** | **12.04** | | **0.68** | **22.11** | **0.56** | **0.75** | | **0.07** | **1.38** |
| 114B | Municipal Waste | 7.58 | | | | 7.58 | 0.37 | | | | 0.37 |
| 115A | Industrial Waste | 1.80 | 12.04 | | 0.68 | 14.53 | 0.19 | 0.75 | | 0.07 | 1.01 |
| | **Total Biomass**(1) | **18.36** | **39.75** | | **87.53** | **145.64** | **(2.02)** | **(4.36)** | | **(8.93)** | **(15.31)** |
| 111A | Fuel Wood | 0.05 | 0.89 | | 70.02 | 70.95 | 0.00 | 0.09 | | 7.00 | 7.10 |
| 116A | Wood Wastes | 17.23 | 14.14 | | 17.07 | 48.43 | 1.90 | 1.55 | | 1.88 | 5.33 |
| 118A | Sewage Sludge | 0.81 | | | | 0.81 | 0.09 | | | | 0.09 |
| 215A | Black Liquor | | 24.26 | | | 24.26 | | 2.67 | | | 2.67 |
| 309A | Biogas | 0.16 | 0.32 | | | 0.48 | 0.02 | 0.04 | | | 0.05 |
| 309B | Sewage Sludge Gas | 0.06 | 0.15 | | 0.03 | 0.25 | 0.01 | 0.02 | | 0.00 | 0.03 |
| 310A | Landfill Gas | 0.05 | | | 0.41 | 0.46 | 0.01 | | | 0.05 | 0.05 |
| | **Total**(1) | **243.05** | **244.43** | **332.45** | **294.41** | **1 114.33** | **16.35** | **14.43** | **24.36** | **13.84** | **69.02** |

*(1) $CO_2$ emissions of Biomass are not included in Total.*

*Table A 45: 2003 energy consumption and $CO_2$ emissions from category 1 A Fuel Combustion by fuel type and sector.*

| | | Consumption (PJ) | | | | | $CO_2$ emissions (Tg) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 A 1 | 1 A 2 | 1 A 3 + 1 A 5 | 1 A 4 | 1 A | 1 A 1 | 1 A 2 | 1 A 3 + 1 A 5 | 1 A 4 | 1 A |
| | | **Energy Ind.** | **Industry** | **Trans-port** | **Other Sectors** | **Total** | **Energy Ind.** | **Industry** | **Trans-port** | **Other Sectors** | **Total** |
| | **Total Solid** | **70.89** | **49.51** | **0.02** | **7.76** | **128.18** | **6.92** | **4.99** | **0.00** | **0.73** | **12.64** |
| 102A | Hard Coal | 57.19 | 7.13 | 0.02 | 1.75 | 66.10 | 5.41 | 0.67 | 0.00 | 0.16 | 6.24 |
| 104A | Hard Coal Briquettes | | | | 0.06 | 0.06 | | | | 0.01 | 0.01 |
| 105A | Brown Coal | 13.70 | 1.70 | | 0.34 | 15.74 | 1.51 | 0.17 | | 0.04 | 1.71 |
| 106A | Brown Coal Briquettes | | 0.00 | | 1.38 | 1.38 | | 0.00 | | 0.13 | 0.13 |
| 107A | Coke | | 33.05 | | 4.22 | 37.26 | | 3.44 | | 0.39 | 3.82 |
| 113A | Peat | | | | 0.00 | 0.00 | | | | 0.00 | 0.00 |
| 304A | Coke Oven Gas | | 7.63 | | | 7.63 | | 0.72 | | | 0.72 |
| | **Total Liquid** | **44.77** | **31.73** | **317.15** | **121.84** | **515.49** | **3.44** | **2.45** | **23.38** | **9.10** | **38.41** |
| 110A | Petrol Coke | 1.85 | 2.13 | | | 3.98 | 0.19 | 0.21 | | | 0.40 |
| 203B | Light Fuel Oil | 0.76 | 5.14 | | 18.16 | 24.06 | 0.06 | 0.40 | | 1.40 | 1.86 |
| 203C | Medium Fuel Oil | | | | 2.25 | 2.25 | | | | 0.18 | 0.18 |
| 203D | Heavy Fuel Oil | 14.40 | 11.45 | | | 25.85 | 1.15 | 0.89 | | | 2.04 |
| 204A | Gasoil | 0.15 | 2.92 | | 82.49 | 85.56 | 0.01 | 0.22 | | 6.19 | 6.42 |
| 2050 | Diesel | 0.19 | 8.15 | 224.24 | 10.92 | 243.50 | 0.01 | 0.60 | 16.52 | 0.80 | 17.94 |
| 206A | Other Kerosene | | 0.01 | | 0.19 | 0.21 | | 0.00 | | 0.02 | 0.02 |
| 206B | Jet Kerosene | | | 1.30 | | 1.30 | | | 0.05 | | 0.09 |
| 207A | Aviation Gasoline | | | 0.11 | | 0.11 | | | 0.01 | | 0.01 |
| 2080 | Motor Gasoline | | 0.11 | 91.49 | 1.53 | 93.14 | | 0.01 | 6.80 | 0.11 | 6.92 |
| 224A | Other Petroleum Prod-ucts | 14.83 | | | | 14.83 | 1.16 | | | | 1.16 |
| 303A | Liquified Petroleum Gas (LPG) | 0.06 | 1.81 | | 6.29 | 8.15 | 0.00 | 0.12 | | 0.40 | 0.52 |
| 308A | Refinery Gas | 12.53 | | | | 12.53 | 0.86 | | | | 0.86 |
| **301A** | **Total Gaseous** (Natu-ral Gas) | **95.11** | **113.35** | **6.63** | **93.03** | **308.12** | **5.27** | **6.28** | **0.37** | **5.15** | **17.07** |
| | **Total Other Fuel** | **7.75** | **9.85** | | **0.65** | **18.24** | **0.49** | **0.71** | | **0.07** | **1.26** |
| 114B | Municipal Waste | 5.77 | | | | 5.77 | 0.28 | | | | 0.28 |
| 115A | Industrial Waste | 1.98 | 9.85 | | 0.65 | 12.47 | 0.21 | 0.71 | | 0.07 | 0.98 |
| | **Total Biomass**(1) | **14.73** | **39.40** | | **89.53** | **143.67** | **(1.62)** | **(4.32)** | | **(9.12)** | **(15.07)** |
| 111A | Fuel Wood | | 1.07 | | 72.69 | 73.75 | | 0.11 | | 7.27 | 7.38 |
| 116A | Wood Wastes | 13.14 | 14.85 | | 16.57 | 44.56 | 1.44 | 1.63 | | 1.82 | 4.90 |
| 118A | Sewage Sludge | 1.32 | | | | 1.32 | 0.15 | | | | 0.15 |
| 215A | Black Liquor | | 22.97 | | | 22.97 | | 2.53 | | | 2.53 |
| 309A | Biogas | | 0.33 | | | 0.33 | | 0.04 | | | 0.04 |
| 309B | Sewage Sludge Gas | 0.05 | 0.19 | | | 0.24 | 0.01 | 0.02 | | | 0.03 |
| 310A | Landfill Gas | 0.23 | | | 0.27 | 0.49 | 0.03 | | | 0.03 | 0.05 |
| | **Total**(1) | **233.25** | **243.83** | **323.80** | **312.81** | **1 113.70** | **16.12** | **14.43** | **23.74** | **15.05** | **69.38** |

*(1) $CO_2$ emissions of Biomass are not included in Total.*

*Table A 46: 2002 energy consumption and $CO_2$ emissions from category 1 A Fuel Combustion by fuel type and sector.*

| | | **Consumption (PJ)** | | | | | **$CO_2$ emissions (Tg)** | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **1 A 1** | **1 A 2** | **1 A 3 + 1 A 5** | **1 A 4** | **1 A** | **1 A 1** | **1 A 2** | **1 A 3 + 1 A 5** | **1 A 4** | **1 A** |
| | | **Energy Ind.** | **Industry** | **Trans-port** | **Other Sectors** | **Total** | **Energy Ind.** | **Industry** | **Trans-port** | **Other Sectors** | **Total** |
| | **Total Solid** | **56.13** | **48.10** | **0.02** | **8.35** | **112.59** | **5.51** | **4.84** | **0.00** | **0.78** | **11.14** |
| 102A | Hard Coal | 42.89 | 8.36 | 0.02 | 1.89 | 53.16 | 4.05 | 0.79 | 0.00 | 0.18 | 5.02 |
| 104A | Hard Coal Briquettes | | | | 0.02 | 0.02 | | | | 0.00 | 0.00 |
| 105A | Brown Coal | 13.24 | 1.60 | | 0.37 | 15.21 | 1.46 | 0.16 | | 0.04 | 1.65 |
| 106A | Brown Coal Briquettes | | 0.00 | | 1.26 | 1.26 | | 0.00 | | 0.12 | 0.12 |
| 107A | Coke | | 31.15 | | 4.80 | 35.95 | | 3.24 | | 0.44 | 3.68 |
| 113A | Peat | | | | 0.00 | 0.00 | | | | 0.00 | 0.00 |
| 304A | Coke Oven Gas | | 6.98 | | | 6.98 | | 0.66 | | | 0.66 |
| | **Total Liquid** | **42.36** | **30.11** | **293.82** | **111.09** | **477.37** | **2.99** | **2.33** | **21.66** | **8.29** | **35.30** |
| 110A | Petrol Coke | 2.54 | 2.05 | | | 4.59 | 0.26 | 0.20 | | | 0.46 |
| 203B | Light Fuel Oil | 1.01 | 3.16 | | 16.75 | 20.92 | 0.08 | 0.25 | | 1.29 | 1.61 |
| 203C | Medium Fuel Oil | | | | 1.91 | 1.91 | | | | 0.15 | 0.15 |
| 203D | Heavy Fuel Oil | 9.63 | 12.77 | | | 22.40 | 0.77 | 1.00 | | | 1.76 |
| 204A | Gasoil | 0.10 | 2.75 | | 73.55 | 76.40 | 0.01 | 0.21 | | 5.52 | 5.73 |
| 2050 | Diesel | 0.03 | 7.36 | 202.94 | 11.37 | 221.71 | 0.00 | 0.54 | 14.95 | 0.84 | 16.33 |
| 206A | Other Kerosene | | 0.01 | | 0.18 | 0.19 | | 0.00 | | 0.01 | 0.02 |
| 206B | Jet Kerosene | | | 1.30 | | 1.30 | | | 0.05 | | 0.09 |
| 207A | Aviation Gasoline | | | 0.10 | | 0.10 | | | 0.01 | | 0.01 |
| 2080 | Motor Gasoline | | 0.10 | 89.47 | 1.51 | 91.09 | | 0.01 | 6.64 | 0.11 | 6.76 |
| 224A | Other Petroleum Prod-ucts | 14.78 | | | | 14.78 | 1.15 | | | | 1.15 |
| 303A | Liquified Petroleum Gas (LPG) | 0.13 | 1.90 | | 5.81 | 7.84 | 0.01 | 0.12 | | 0.37 | 0.50 |
| 308A | Refinery Gas | 14.13 | | | | 14.13 | 0.72 | | | | 0.72 |
| **301A** | **Total Gaseous** (Natu-ral Gas) | **85.54** | **113.50** | **4.96** | **81.06** | **285.06** | **4.74** | **6.29** | **0.27** | **4.49** | **15.79** |
| | **Total Other Fuel** | **6.76** | **8.90** | | **0.62** | **16.28** | **0.43** | **0.63** | | **0.06** | **1.12** |
| 114B | Municipal Waste | 4.91 | | | | 4.91 | 0.24 | | | | 0.24 |
| 115A | Industrial Waste | 1.84 | 8.90 | | 0.62 | 11.36 | 0.19 | 0.63 | | 0.06 | 0.88 |
| | **Total Biomass**(1) | **13.71** | **41.22** | | **81.68** | **136.61** | **(1.51)** | **(4.53)** | | **(8.3)** | **(14.34)** |
| 111A | Fuel Wood | | 1.42 | | 68.33 | 69.75 | | 0.14 | | 6.83 | 6.98 |
| 116A | Wood Wastes | 12.47 | 14.46 | | 13.05 | 39.99 | 1.37 | 1.59 | | 1.44 | 4.40 |
| 118A | Sewage Sludge | 1.12 | | | | 1.12 | 0.12 | | | | 0.12 |
| 215A | Black Liquor | | 22.78 | | | 22.78 | | 2.51 | | | 2.51 |
| 309A | Biogas | | 2.56 | | | 2.56 | | 0.29 | | | 0.29 |
| 309B | Sewage Sludge Gas | 0.06 | | | | 0.06 | 0.01 | | | | 0.01 |
| 310A | Landfill Gas | 0.06 | | | 0.30 | 0.36 | 0.01 | | | 0.03 | 0.04 |
| | **Total**(1) | **204.49** | **241.83** | **298.80** | **282.80** | **1 027.92** | **13.67** | **14.08** | **21.93** | **13.63** | **63.36** |

*(1) $CO_2$ emissions of Biomass are not included in Total.*

*Table A 47: 2001 energy consumption and $CO_2$ emissions from category 1 A Fuel Combustion by fuel type and sector.*

| | | Consumption (PJ) | | | | | $CO_2$ emissions (Tg) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 A 1 | 1 A 2 | 1 A 3 + 1 A 5 | 1 A 4 | 1 A | 1 A 1 | 1 A 2 | 1 A 3 + 1 A 5 | 1 A 4 | 1 A |
| | | **Energy Ind.** | **Industry** | **Trans-port** | **Other Sectors** | **Total** | **Energy Ind.** | **Industry** | **Trans-port** | **Other Sectors** | **Total** |
| | **Total Solid** | **59.77** | **43.94** | **0.03** | **10.19** | **113.93** | **5.87** | **4.43** | **0.00** | **0.96** | **11.26** |
| 102A | Hard Coal | 45.15 | 9.36 | 0.03 | 2.14 | 56.68 | 4.27 | 0.88 | 0.00 | 0.20 | 5.35 |
| 104A | Hard Coal Briquettes | | | | 0.02 | 0.02 | | | | 0.00 | 0.00 |
| 105A | Brown Coal | 14.62 | 1.31 | | 0.46 | 16.39 | 1.60 | 0.13 | | 0.05 | 1.78 |
| 106A | Brown Coal Briquettes | | 0.00 | | 2.09 | 2.09 | | 0.00 | | 0.20 | 0.20 |
| 107A | Coke | | 29.03 | | 5.49 | 34.52 | | 3.02 | | 0.50 | 3.52 |
| 113A | Peat | | | | 0.00 | 0.00 | | | | 0.00 | 0.00 |
| 304A | Coke Oven Gas | | 4.24 | | | 4.24 | | 0.40 | | | 0.40 |
| | **Total Liquid** | **49.01** | **34.77** | **265.55** | **111.87** | **461.21** | **3.49** | **2.66** | **19.57** | **8.36** | **34.12** |
| 110A | Petrol Coke | 2.27 | 0.67 | | | 2.94 | 0.23 | 0.07 | | | 0.30 |
| 203B | Light Fuel Oil | 3.05 | 5.89 | | 17.12 | 26.06 | 0.24 | 0.46 | | 1.32 | 2.02 |
| 203C | Medium Fuel Oil | | | | 1.40 | 1.40 | | | | 0.11 | 0.11 |
| 203D | Heavy Fuel Oil | 15.14 | 15.68 | | 0.00 | 30.82 | 1.20 | 1.22 | | 0.00 | 2.43 |
| 204A | Gasoil | 0.80 | 2.91 | | 75.99 | 79.70 | 0.06 | 0.22 | | 5.70 | 5.98 |
| 2050 | Diesel | 0.02 | 7.32 | 181.03 | 11.44 | 199.82 | 0.00 | 0.54 | 13.33 | 0.84 | 14.72 |
| 206A | Other Kerosene | | 0.01 | | 0.04 | 0.04 | | 0.00 | | 0.00 | 0.00 |
| 206B | Jet Kerosene | | | 1.28 | | 1.28 | | | 0.05 | | 0.09 |
| 207A | Aviation Gasoline | | | 0.08 | | 0.08 | | | 0.01 | | 0.01 |
| 2080 | Motor Gasoline | | 0.10 | 83.16 | 1.50 | 84.76 | | 0.01 | 6.17 | 0.11 | 6.29 |
| 224A | Other Petroleum Prod-ucts | 12.72 | | | | 12.72 | 0.99 | | | | 0.99 |
| 303A | Liquified Petroleum Gas (LPG) | | 2.19 | | 4.38 | 6.58 | | 0.14 | | 0.28 | 0.42 |
| 308A | Refinery Gas | 15.01 | | | | 15.01 | 0.77 | | | | 0.77 |
| **301A** | **Total Gaseous** (Natu-ral Gas) | **80.07** | **106.40** | **8.24** | **87.40** | **282.11** | **4.44** | **5.89** | **0.46** | **4.84** | **15.63** |
| | **Total Other Fuel** | **5.62** | **8.14** | | **0.63** | **14.38** | **0.33** | **0.56** | | **0.07** | **0.96** |
| 114B | Municipal Waste | 4.65 | | | | 4.65 | 0.23 | | | | 0.23 |
| 115A | Industrial Waste | 0.97 | 8.14 | | 0.63 | 9.74 | 0.10 | 0.56 | | 0.07 | 0.73 |
| | **Total Biomass**(1) | **11.11** | **40.10** | | **80.34** | **131.55** | **(1.22)** | **(4.4)** | | **(8.16)** | **(13.79)** |
| 111A | Fuel Wood | | 1.15 | | 67.33 | 68.48 | | 0.11 | | 6.73 | 6.85 |
| 116A | Wood Wastes | 8.69 | 15.10 | | 12.57 | 36.35 | 0.96 | 1.66 | | 1.38 | 4.00 |
| 118A | Sewage Sludge | 2.35 | | | | 2.35 | 0.26 | | | | 0.26 |
| 215A | Black Liquor | | 23.30 | | | 23.30 | | 2.56 | | | 2.56 |
| 309A | Biogas | 0.00 | 0.26 | | 0.01 | 0.27 | 0.00 | 0.03 | | 0.00 | 0.03 |
| 309B | Sewage Sludge Gas | | 0.30 | | 0.03 | 0.33 | | 0.03 | | 0.00 | 0.04 |
| 310A | Landfill Gas | 0.07 | | | 0.41 | 0.47 | 0.01 | | | 0.05 | 0.05 |
| | **Total**(1) | **205.58** | **233.36** | **273.82** | **290.43** | **1 003.18** | **14.13** | **13.54** | **20.03** | **14.23** | **61.96** |

*(1) $CO_2$ emissions of Biomass are not included in Total.*

*Table A 48: 2000 energy consumption and $CO_2$ emissions from category 1 A Fuel Combustion by fuel type and sector.*

| | | Consumption (PJ) | | | | | $CO_2$ emissions (Tg) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 A 1 | 1 A 2 | 1 A 3 + 1 A 5 | 1 A 4 | 1 A | 1 A 1 | 1 A 2 | 1 A 3 + 1 A 5 | 1 A 4 | 1 A |
| | | Energy Ind. | Industry | Trans-port | Other Sectors | Total | Energy Ind. | Industry | Trans-port | Other Sectors | Total |
| | **Total Solid** | **49.16** | **45.96** | **0.03** | **10.28** | **105.43** | **4.82** | **4.65** | **0.00** | **0.97** | **10.44** |
| 102A | Hard Coal | 37.36 | 10.31 | 0.03 | 2.18 | 49.87 | 3.53 | 0.97 | 0.00 | 0.20 | 4.70 |
| 104A | Hard Coal Briquettes | | | | 0.11 | 0.11 | | | | 0.01 | 0.01 |
| 105A | Brown Coal | 11.80 | 1.38 | | 0.43 | 13.61 | 1.29 | 0.13 | | 0.05 | 1.48 |
| 106A | Brown Coal Briquettes | | 0.00 | | 2.06 | 2.06 | | 0.00 | | 0.20 | 0.20 |
| 107A | Coke | | 31.98 | | 5.51 | 37.49 | | 3.33 | | 0.51 | 3.83 |
| 113A | Peat | | | | 0.00 | 0.00 | | | | 0.00 | 0.00 |
| 304A | Coke Oven Gas | | 2.28 | | | 2.28 | | 0.22 | | | 0.22 |
| | **Total Liquid** | **45.09** | **34.39** | **247.68** | **103.89** | **431.05** | **3.18** | **2.63** | **18.25** | **7.76** | **31.86** |
| 110A | Petrol Coke | 1.61 | 0.81 | | | 2.42 | 0.16 | 0.08 | | | 0.24 |
| 203B | Light Fuel Oil | 1.83 | 5.55 | | 15.65 | 23.02 | 0.14 | 0.43 | | 1.20 | 1.78 |
| 203C | Medium Fuel Oil | | | | 1.47 | 1.47 | | | | 0.11 | 0.11 |
| 203D | Heavy Fuel Oil | 14.60 | 16.17 | | 0.14 | 30.90 | 1.16 | 1.26 | | 0.01 | 2.44 |
| 204A | Gasoil | 0.01 | 1.61 | | 69.41 | 71.02 | 0.00 | 0.12 | | 5.21 | 5.33 |
| 2050 | Diesel | 0.03 | 7.59 | 163.69 | 11.12 | 182.43 | 0.00 | 0.56 | 12.06 | 0.82 | 13.44 |
| 206A | Other Kerosene | | 0.01 | | 0.24 | 0.26 | | 0.00 | | 0.02 | 0.02 |
| 206B | Jet Kerosene | | | 1.37 | | 1.37 | | | 0.06 | | 0.10 |
| 207A | Aviation Gasoline | | | 0.09 | | 0.09 | | | 0.01 | | 0.01 |
| 2080 | Motor Gasoline | | 0.11 | 82.53 | 1.49 | 84.13 | | 0.01 | 6.13 | 0.11 | 6.25 |
| 224A | Other Petroleum Prod-ucts | 11.81 | | | | 11.81 | 0.92 | | | | 0.92 |
| 303A | Liquified Petroleum Gas (LPG) | 0.94 | 2.54 | | 4.37 | 7.85 | 0.06 | 0.16 | | 0.28 | 0.50 |
| 308A | Refinery Gas | 14.26 | | | | 14.26 | 0.72 | | | | 0.72 |
| **301A** | **Total Gaseous** (Natu-ral Gas) | **74.31** | **108.58** | **9.70** | **72.45** | **265.05** | **4.12** | **6.02** | **0.54** | **4.01** | **14.68** |
| | **Total Other Fuel** | **4.64** | **6.16** | | **1.38** | **12.18** | **0.23** | **0.45** | | **0.14** | **0.83** |
| 114B | Municipal Waste | 4.51 | | | | 4.51 | 0.22 | | | | 0.22 |
| 115A | Industrial Waste | 0.13 | 6.16 | | 1.38 | 7.67 | 0.01 | 0.45 | | 0.14 | 0.61 |
| | **Total Biomass**(1) | **8.52** | **40.99** | | **69.68** | **119.19** | **(0.94)** | **(4.5)** | | **(7.07)** | **(12.51)** |
| 111A | Fuel Wood | | 0.95 | | 59.22 | 60.17 | | 0.10 | | 5.92 | 6.02 |
| 116A | Wood Wastes | 7.46 | 15.24 | | 9.96 | 32.66 | 0.82 | 1.68 | | 1.10 | 3.59 |
| 118A | Sewage Sludge | 0.96 | | | | 0.96 | 0.11 | | | | 0.11 |
| 215A | Black Liquor | | 24.12 | | | 24.12 | | 2.65 | | | 2.65 |
| 309A | Biogas | 0.00 | 0.31 | | 0.05 | 0.36 | 0.00 | 0.03 | | 0.01 | 0.04 |
| 309B | Sewage Sludge Gas | 0.08 | 0.36 | | 0.03 | 0.47 | 0.01 | 0.04 | | 0.00 | 0.05 |
| 310A | Landfill Gas | 0.01 | | | 0.43 | 0.44 | 0.00 | | | 0.05 | 0.05 |
| | **Total**(1) | **181.73** | **236.07** | **257.41** | **257.68** | **932.90** | **12.35** | **13.74** | **18.79** | **12.89** | **57.82** |

*(1) $CO_2$ emissions of Biomass are not included in Total.*

*Table A 49: 1999 energy consumption and $CO_2$ emissions from category 1 A Fuel Combustion by fuel type and sector.*

| | | Consumption (PJ) | | | | | $CO_2$ emissions (Tg) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 A 1 | 1 A 2 | 1 A 3 + 1 A 5 | 1 A 4 | 1 A | 1 A 1 | 1 A 2 | 1 A 3 + 1 A 5 | 1 A 4 | 1 A |
| | | **Energy Ind.** | **Industry** | **Trans-port** | **Other Sectors** | **Total** | **Energy Ind.** | **Industry** | **Trans-port** | **Other Sectors** | **Total** |
| | **Total Solid** | **37.89** | **43.08** | **0.03** | **11.35** | **92.35** | **3.79** | **4.35** | **0.00** | **1.07** | **9.21** |
| 102A | Hard Coal | 24.21 | 9.01 | 0.03 | 2.72 | 35.97 | 2.28 | 0.85 | 0.00 | 0.25 | 3.39 |
| 104A | Hard Coal Briquettes | | | | 0.12 | 0.12 | | | | 0.01 | 0.01 |
| 105A | Brown Coal | 13.68 | 1.17 | | 0.52 | 15.36 | 1.50 | 0.11 | | 0.06 | 1.67 |
| 106A | Brown Coal Briquettes | | 0.00 | | 2.05 | 2.05 | | 0.00 | | 0.20 | 0.20 |
| 107A | Coke | | 29.50 | | 5.94 | 35.43 | | 3.07 | | 0.55 | 3.61 |
| 113A | Peat | | | | 0.00 | 0.00 | | | | 0.00 | 0.00 |
| 304A | Coke Oven Gas | | 3.41 | | | 3.41 | | 0.32 | | | 0.32 |
| | **Total Liquid** | **52.08** | **33.68** | **235.70** | **117.49** | **438.95** | **3.82** | **2.59** | **17.37** | **8.79** | **32.62** |
| 110A | Petrol Coke | 2.14 | 1.19 | | | 3.32 | 0.22 | 0.12 | | | 0.34 |
| 203B | Light Fuel Oil | 1.17 | 7.25 | | 18.80 | 27.22 | 0.09 | 0.57 | | 1.45 | 2.10 |
| 203C | Medium Fuel Oil | 0.09 | 0.00 | | 2.18 | 2.26 | 0.01 | 0.00 | | 0.17 | 0.18 |
| 203D | Heavy Fuel Oil | 21.69 | 15.37 | | 0.17 | 37.24 | 1.73 | 1.20 | | 0.01 | 2.94 |
| 204A | Gasoil | 0.31 | 1.05 | | 78.27 | 79.62 | 0.02 | 0.08 | | 5.87 | 5.97 |
| 2050 | Diesel | 0.03 | 6.43 | 148.62 | 11.44 | 166.52 | 0.00 | 0.47 | 10.95 | 0.84 | 12.27 |
| 206A | Other Kerosene | | 0.04 | | 0.66 | 0.70 | | 0.00 | | 0.05 | 0.05 |
| 206B | Jet Kerosene | | | 1.54 | | 1.54 | | | 0.07 | | 0.11 |
| 207A | Aviation Gasoline | | | 0.12 | | 0.12 | | | 0.01 | | 0.01 |
| 2080 | Motor Gasoline | | 0.09 | 85.42 | 1.50 | 87.02 | | 0.01 | 6.34 | 0.11 | 6.46 |
| 224A | Other Petroleum Prod-ucts | 12.17 | | | | 12.17 | 0.95 | | | | 0.95 |
| 303A | Liquified Petroleum Gas (LPG) | 0.20 | 2.27 | | 4.47 | 6.94 | 0.01 | 0.15 | | 0.29 | 0.44 |
| 308A | Refinery Gas | 14.29 | | | | 14.29 | 0.79 | | | | 0.79 |
| **301A** | **Total Gaseous** (Natu-ral Gas) | **90.26** | **102.69** | **7.84** | **77.30** | **278.09** | **5.00** | **5.69** | **0.43** | **4.28** | **15.41** |
| | **Total Other Fuel** | **4.74** | **5.30** | | **1.46** | **11.50** | **0.23** | **0.43** | | **0.15** | **0.82** |
| 114B | Municipal Waste | 4.74 | | | | 4.74 | 0.23 | | | | 0.23 |
| 115A | Industrial Waste | 0.01 | 5.30 | | 1.46 | 6.76 | 0.00 | 0.43 | | 0.15 | 0.59 |
| | **Total Biomass**(1) | **6.78** | **45.90** | | **73.57** | **126.25** | **(0.75)** | **(5.03)** | | **(7.45)** | **(13.23)** |
| 111A | Fuel Wood | | 1.87 | | 64.10 | 65.97 | | 0.19 | | 6.41 | 6.60 |
| 116A | Wood Wastes | 5.79 | 19.83 | | 8.94 | 34.57 | 0.64 | 2.18 | | 0.98 | 3.80 |
| 118A | Sewage Sludge | 0.96 | | | | 0.96 | 0.11 | | | | 0.11 |
| 215A | Black Liquor | | 23.65 | | | 23.65 | | 2.60 | | | 2.60 |
| 309A | Biogas | | 0.20 | | 0.03 | 0.22 | | 0.02 | | 0.00 | 0.03 |
| 309B | Sewage Sludge Gas | | 0.35 | | 0.02 | 0.37 | | 0.04 | | 0.00 | 0.04 |
| 310A | Landfill Gas | 0.02 | | | 0.48 | 0.50 | 0.00 | | | 0.05 | 0.06 |
| | **Total**(1) | **191.74** | **230.66** | **243.57** | **281.17** | **947.13** | **12.84** | **13.07** | **17.81** | **14.29** | **58.05** |

*(1) $CO_2$ emissions of Biomass are not included in Total.*

*Table A 50: 1998 energy consumption and $CO_2$ emissions from category 1 A Fuel Combustion by fuel type and sector.*

| | | Consumption (PJ) | | | | | $CO_2$ emissions (Tg) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 A 1 | 1 A 2 | 1 A 3 + 1 A 5 | 1 A 4 | 1 A | 1 A 1 | 1 A 2 | 1 A 3 + 1 A 5 | 1 A 4 | 1 A |
| | | **Energy Ind.** | **Industry** | **Trans-port** | **Other Sectors** | **Total** | **Energy Ind.** | **Industry** | **Trans-port** | **Other Sectors** | **Total** |
| | **Total Solid** | **35.81** | **42.49** | **0.03** | **12.01** | **90.34** | **3.50** | **4.28** | **0.00** | **1.13** | **8.90** |
| 102A | Hard Coal | 28.48 | 11.94 | 0.03 | 3.06 | 43.51 | 2.69 | 1.12 | 0.00 | 0.28 | 4.10 |
| 104A | Hard Coal Briquettes | | | | 0.12 | 0.12 | | | | 0.01 | 0.01 |
| 105A | Brown Coal | 7.33 | 0.66 | | 0.57 | 8.57 | 0.81 | 0.06 | | 0.06 | 0.93 |
| 106A | Brown Coal Briquettes | | 0.00 | | 1.99 | 1.99 | | 0.00 | | 0.19 | 0.19 |
| 107A | Coke | | 27.93 | | 6.26 | 34.20 | | 2.91 | | 0.58 | 3.48 |
| 113A | Peat | | | | 0.00 | 0.00 | | | | 0.00 | 0.00 |
| 304A | Coke Oven Gas | | 1.94 | | | 1.94 | | 0.18 | | | 0.18 |
| | **Total Liquid** | **60.96** | **44.99** | **243.74** | **112.29** | **461.99** | **4.38** | **3.45** | **17.99** | **8.40** | **34.27** |
| 110A | Petrol Coke | 2.20 | 0.67 | | | 2.87 | 0.22 | 0.07 | | | 0.29 |
| 203B | Light Fuel Oil | 2.12 | 12.96 | | 12.83 | 27.90 | 0.16 | 1.01 | | 0.99 | 2.16 |
| 203C | Medium Fuel Oil | 0.14 | 0.00 | | 2.13 | 2.28 | 0.01 | 0.00 | | 0.17 | 0.18 |
| 203D | Heavy Fuel Oil | 28.01 | 20.63 | | 0.26 | 48.90 | 2.23 | 1.61 | | 0.02 | 3.86 |
| 204A | Gasoil | 0.20 | 1.04 | | 79.97 | 81.21 | 0.02 | 0.08 | | 6.00 | 6.09 |
| 2050 | Diesel | 0.07 | 6.54 | 150.22 | 11.31 | 168.15 | 0.01 | 0.48 | 11.09 | 0.84 | 12.42 |
| 206A | Other Kerosene | | 0.01 | | 0.73 | 0.73 | | 0.00 | | 0.06 | 0.06 |
| 206B | Jet Kerosene | | | 1.51 | | 1.51 | | | 0.07 | | 0.11 |
| 207A | Aviation Gasoline | | | 0.11 | | 0.11 | | | 0.01 | | 0.01 |
| 2080 | Motor Gasoline | | 0.09 | 91.90 | 1.50 | 93.49 | | 0.01 | 6.83 | 0.11 | 6.94 |
| 224A | Other Petroleum Prod-ucts | 11.05 | | | | 11.05 | 0.86 | | | | 0.86 |
| 303A | Liquified Petroleum Gas (LPG) | 0.13 | 3.04 | | 3.57 | 6.74 | 0.01 | 0.19 | | 0.23 | 0.43 |
| 308A | Refinery Gas | 17.04 | | | | 17.04 | 0.87 | | | | 0.87 |
| **301A** | **Total Gaseous** (Natu-ral Gas) | **88.04** | **105.48** | **6.34** | **73.35** | **273.20** | **4.88** | **5.84** | **0.35** | **4.06** | **15.14** |
| | **Total Other Fuel** | **4.78** | **5.89** | | **1.61** | **12.29** | **0.23** | **0.42** | | **0.17** | **0.82** |
| 114B | Municipal Waste | 4.78 | | | | 4.78 | 0.23 | | | | 0.23 |
| 115A | Industrial Waste | | 5.89 | | 1.61 | 7.50 | | 0.42 | | 0.17 | 0.58 |
| | **Total Biomass**(1) | **7.10** | **32.89** | | **70.49** | **110.48** | **(0.78)** | **(3.62)** | | **(7.11)** | **(11.51)** |
| 111A | Fuel Wood | 0.21 | 0.15 | | 64.52 | 64.88 | 0.02 | 0.02 | | 6.45 | 6.49 |
| 116A | Wood Wastes | 5.99 | 9.31 | | 5.30 | 20.59 | 0.66 | 1.02 | | 0.58 | 2.27 |
| 118A | Sewage Sludge | 0.82 | | | | 0.82 | 0.09 | | | | 0.09 |
| 215A | Black Liquor | | 22.92 | | | 22.92 | | 2.52 | | | 2.52 |
| 309A | Biogas | | 0.03 | | | 0.03 | | 0.00 | | | 0.00 |
| 309B | Sewage Sludge Gas | 0.05 | | | 0.66 | 0.71 | 0.01 | | | 0.07 | 0.08 |
| 310A | Landfill Gas | 0.03 | 0.49 | | 0.01 | 0.53 | 0.00 | 0.05 | | 0.00 | 0.06 |
| | **Total**(1) | **196.70** | **231.73** | **250.12** | **269.75** | **948.29** | **12.99** | **13.99** | **18.35** | **13.76** | **59.13** |

*(1) $CO_2$ emissions of Biomass are not included in Total.*

*Table A 51: 1997 energy consumption and $CO_2$ emissions from category 1 A Fuel Combustion by fuel type and sector.*

| | | Consumption (PJ) | | | | | $CO_2$ emissions (Tg) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 A 1 | 1 A 2 | 1 A 3 + 1 A 5 | 1 A 4 | 1 A | 1 A 1 | 1 A 2 | 1 A 3 + 1 A 5 | 1 A 4 | 1 A |
| | | Energy Ind. | Industry | Trans-port | Other Sectors | Total | Energy Ind. | Indus-try | Trans-port | Other Sectors | Total |
| | **Total Solid** | **50.96** | **50.20** | **0.03** | **13.78** | **114.97** | **5.00** | **5.02** | **0.00** | **1.29** | **11.32** |
| 102A | Hard Coal | 39.25 | 12.17 | 0.03 | 3.36 | 54.82 | 3.71 | 1.14 | 0.00 | 0.31 | 5.17 |
| 104A | Hard Coal Briquettes | | | | 0.22 | 0.22 | | | | 0.02 | 0.02 |
| 105A | Brown Coal | 11.70 | 0.69 | | 0.64 | 13.03 | 1.29 | 0.07 | | 0.07 | 1.42 |
| 106A | Brown Coal Briquettes | | 0.00 | | 2.55 | 2.56 | | 0.00 | | 0.25 | 0.25 |
| 107A | Coke | | 29.29 | | 7.01 | 36.29 | | 3.05 | | 0.64 | 3.69 |
| 113A | Peat | | | | 0.00 | 0.00 | | | | 0.00 | 0.00 |
| 304A | Coke Oven Gas | | 8.05 | | | 8.05 | | 0.76 | | | 0.76 |
| | **Total Liquid** | **57.44** | **47.40** | **216.81** | **111.83** | **433.48** | **4.09** | **3.64** | **16.01** | **8.37** | **32.15** |
| 110A | Petrol Coke | 2.15 | 0.49 | | | 2.64 | 0.22 | 0.05 | | | 0.27 |
| 203B | Light Fuel Oil | 2.54 | 16.26 | | 12.59 | 31.40 | 0.20 | 1.27 | | 0.97 | 2.44 |
| 203C | Medium Fuel Oil | 0.09 | 0.01 | | 2.06 | 2.16 | 0.01 | 0.00 | | 0.16 | 0.17 |
| 203D | Heavy Fuel Oil | 23.37 | 20.95 | | 0.17 | 44.49 | 1.86 | 1.63 | | 0.01 | 3.50 |
| 204A | Gasoil | 0.11 | 1.19 | | 80.30 | 81.60 | 0.01 | 0.09 | | 6.02 | 6.12 |
| 2050 | Diesel | 0.31 | 5.64 | 127.51 | 11.52 | 144.97 | 0.02 | 0.42 | 9.41 | 0.85 | 10.70 |
| 206A | Other Kerosene | | 0.00 | | 0.42 | 0.43 | | 0.00 | | 0.03 | 0.03 |
| 206B | Jet Kerosene | | | 1.35 | | 1.35 | | | 0.06 | | 0.10 |
| 207A | Aviation Gasoline | | | 0.10 | | 0.10 | | | 0.01 | | 0.01 |
| 2080 | Motor Gasoline | | 0.08 | 87.85 | 1.52 | 89.44 | | 0.01 | 6.52 | 0.11 | 6.64 |
| 224A | Other Petroleum Prod-ucts | 11.60 | | | | 11.60 | 0.90 | | | | 0.90 |
| 303A | Liquified Petroleum Gas (LPG) | 0.09 | 2.78 | | 3.25 | 6.12 | 0.01 | 0.18 | | 0.21 | 0.39 |
| 308A | Refinery Gas | 17.18 | | | | 17.18 | 0.87 | | | | 0.87 |
| **301A** | **Total Gaseous** (Natu-ral Gas) | **82.16** | **109.34** | **4.20** | **70.01** | **265.71** | **4.55** | **6.06** | **0.23** | **3.88** | **14.72** |
| | **Total Other Fuel** | **4.89** | **5.69** | | **2.54** | **13.12** | **0.24** | **0.51** | | **0.26** | **1.02** |
| 114B | Municipal Waste | 4.89 | | | | 4.89 | 0.24 | | | | 0.24 |
| 115A | Industrial Waste | | 5.69 | | 2.54 | 8.23 | | 0.51 | | 0.26 | 0.78 |
| | **Total Biomass**(1) | **6.22** | **34.32** | | **72.23** | **112.78** | **(0.68)** | **(3.77)** | | **(7.28)** | **(11.74)** |
| 111A | Fuel Wood | | 0.27 | | 66.93 | 67.21 | | 0.03 | | 6.69 | 6.72 |
| 116A | Wood Wastes | 5.36 | 11.83 | | 4.66 | 21.85 | 0.59 | 1.30 | | 0.51 | 2.40 |
| 118A | Sewage Sludge | 0.78 | | | | 0.78 | 0.09 | | | | 0.09 |
| 215A | Black Liquor | | 21.67 | | | 21.67 | | 2.38 | | | 2.38 |
| 309A | Biogas | | 0.05 | | | 0.05 | | 0.01 | | | 0.01 |
| 309B | Sewage Sludge Gas | 0.06 | | | 0.63 | 0.69 | 0.01 | | | 0.07 | 0.08 |
| 310A | Landfill Gas | 0.03 | 0.49 | | 0.01 | 0.52 | 0.00 | 0.06 | | 0.00 | 0.06 |
| | **Total**(1) | **201.67** | **246.95** | **221.04** | **270.39** | **940.05** | **13.89** | **15.23** | **16.24** | **13.81** | **59.21** |

*(1) $CO_2$ emissions of Biomass are not included in Total.*

*Table A 52: 1996 energy consumption and $CO_2$ emissions from category 1 A Fuel Combustion by fuel type and sector.*

| | | Consumption (PJ) | | | | | $CO_2$ emissions (Tg) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 A 1 | 1 A 2 | 1 A 3 + 1 A 5 | 1 A 4 | 1 A | 1 A 1 | 1 A 2 | 1 A 3 + 1 A 5 | 1 A 4 | 1 A |
| | | Energy Ind. | Indus-try | Trans-port | Other Sectors | Total | Energy Ind. | Indus-try | Trans-port | Other Sectors | Total |
| | **Total Solid** | **47.52** | **43.95** | **0.06** | **17.65** | **109.19** | **4.70** | **4.40** | **0.01** | **1.66** | **10.76** |
| 102A | Hard Coal | 33.51 | 9.72 | 0.06 | 4.30 | 47.60 | 3.17 | 0.91 | 0.01 | 0.40 | 4.49 |
| 104A | Hard Coal Briquettes | | | | | | | | | | |
| 105A | Brown Coal | 14.01 | 1.12 | | 0.92 | 16.05 | 1.52 | 0.11 | | 0.10 | 1.73 |
| 106A | Brown Coal Briquettes | | 0.26 | | 2.96 | 3.22 | | 0.02 | | 0.29 | 0.31 |
| 107A | Coke | | 26.03 | | 9.46 | 35.49 | | 2.71 | | 0.87 | 3.58 |
| 113A | Peat | | | | 0.00 | 0.00 | | | | 0.00 | 0.00 |
| 304A | Coke Oven Gas | | 6.82 | | | 6.82 | | 0.65 | | | 0.65 |
| | **Total Liquid** | **52.93** | **46.24** | **214.15** | **131.49** | **444.82** | **3.73** | **3.51** | **15.82** | **9.85** | **32.95** |
| 110A | Petrol Coke | 2.13 | 0.32 | | | 2.45 | 0.21 | 0.03 | | | 0.25 |
| 203B | Light Fuel Oil | 1.88 | 12.45 | | 21.41 | 35.74 | 0.15 | 0.97 | | 1.65 | 2.77 |
| 203C | Medium Fuel Oil | 0.34 | 0.00 | | 1.66 | 2.00 | 0.03 | 0.00 | | 0.13 | 0.16 |
| 203D | Heavy Fuel Oil | 19.39 | 16.19 | | 0.25 | 35.83 | 1.54 | 1.26 | | 0.02 | 2.82 |
| 204A | Gasoil | 0.07 | 0.49 | | 83.18 | 83.74 | 0.00 | 0.04 | | 6.24 | 6.28 |
| 2050 | Diesel | 0.16 | 13.60 | 120.24 | 18.98 | 152.97 | 0.01 | 1.00 | 8.88 | 1.40 | 11.30 |
| 206A | Other Kerosene | | 0.01 | | 0.51 | 0.51 | | 0.00 | | 0.04 | 0.04 |
| 206B | Jet Kerosene | | | 1.29 | | 1.29 | | | 0.06 | | 0.09 |
| 207A | Aviation Gasoline | | | 0.09 | | 0.09 | | | 0.01 | | 0.01 |
| 2080 | Motor Gasoline | | 0.09 | 92.53 | 1.66 | 94.29 | | 0.01 | 6.88 | 0.12 | 7.01 |
| 224A | Other Petroleum Prod-ucts | 11.02 | | | | 11.02 | 0.86 | | | | 0.86 |
| 303A | Liquified Petroleum Gas (LPG) | 0.38 | 3.10 | | 3.83 | 7.31 | 0.02 | 0.20 | | 0.25 | 0.47 |
| 308A | Refinery Gas | 17.57 | | | | 17.57 | 0.91 | | | | 0.91 |
| **301A** | **Total Gaseous** (Natu-ral Gas) | **92.83** | **104.97** | **4.22** | **73.93** | **275.94** | **5.14** | **5.82** | **0.23** | **4.10** | **15.29** |
| | **Total Other Fuel** | **4.77** | **6.35** | | **2.90** | **14.02** | **0.23** | **0.54** | | **0.30** | **1.07** |
| 114B | Municipal Waste | 4.77 | | | | 4.77 | 0.23 | | | | 0.23 |
| 115A | Industrial Waste | | 6.35 | | 2.90 | 9.25 | | 0.54 | | 0.30 | 0.84 |
| | **Total Biomass**(1) | **6.12** | **32.54** | | **76.31** | **114.97** | **(0.67)** | **(3.57)** | | **(7.67)** | **(11.92)** |
| 111A | Fuel Wood | | 0.78 | | 72.50 | 73.29 | | 0.08 | | 7.25 | 7.33 |
| 116A | Wood Wastes | 5.32 | 10.31 | | 3.13 | 18.76 | 0.59 | 1.13 | | 0.34 | 2.06 |
| 118A | Sewage Sludge | 0.74 | | | | 0.74 | 0.08 | | | | 0.08 |
| 215A | Black Liquor | | 21.17 | | | 21.17 | | 2.33 | | | 2.33 |
| 309A | Biogas | | 0.04 | | | 0.04 | | 0.00 | | | 0.00 |
| 309B | Sewage Sludge Gas | 0.03 | | | 0.64 | 0.67 | 0.00 | | | 0.07 | 0.07 |
| 310A | Landfill Gas | 0.03 | 0.24 | | 0.04 | 0.31 | 0.00 | 0.03 | | 0.00 | 0.03 |
| | **Total**(1) | **204.17** | **234.05** | **218.43** | **302.28** | **958.93** | **13.80** | **14.27** | **16.06** | **15.90** | **60.07** |

*(1) $CO_2$ emissions of Biomass are not included in Total.*

*Table A 53: 1995 energy consumption and $CO_2$ emissions from category 1 A Fuel Combustion by fuel type and sector.*

| | | Consumption (PJ) | | | | | $CO_2$ emissions (Tg) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 A 1 | 1 A 2 | 1 A 3 + 1 A 5 | 1 A 4 | 1 A | 1 A 1 | 1 A 2 | 1 A 3 + 1 A 5 | 1 A 4 | 1 A |
| | | **Energy Ind.** | **Indus-try** | **Trans-port** | **Other Sectors** | **Total** | **Energy Ind.** | **Indus-try** | **Trans-port** | **Other Sectors** | **Total** |
| | **Total Solid** | **45.49** | **44.37** | **0.06** | **18.57** | **108.50** | **4.53** | **4.46** | **0.01** | **1.75** | **10.74** |
| 102A | Hard Coal | 29.91 | 7.44 | 0.06 | 4.09 | 41.50 | 2.82 | 0.70 | 0.01 | 0.38 | 3.91 |
| 104A | Hard Coal Briquettes | | | | | | | | | | |
| 105A | Brown Coal | 15.58 | 2.29 | | 1.14 | 19.00 | 1.71 | 0.22 | | 0.12 | 2.05 |
| 106A | Brown Coal Briquettes | | 0.28 | | 3.05 | 3.32 | | 0.03 | | 0.30 | 0.32 |
| 107A | Coke | | 27.66 | | 10.30 | 37.96 | | 2.88 | | 0.95 | 3.82 |
| 113A | Peat | | | | 0.00 | 0.00 | | | | 0.00 | 0.00 |
| 304A | Coke Oven Gas | | 6.70 | | | 6.70 | | 0.63 | | | 0.63 |
| | **Total Liquid** | **51.95** | **39.74** | **208.84** | **108.15** | **408.68** | **3.73** | **3.05** | **15.44** | **8.09** | **30.34** |
| 110A | Petrol Coke | 1.87 | 0.36 | | | 2.23 | 0.19 | 0.04 | | | 0.23 |
| 203B | Light Fuel Oil | 1.39 | 11.55 | | 17.79 | 30.73 | 0.11 | 0.90 | | 1.37 | 2.38 |
| 203C | Medium Fuel Oil | 0.11 | 0.00 | | 2.32 | 2.43 | 0.01 | 0.00 | | 0.18 | 0.19 |
| 203D | Heavy Fuel Oil | 23.32 | 19.84 | | 0.46 | 43.61 | 1.85 | 1.55 | | 0.04 | 3.44 |
| 204A | Gasoil | 0.09 | 0.20 | | 70.50 | 70.80 | 0.01 | 0.02 | | 5.29 | 5.31 |
| 2050 | Diesel | 0.28 | 4.84 | 107.45 | 10.64 | 123.22 | 0.02 | 0.36 | 7.93 | 0.79 | 9.10 |
| 206A | Other Kerosene | | | | 0.25 | 0.25 | | | | 0.02 | 0.02 |
| 206B | Jet Kerosene | | | 1.11 | | 1.11 | | | 0.05 | | 0.08 |
| 207A | Aviation Gasoline | | | 0.10 | | 0.10 | | | 0.01 | | 0.01 |
| 2080 | Motor Gasoline | | 0.07 | 100.18 | 1.52 | 101.77 | | 0.00 | 7.45 | 0.11 | 7.57 |
| 224A | Other Petroleum Prod-ucts | 8.88 | | | 0.01 | 8.89 | 0.69 | | | 0.00 | 0.69 |
| 303A | Liquified Petroleum Gas (LPG) | 1.06 | 2.87 | | 4.67 | 8.61 | 0.07 | 0.18 | | 0.30 | 0.55 |
| 308A | Refinery Gas | 14.94 | | | | 14.94 | 0.78 | | | | 0.78 |
| **301A** | **Total Gaseous** (Natu-ral Gas) | **80.70** | **99.58** | **4.09** | **74.46** | **258.83** | **4.47** | **5.52** | **0.23** | **4.13** | **14.34** |
| | **Total Other Fuel** | **3.91** | **5.27** | | **1.74** | **10.92** | **0.19** | **0.47** | | **0.18** | **0.84** |
| 114B | Municipal Waste | 3.91 | | | | 3.91 | 0.19 | | | | 0.19 |
| 115A | Industrial Waste | | 5.27 | | 1.74 | 7.00 | | 0.47 | | 0.18 | 0.65 |
| | **Total Biomass**(1) | **4.37** | **34.06** | | **70.05** | **108.47** | **(0.48)** | **(3.74)** | | **(7.04)** | **(11.26)** |
| 111A | Fuel Wood | | 1.08 | | 66.28 | 67.35 | | 0.11 | | 6.63 | 6.74 |
| 116A | Wood Wastes | 3.60 | 11.20 | | 3.11 | 17.91 | 0.40 | 1.23 | | 0.34 | 1.97 |
| 118A | Sewage Sludge | 0.73 | | | | 0.73 | 0.08 | | | | 0.08 |
| 215A | Black Liquor | | 21.63 | | | 21.63 | | 2.38 | | | 2.38 |
| 309A | Biogas | | 0.04 | | | 0.04 | | 0.00 | | | 0.00 |
| 309B | Sewage Sludge Gas | 0.01 | 0.00 | | 0.61 | 0.62 | 0.00 | 0.00 | | 0.07 | 0.07 |
| 310A | Landfill Gas | 0.03 | 0.12 | | 0.05 | 0.20 | 0.00 | 0.01 | | 0.01 | 0.02 |
| | **Total**(1) | **186.41** | **223.01** | **213.00** | **272.97** | **895.39** | **12.92** | **13.49** | **15.67** | **14.14** | **56.25** |

*(1) $CO_2$ emissions of Biomass are not included in Total.*

*Table A 54: 1994 energy consumption and $CO_2$ emissions from category 1 A Fuel Combustion by fuel type and sector.*

| | | Consumption (PJ) | | | | | $CO_2$ emissions (Tg) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 A 1 | 1 A 2 | 1 A 3 + 1 A 5 | 1 A 4 | 1 A | 1 A 1 | 1 A 2 | 1 A 3 + 1 A 5 | 1 A 4 | 1 A |
| | | **Energy Ind.** | **Indus-try** | **Trans-port** | **Other Sectors** | **Total** | **Energy Ind.** | **Indus-try** | **Trans-port** | **Other Sectors** | **Total** |
| | **Total Solid** | **45.49** | **44.37** | **0.06** | **18.57** | **108.50** | **4.53** | **4.46** | **0.01** | **1.75** | **10.74** |
| 102A | Hard Coal | 29.91 | 7.44 | 0.06 | 4.09 | 41.50 | 2.82 | 0.70 | 0.01 | 0.38 | 3.91 |
| 104A | Hard Coal Briquettes | | | | | | | | | | |
| 105A | Brown Coal | 15.58 | 2.29 | | 1.14 | 19.00 | 1.71 | 0.22 | | 0.12 | 2.05 |
| 106A | Brown Coal Briquettes | | 0.28 | | 3.05 | 3.32 | | 0.03 | | 0.30 | 0.32 |
| 107A | Coke | | 27.66 | | 10.30 | 37.96 | | 2.88 | | 0.95 | 3.82 |
| 113A | Peat | | | | 0.00 | 0.00 | | | | 0.00 | 0.00 |
| 304A | Coke Oven Gas | | 6.70 | | | 6.70 | | 0.63 | | | 0.63 |
| | **Total Liquid** | **51.95** | **39.74** | **208.84** | **108.15** | **408.68** | **3.73** | **3.05** | **15.44** | **8.09** | **30.34** |
| 110A | Petrol Coke | 1.87 | 0.36 | | | 2.23 | 0.19 | 0.04 | | | 0.23 |
| 203B | Light Fuel Oil | 1.39 | 11.55 | | 17.79 | 30.73 | 0.11 | 0.90 | | 1.37 | 2.38 |
| 203C | Medium Fuel Oil | 0.11 | 0.00 | | 2.32 | 2.43 | 0.01 | 0.00 | | 0.18 | 0.19 |
| 203D | Heavy Fuel Oil | 23.32 | 19.84 | | 0.46 | 43.61 | 1.85 | 1.55 | | 0.04 | 3.44 |
| 204A | Gasoil | 0.09 | 0.20 | | 70.50 | 70.80 | 0.01 | 0.02 | | 5.29 | 5.31 |
| 2050 | Diesel | 0.28 | 4.84 | 107.45 | 10.64 | 123.22 | 0.02 | 0.36 | 7.93 | 0.79 | 9.10 |
| 206A | Other Kerosene | | | | 0.25 | 0.25 | | | | 0.02 | 0.02 |
| 206B | Jet Kerosene | | | 1.11 | | 1.11 | | | 0.05 | | 0.08 |
| 207A | Aviation Gasoline | | | 0.10 | | 0.10 | | | 0.01 | | 0.01 |
| 2080 | Motor Gasoline | | 0.07 | 100.18 | 1.52 | 101.77 | | 0.00 | 7.45 | 0.11 | 7.57 |
| 224A | Other Petroleum Prod-ucts | 8.88 | | | 0.01 | 8.89 | 0.69 | | | 0.00 | 0.69 |
| 303A | Liquified Petroleum Gas (LPG) | 1.06 | 2.87 | | 4.67 | 8.61 | 0.07 | 0.18 | | 0.30 | 0.55 |
| 308A | Refinery Gas | 14.94 | | | | 14.94 | 0.78 | | | | 0.78 |
| **301A** | **Total Gaseous** (Natu-ral Gas) | **80.70** | **99.58** | **4.09** | **74.46** | **258.83** | **4.47** | **5.52** | **0.23** | **4.13** | **14.34** |
| | **Total Other Fuel** | **3.91** | **5.27** | | **1.74** | **10.92** | **0.19** | **0.47** | | **0.18** | **0.84** |
| 114B | Municipal Waste | 3.91 | | | | 3.91 | 0.19 | | | | 0.19 |
| 115A | Industrial Waste | | 5.27 | | 1.74 | 7.00 | | 0.47 | | 0.18 | 0.65 |
| | **Total Biomass**(1) | **4.37** | **34.06** | | **70.05** | **108.47** | **(0.48)** | **(3.74)** | | **(7.04)** | **(11.26)** |
| 111A | Fuel Wood | | 1.08 | | 66.28 | 67.35 | | 0.11 | | 6.63 | 6.74 |
| 116A | Wood Wastes | 3.60 | 11.20 | | 3.11 | 17.91 | 0.40 | 1.23 | | 0.34 | 1.97 |
| 118A | Sewage Sludge | 0.73 | | | | 0.73 | 0.08 | | | | 0.08 |
| 215A | Black Liquor | | 21.63 | | | 21.63 | | 2.38 | | | 2.38 |
| 309A | Biogas | | 0.04 | | | 0.04 | | 0.00 | | | 0.00 |
| 309B | Sewage Sludge Gas | 0.01 | 0.00 | | 0.61 | 0.62 | 0.00 | 0.00 | | 0.07 | 0.07 |
| 310A | Landfill Gas | 0.03 | 0.12 | | 0.05 | 0.20 | 0.00 | 0.01 | | 0.01 | 0.02 |
| | **Total**(1) | **186.41** | **223.01** | **213.00** | **272.97** | **895.39** | **12.92** | **13.49** | **15.67** | **14.14** | **56.25** |

*(1) $CO_2$ emissions of Biomass are not included in Total.*

*Table A 55: 1993 energy consumption and $CO_2$ emissions from category 1 A Fuel Combustion by fuel type and sector.*

| | | Consumption (PJ) | | | | | $CO_2$ emissions (Tg) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 A 1 | 1 A 2 | 1 A 3 + 1 A 5 | 1 A 4 | 1 A | 1 A 1 | 1 A 2 | 1 A 3 + 1 A 5 | 1 A 4 | 1 A |
| | | Energy Ind. | Indus-try | Trans-port | Other Sectors | Total | Energy Ind. | Indus-try | Trans-port | Other Sectors | Total |
| | **Total Solid** | **30.81** | **43.32** | **0.06** | **22.10** | **96.29** | **3.09** | **4.32** | **0.01** | **2.08** | **9.49** |
| 102A | Hard Coal | 19.93 | 8.35 | 0.06 | 4.23 | 32.58 | 1.92 | 0.79 | 0.01 | 0.39 | 3.10 |
| 104A | Hard Coal Briquettes | | | | | | | | | | |
| 105A | Brown Coal | 10.64 | 2.48 | | 1.54 | 14.66 | 1.15 | 0.24 | | 0.17 | 1.55 |
| 106A | Brown Coal Briquettes | 0.23 | 0.34 | | 3.61 | 4.18 | 0.02 | 0.03 | | 0.35 | 0.41 |
| 107A | Coke | | 23.38 | | 12.71 | 36.09 | | 2.43 | | 1.17 | 3.60 |
| 113A | Peat | | | | 0.00 | 0.00 | | | | 0.00 | 0.00 |
| 304A | Coke Oven Gas | | 8.77 | | | 8.77 | | 0.83 | | | 0.83 |
| | **Total Liquid** | **59.10** | **43.03** | **204.35** | **107.51** | **413.98** | **4.24** | **3.32** | **15.12** | **8.04** | **30.76** |
| 110A | Petrol Coke | 2.22 | 0.78 | | | 3.01 | 0.22 | 0.08 | | | 0.30 |
| 203B | Light Fuel Oil | 2.22 | 13.32 | | 17.41 | 32.95 | 0.17 | 1.04 | | 1.34 | 2.55 |
| 203C | Medium Fuel Oil | 0.39 | 0.04 | | 3.50 | 3.92 | 0.03 | 0.00 | | 0.27 | 0.31 |
| 203D | Heavy Fuel Oil | 28.19 | 21.66 | | 0.42 | 50.27 | 2.23 | 1.69 | | 0.03 | 3.96 |
| 204A | Gasoil | 0.11 | 0.26 | | 67.95 | 68.32 | 0.01 | 0.02 | | 5.10 | 5.12 |
| 2050 | Diesel | 0.24 | 4.36 | 95.59 | 10.99 | 111.19 | 0.02 | 0.32 | 7.07 | 0.81 | 8.23 |
| 206A | Other Kerosene | | | | 0.62 | 0.62 | | | | 0.05 | 0.05 |
| 206B | Jet Kerosene | | | 1.07 | | 1.07 | | | 0.04 | | 0.08 |
| 207A | Aviation Gasoline | | | 0.12 | | 0.12 | | | 0.01 | | 0.01 |
| 2080 | Motor Gasoline | | 0.06 | 107.56 | 1.51 | 109.13 | | 0.00 | 8.00 | 0.11 | 8.11 |
| 224A | Other Petroleum Prod-ucts | 9.86 | | | 0.03 | 9.90 | 0.77 | | | 0.00 | 0.77 |
| 303A | Liquified Petroleum Gas (LPG) | 0.22 | 2.54 | | 5.08 | 7.84 | 0.01 | 0.16 | | 0.32 | 0.50 |
| 308A | Refinery Gas | 15.65 | | | | 15.65 | 0.77 | | | | 0.77 |
| **301A** | **Total Gaseous** (Natu-ral Gas) | **71.43** | **77.79** | **3.87** | **71.70** | **224.79** | **3.96** | **4.31** | **0.21** | **3.97** | **12.45** |
| | **Total Other Fuel** | **3.76** | **4.18** | | **1.84** | **9.78** | **0.18** | **0.30** | | **0.19** | **0.67** |
| 114B | Municipal Waste | 3.76 | | | | 3.76 | 0.18 | | | | 0.18 |
| 115A | Industrial Waste | | 4.18 | | 1.84 | 6.02 | | 0.30 | | 0.19 | 0.49 |
| | **Total Biomass**(1) | **3.52** | **32.31** | | **69.89** | **105.71** | **(0.39)** | **(3.55)** | | **(7.03)** | **(10.96)** |
| 111A | Fuel Wood | | 0.80 | | 66.38 | 67.18 | | 0.08 | | 6.64 | 6.72 |
| 116A | Wood Wastes | 2.74 | 12.76 | | 2.81 | 18.31 | 0.30 | 1.40 | | 0.31 | 2.01 |
| 118A | Sewage Sludge | 0.77 | | | | 0.77 | 0.09 | | | | 0.09 |
| 215A | Black Liquor | | 18.75 | | | 18.75 | | 2.06 | | | 2.06 |
| 309A | Biogas | | | | | | | | | | |
| 309B | Sewage Sludge Gas | | 0.00 | | 0.63 | 0.63 | | 0.00 | | 0.07 | 0.07 |
| 310A | Landfill Gas | | | | 0.08 | 0.08 | | | | 0.01 | 0.01 |
| | **Total**(1) | **168.61** | **200.63** | **208.27** | **273.04** | **850.55** | **11.47** | **12.25** | **15.34** | **14.29** | **53.38** |

*(1) $CO_2$ emissions of Biomass are not included in Total.*

*Table A 56: 1992 energy consumption and $CO_2$ emissions from category 1 A Fuel Combustion by fuel type and sector.*

| | | Consumption (PJ) | | | | | $CO_2$ emissions (Tg) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 A 1 | 1 A 2 | 1 A 3 + 1 A 5 | 1 A 4 | 1 A | 1 A 1 | 1 A 2 | 1 A 3 + 1 A 5 | 1 A 4 | 1 A |
| | | **Energy Ind.** | **Indus-try** | **Trans-port** | **Other Sectors** | **Total** | **Energy Ind.** | **Industry** | **Trans-port** | **Other Sectors** | **Total** |
| | **Total Solid** | **39.96** | **41.61** | **0.07** | **26.69** | **108.34** | **4.01** | **4.14** | **0.01** | **2.51** | **10.67** |
| 102A | Hard Coal | 27.97 | 10.19 | 0.07 | 3.35 | 41.58 | 2.73 | 0.96 | 0.01 | 0.31 | 4.01 |
| 104A | Hard Coal Briquettes | | | | | | | | | | |
| 105A | Brown Coal | 11.74 | 2.27 | | 1.89 | 15.91 | 1.25 | 0.22 | | 0.20 | 1.67 |
| 106A | Brown Coal Briquettes | 0.26 | 0.39 | | 4.23 | 4.87 | 0.03 | 0.04 | | 0.41 | 0.47 |
| 107A | Coke | | 21.60 | | 17.22 | 38.82 | | 2.25 | | 1.58 | 3.83 |
| 113A | Peat | | | | 0.00 | 0.00 | | | | 0.00 | 0.00 |
| 304A | Coke Oven Gas | | 7.16 | | | 7.16 | | 0.68 | | | 0.68 |
| | **Total Liquid** | **48.41** | **36.68** | **199.96** | **108.04** | **393.09** | **3.40** | **2.83** | **14.98** | **8.10** | **29.35** |
| 110A | Petrol Coke | 2.30 | 0.93 | | | 3.23 | 0.23 | 0.09 | | | 0.33 |
| 203B | Light Fuel Oil | 1.88 | 9.15 | | 24.10 | 35.13 | 0.15 | 0.71 | | 1.86 | 2.72 |
| 203C | Medium Fuel Oil | 0.12 | 0.07 | | 3.68 | 3.87 | 0.01 | 0.01 | | 0.29 | 0.30 |
| 203D | Heavy Fuel Oil | 19.86 | 19.92 | | 1.12 | 40.91 | 1.57 | 1.55 | | 0.09 | 3.21 |
| 204A | Gasoil | 0.04 | 0.18 | | 60.38 | 60.61 | 0.00 | 0.01 | | 4.53 | 4.55 |
| 2050 | Diesel | 0.00 | 4.10 | 89.18 | 10.92 | 104.21 | 0.00 | 0.30 | 6.60 | 0.81 | 7.71 |
| 206A | Other Kerosene | | 0.05 | | 1.26 | 1.31 | | 0.00 | | 0.10 | 0.10 |
| 206B | Jet Kerosene | | | 0.92 | | 0.92 | | | 0.03 | | 0.07 |
| 207A | Aviation Gasoline | | | 0.12 | | 0.12 | | | 0.01 | | 0.01 |
| 2080 | Motor Gasoline | | 0.06 | 109.75 | 1.47 | 111.28 | | 0.00 | 8.34 | 0.11 | 8.45 |
| 224A | Other Petroleum Prod-ucts | 7.38 | | | 0.00 | 7.38 | 0.58 | | | 0.00 | 0.58 |
| 303A | Liquified Petroleum Gas (LPG) | 0.22 | 2.23 | | 5.09 | 7.54 | 0.01 | 0.14 | | 0.33 | 0.48 |
| 308A | Refinery Gas | 16.60 | | | | 16.60 | 0.84 | | | | 0.84 |
| **301A** | **Total Gaseous** (Natu-ral Gas) | **70.45** | **78.76** | **3.97** | **63.44** | **216.61** | **3.90** | **4.36** | **0.22** | **3.51** | **12.00** |
| | **Total Other Fuel** | **3.48** | **5.27** | | **3.25** | **12.01** | **0.17** | **0.45** | | **0.34** | **0.96** |
| 114B | Municipal Waste | 3.48 | | | | 3.48 | 0.17 | | | | 0.17 |
| 115A | Industrial Waste | | 5.27 | | 3.25 | 8.52 | | 0.45 | | 0.34 | 0.79 |
| | **Total Biomass**(1) | **3.40** | **29.37** | | **67.80** | **100.57** | **(0.37)** | **(3.22)** | | **(6.81)** | **(10.4)** |
| 111A | Fuel Wood | | 0.71 | | 65.28 | 65.98 | | 0.07 | | 6.53 | 6.60 |
| 116A | Wood Wastes | 2.74 | 10.38 | | 2.53 | 15.66 | 0.30 | 1.14 | | 0.28 | 1.72 |
| 118A | Sewage Sludge | 0.66 | | | | 0.66 | 0.07 | | | | 0.07 |
| 215A | Black Liquor | | 18.28 | | | 18.28 | | 2.01 | | | 2.01 |
| 309A | Biogas | | | | | | | | | | |
| 309B | Sewage Sludge Gas | | | | | | | | | | |
| 310A | Landfill Gas | | | | | | | | | | |
| | **Total**(1) | **165.71** | **191.68** | **204.00** | **269.23** | **830.61** | **11.48** | **11.78** | **15.21** | **14.47** | **52.97** |

*(1) $CO_2$ emissions of Biomass are not included in Total.*

*Table A 57: 1991 energy consumption and $CO_2$ emissions from category 1 A Fuel Combustion by fuel type and sector.*

| | | Consumption (PJ) | | | | | $CO_2$ emissions (Tg) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 A 1 | 1 A 2 | 1 A 3 + 1 A 5 | 1 A 4 | 1 A | 1 A 1 | 1 A 2 | 1 A 3 + 1 A 5 | 1 A 4 | 1 A |
| | | **Energy Ind.** | **Indus-try** | **Trans-port** | **Other Sectors** | **Total** | **Energy Ind.** | **Industry** | **Trans-port** | **Other Sectors** | **Total** |
| | **Total Solid** | **67.34** | **47.60** | **0.06** | **31.15** | **146.16** | **6.82** | **4.76** | **0.01** | **2.93** | **14.52** |
| 102A | Hard Coal | 41.79 | 8.24 | 0.06 | 5.51 | 55.60 | 4.13 | 0.77 | 0.01 | 0.51 | 5.42 |
| 104A | Hard Coal Briquettes | | | | | | | | | | |
| 105A | Brown Coal | 24.92 | 2.89 | | 2.38 | 30.19 | 2.62 | 0.28 | | 0.26 | 3.16 |
| 106A | Brown Coal Briquettes | 0.63 | 0.62 | | 4.90 | 6.15 | 0.06 | 0.06 | | 0.47 | 0.60 |
| 107A | Coke | | 27.00 | | 18.36 | 45.35 | | 2.81 | | 1.69 | 4.50 |
| 113A | Peat | | | | 0.00 | 0.00 | | | | 0.00 | 0.00 |
| 304A | Coke Oven Gas | | 8.86 | | | 8.86 | | 0.84 | | | 0.84 |
| | **Total Liquid** | **48.53** | **46.20** | **200.17** | **114.50** | **409.40** | **3.41** | **3.56** | **15.00** | **8.61** | **30.61** |
| 110A | Petrol Coke | 2.20 | 1.02 | | | 3.22 | 0.22 | 0.10 | | | 0.32 |
| 203B | Light Fuel Oil | 2.08 | 11.75 | | 26.29 | 40.12 | 0.16 | 0.92 | | 2.02 | 3.10 |
| 203C | Medium Fuel Oil | 0.06 | 0.02 | | 4.81 | 4.88 | 0.00 | 0.00 | | 0.37 | 0.38 |
| 203D | Heavy Fuel Oil | 19.88 | 25.76 | | 0.79 | 46.43 | 1.57 | 2.01 | | 0.06 | 3.64 |
| 204A | Gasoil | 0.01 | 0.19 | | 64.86 | 65.07 | 0.00 | 0.01 | | 4.86 | 4.88 |
| 2050 | Diesel | 0.00 | 3.87 | 84.38 | 10.83 | 99.08 | 0.00 | 0.29 | 6.24 | 0.80 | 7.33 |
| 206A | Other Kerosene | | | | 1.36 | 1.36 | | | | 0.11 | 0.11 |
| 206B | Jet Kerosene | | | 0.89 | | 0.89 | | | 0.03 | | 0.06 |
| 207A | Aviation Gasoline | | | 0.11 | | 0.11 | | | 0.01 | | 0.01 |
| 2080 | Motor Gasoline | | 0.05 | 114.79 | 1.45 | 116.30 | | 0.00 | 8.72 | 0.11 | 8.83 |
| 224A | Other Petroleum Prod-ucts | 7.72 | 0.02 | | 0.53 | 8.27 | 0.60 | 0.00 | | 0.03 | 0.64 |
| 303A | Liquified Petroleum Gas (LPG) | 0.58 | 3.50 | | 3.58 | 7.67 | 0.04 | 0.22 | | 0.23 | 0.49 |
| 308A | Refinery Gas | 16.00 | | | | 16.00 | 0.81 | | | | 0.81 |
| **301A** | **Total Gaseous** (Natu-ral Gas) | **76.80** | **78.77** | **4.07** | **55.89** | **215.53** | **4.25** | **4.36** | **0.23** | **3.10** | **11.94** |
| | **Total Other Fuel** | **2.90** | **4.56** | | **2.62** | **10.08** | **0.14** | **0.39** | | **0.27** | **0.81** |
| 114B | Municipal Waste | 2.90 | | | | 2.90 | 0.14 | | | | 0.14 |
| 115A | Industrial Waste | | 4.56 | | 2.62 | 7.18 | | 0.39 | | 0.27 | 0.66 |
| | **Total Biomass**(1) | **3.02** | **28.65** | | **71.66** | **103.33** | **(0.33)** | **(3.14)** | | **(7.19)** | **(10.67)** |
| 111A | Fuel Wood | | 0.74 | | 69.23 | 69.96 | | 0.07 | | 6.92 | 7.00 |
| 116A | Wood Wastes | 2.36 | 9.97 | | 2.44 | 14.77 | 0.26 | 1.10 | | 0.27 | 1.62 |
| 118A | Sewage Sludge | 0.66 | | | | 0.66 | 0.07 | | | | 0.07 |
| 215A | Black Liquor | | 17.94 | | | 17.94 | | 1.97 | | | 1.97 |
| 309A | Biogas | | | | | | | | | | |
| 309B | Sewage Sludge Gas | | | | | | | | | | |
| 310A | Landfill Gas | | | | | | | | | | |
| | **Total**(1) | **198.59** | **205.78** | **204.30** | **275.83** | **884.50** | **14.62** | **13.08** | **15.23** | **14.91** | **57.88** |

*(1) $CO_2$ emissions of Biomass are not included in Total.*

*Table A 58: 1990 energy consumption and $CO_2$ emissions from category 1 A Fuel Combustion by fuel type and sector.*

| | | Consumption (PJ) | | | | | $CO_2$ emissions (Tg) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 A 1 | 1 A 2 | 1 A 3 + 1 A 5 | 1 A 4 | 1 A | 1 A 1 | 1 A 2 | 1 A 3 + 1 A 5 | 1 A 4 | 1 A |
| | | Energy Ind. | Indus-try | Trans-port | Other Sectors | Total | Energy Ind. | Industry | Trans-port | Other Sectors | Total |
| | **Total Solid** | **61.40** | **50.28** | **0.07** | **28.14** | **139.89** | **6.25** | **5.02** | **0.01** | **2.65** | **13.92** |
| 102A | Hard Coal | 38.44 | 7.17 | 0.07 | 5.29 | 50.97 | 3.85 | 0.67 | 0.01 | 0.49 | 5.03 |
| 104A | Hard Coal Briquettes | | | | | | | | | | |
| 105A | Brown Coal | 22.73 | 2.19 | | 2.36 | 27.28 | 2.37 | 0.21 | | 0.26 | 2.84 |
| 106A | Brown Coal Briquettes | 0.23 | 1.24 | | 4.45 | 5.91 | 0.02 | 0.12 | | 0.43 | 0.57 |
| 107A | Coke | | 27.19 | | 16.04 | 43.22 | | 2.83 | | 1.48 | 4.30 |
| 113A | Peat | | | | 0.00 | 0.00 | | | | 0.00 | 0.00 |
| 304A | Coke Oven Gas | | 12.51 | | | 12.51 | | 1.18 | | | 1.18 |
| | **Total Liquid** | **46.45** | **40.70** | **180.63** | **109.27** | **377.04** | **3.19** | **3.14** | **13.54** | **8.23** | **28.14** |
| 110A | Petrol Coke | 1.95 | 0.98 | | | 2.92 | 0.20 | 0.10 | | | 0.29 |
| 203B | Light Fuel Oil | 1.61 | 10.99 | | 33.54 | 46.14 | 0.13 | 0.86 | | 2.58 | 3.57 |
| 203C | Medium Fuel Oil | 0.29 | 0.01 | | 4.47 | 4.77 | 0.02 | 0.00 | | 0.35 | 0.37 |
| 203D | Heavy Fuel Oil | 16.97 | 22.17 | | 1.63 | 40.78 | 1.34 | 1.73 | | 0.13 | 3.19 |
| 204A | Gasoil | 0.00 | 0.06 | | 52.94 | 53.00 | 0.00 | 0.00 | | 3.97 | 3.97 |
| 2050 | Diesel | 0.01 | 3.43 | 75.07 | 10.81 | 89.31 | 0.00 | 0.25 | 5.55 | 0.80 | 6.61 |
| 206A | Other Kerosene | | | | 0.77 | 0.77 | | | | 0.06 | 0.06 |
| 206B | Jet Kerosene | | | 0.79 | | 0.79 | | | 0.02 | | 0.06 |
| 207A | Aviation Gasoline | | | 0.11 | | 0.11 | | | 0.01 | | 0.01 |
| 2080 | Motor Gasoline | | 0.05 | 104.66 | 1.51 | 106.22 | | 0.00 | 7.95 | 0.11 | 8.07 |
| 224A | Other Petroleum Prod-ucts | 6.93 | 0.02 | | 0.87 | 7.82 | 0.54 | 0.00 | | 0.06 | 0.60 |
| 303A | Liquified Petroleum Gas (LPG) | 0.41 | 2.99 | | 2.73 | 6.14 | 0.03 | 0.19 | | 0.18 | 0.39 |
| 308A | Refinery Gas | 18.28 | | | | 18.28 | 0.94 | | | | 0.94 |
| **301A** | **Total Gaseous** (Natu-ral Gas) | **76.48** | **76.99** | **4.05** | **46.46** | **203.98** | **4.24** | **4.27** | **0.22** | **2.57** | **11.30** |
| | **Total Other Fuel** | **2.41** | **3.22** | | **3.36** | **8.99** | **0.12** | **0.26** | | **0.35** | **0.73** |
| 114B | Municipal Waste | 2.41 | | | | 2.41 | 0.12 | | | | 0.12 |
| 115A | Industrial Waste | | 3.22 | | 3.36 | 6.58 | | 0.26 | | 0.35 | 0.61 |
| | **Total Biomass**(1) | **2.04** | **28.30** | | **64.52** | **94.86** | **(0.22)** | **(3.11)** | | **(6.47)** | **(9.8)** |
| 111A | Fuel Wood | | 0.66 | | 62.46 | 63.12 | | 0.07 | | 6.25 | 6.31 |
| 116A | Wood Wastes | 1.38 | 9.65 | | 2.06 | 13.10 | 0.15 | 1.06 | | 0.23 | 1.44 |
| 118A | Sewage Sludge | 0.66 | | | | 0.66 | 0.07 | | | | 0.07 |
| 215A | Black Liquor | | 17.98 | | | 17.98 | | 1.98 | | | 1.98 |
| 309A | Biogas | | | | | | | | | | |
| 309B | Sewage Sludge Gas | | | | | | | | | | |
| 310A | Landfill Gas | | | | | | | | | | |
| | **Total**(1) | **188.78** | **199.50** | **184.75** | **251.74** | **824.76** | **13.79** | **12.69** | **13.77** | **13.81** | **54.09** |

*(1) $CO_2$ emissions of Biomass are not included in Total.*

# ANNEX 3: $CO_2$ REFERENCE APPROACH

In this annex the results, methodology and detailed data for the $CO_2$ reference approach are presented.

**Methodology**

The default methodology according to IPCC Worksheet 1-1 was used.

**Emission factors**

Carbon emission factors

For estimation of emissions that arise from combustion of fossil fuels the default carbon emission factors described in chapter 1.4.1.1 of the IPCC Reference Manual have been used (IPCC Workbook 1.6 table 1-2). For selected values see Table A 63.

Fraction of carbon oxidised

The default values of table 1-6 of the IPCC Reference Manual have been used. For selected values see Table A 63.

**Activity data**

Production, Imports, Exports, Stock Change

Activity data are taken from the national energy balance (IEA JQ 2006) (see Annex 2 and Annex 4). The reference approach requires more detailed fuel categories than provided in the national energy balance. Some fuel categories are aggregations of the detailed fuel categories the reference approach asks for. The following fuel types are included elsewhere:

- Ethane is included in Refinery Feedstocks.
- Liquid Biomass is included in Solid Biomass.

International Bunkers

International bunkers are only relevant for aviation. However, there is "international" navigation on the Danube, but this is included in national navigation.

Fuel consumption of international bunkers is consistent with memo item international bunkers as described in the relevant chapter for Category *1.A.3*.

Carbon Stored (Feedstocks)

Emissions from carbon stored in products are calculated for each fuel by multiplying its non–energy use with the corresponding default IPCC carbon emission factor.

For all fuels except for coke oven coke the IPCC default values for the fraction of carbon stored are used. To estimate carbon stored from coke oven coke carbon remaining in steel is calculated as the following:

*Carbon stored in steel [Mg]= raw steel production [Mg]* 0.0015 + electric steel [Mg] * 0.01*

which leads to an average fraction of carbon stored of 0.007 of total inland coke consumption.

In the Sectoral Approach the release of stored carbon as emissions is considered as quoted in the NIR, chapter *3.4 Feedstock*.

**Recalculations**

Activity data

Imports, Exports and Production are updated according to the new version of the energy balance (IEA JQ 2007). Changes of activity data are based on energy balance recalculations as described in Annex 2.

**Results of the Reference Approach**

Table A 59-Table A 63 present calculation results, apparent fuel consumption, carbon stored, international bunker fuels, conversion factors, carbon emission factors and the fraction of carbon oxidised for all fuel types of the Reference Approach.

Table A 59 present the calculation results for each fuel type of the Reference Approach for selected years.

*Table A 59: Actual $CO_2$ emissions (Gg $CO_2$) for selected years.*

| Fuel Type | 1990 | 1995 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Crude Oil | 24 681 | 26 751 | 28 522 | 26 802 | 25 573 | 27 308 | 27 771 | 27 371 | 26 201 | 27 135 | 26 294 | 26 523 |
| Orimulsion | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Natural Gas Liquids | 116 | 121 | 637 | 199 | 302 | 154 | 149 | 261 | 249 | 215 | 243 | 503 |
| Gasoline | -229 | 386 | -82 | -258 | 519 | 215 | 674 | 1 228 | 1 306 | 870 | 1 216 | 748 |
| Jet Kerosene | -843 | -1 206 | -1 536 | -1 445 | -1 569 | -1 479 | -1 387 | -1 269 | -1 287 | -1 713 | -1 495 | -1 735 |
| Other Kerosene | -44 | -8 | 47 | 48 | 16 | -1 | 10 | 11 | 9 | 8 | 7 | 6 |
| Shale Oil | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Gas / Diesel Oil | 1 815 | 3 719 | 6 165 | 6 599 | 6 985 | 8 168 | 9 471 | 12 198 | 13 336 | 13 083 | 13 362 | 12 918 |
| Residuel Fuel Oil | 995 | 1 212 | 1 893 | 922 | 1 097 | 1 079 | 242 | 865 | 467 | 311 | 465 | 376 |
| LPG | 252 | 373 | 341 | 389 | 405 | 422 | 434 | 376 | 355 | 335 | 391 | 326 |
| Ethane | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Naphtha | -1 060 | -1 233 | -1 524 | -1 549 | -1 429 | -1 569 | -1 551 | -1 549 | -1 757 | -1 388 | -2 094 | 0 |
| Bitumen | -864 | -815 | -950 | -1 046 | -1 100 | -1 291 | -1 336 | -1 276 | -1 391 | -1 496 | -1 257 | -1 319 |
| Lubricants | 165 | -85 | -158 | -156 | -166 | -183 | -165 | -226 | -204 | -206 | -234 | -247 |
| Petroleum Coke | -17 | 14 | 29 | 54 | 17 | -5 | 136 | 134 | 228 | 152 | 107 | 82 |
| Refinery Feedstocks | 3 031 | 1 643 | 1 719 | 2 543 | 1 516 | 1 785 | 1 278 | 323 | 1 026 | 1 461 | 1 382 | 1 034 |
| OtherOil | 210 | -122 | -180 | -195 | -128 | -332 | -389 | -367 | 32 | -136 | -157 | -2 191 |
| **Liquid Fossil Totals** | **28 208** | **30 751** | **34 924** | **32 907** | **32 037** | **34 274** | **35 337** | **38 080** | **38 569** | **38 631** | **38 231** | **37 023** |
| Anthracite | 40 | 44 | 4 | 4 | 7 | 4 | 19 | 8 | 18 | 12 | 244 | 0 |
| Coking Coal | 5 926 | 4 766 | 5 500 | 5 560 | 4 658 | 4 720 | 4 681 | 4 695 | 4 716 | 4 647 | 4 623 | 4 653 |
| Other Bit. Coal | 4 688 | 3 808 | 4 034 | 3 341 | 4 784 | 5 286 | 4 933 | 6 136 | 6 369 | 5 571 | 5 846 | 5 953 |
| Sub- Bit. Coal | 0 | 0 | 0 | 29 | 79 | 92 | 123 | 150 | 136 | 136 | 163 | 0 |

| Fuel Type | 1990 | 1995 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lignite | 2 707 | 1 884 | 850 | 1 506 | 1 307 | 1 538 | 1 459 | 1 516 | 1 116 | 1 173 | 731 | 222 |
| Oil Shale | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Peat | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| BKB & Patent Fuel | 548 | 308 | 192 | 197 | 197 | 195 | 118 | 132 | 107 | 92 | 93 | 99 |
| Coke Oven / Gas Coke | 2 008 | 2 687 | 1 970 | 1 840 | 3 118 | 2 746 | 3 546 | 3 339 | 3 301 | 4 048 | 4 131 | 4 022 |
| **Solid Fuel Totals** | **15 917** | **13 499** | **12 550** | **12 478** | **14 151** | **14 581** | **14 880** | **15 977** | **15 762** | **15 680** | **15 832** | **14 950** |
| **Gaseous Fossil** | **12 238** | **15 048** | **15 848** | **16 125** | **15 388** | **16 309** | **16 494** | **17 833** | **17 622** | **19 307** | **17 605** | **16 476** |
| **TOTAL** | **56 362** | **59 298** | **63 323** | **61 510** | **61 577** | **65 163** | **66 711** | **71 890** | **71 953** | **73 618** | **71 668** | **68 449** |
| **Biomass Total** | **9 134** | **10 452** | **10 674** | **12 193** | **11 515** | **12 705** | **13 216** | **13 873** | **13 875** | **14 718** | **16 245** | **16 481** |
| Solid Biomass | 9 134 | 10 360 | 10 536 | 12 075 | 11 376 | 12 589 | 12 893 | 13 758 | 13 745 | 14 578 | 16 069 | 16 297 |
| Liquid Biomass | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Gas Biomass | 0 | 92 | 138 | 119 | 138 | 116 | 323 | 115 | 129 | 140 | 177 | 184 |

Table A 60 present the apparent fuel consumption for each fuel type of the Reference Approach.

*Table A 60: Apparent Consumption (PJ)*

| Fuel Type | 1990 | 1995 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Crude Oil | 339.95 | 368.47 | 392.86 | 369.17 | 352.24 | 376.14 | 382.52 | 377.01 | 360.90 | 373.76 | 362.18 | 365.34 |
| Orimulsion | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Natural Gas Liquids | 1.85 | 1.94 | 10.21 | 3.19 | 4.84 | 2.47 | 2.39 | 4.18 | 3.99 | 3.44 | 3.89 | 8.06 |
| Gasoline | -3.34 | 5.63 | -1.12 | -3.76 | 7.56 | 3.14 | 9.82 | 17.90 | 19.03 | 12.69 | 17.73 | 10.90 |
| Jet Kerosene | -11.91 | -17.04 | -21.70 | -20.41 | -22.17 | -20.89 | -19.60 | -17.93 | -18.19 | -24.19 | -21.12 | -24.51 |
| Other Kerosene | -0.62 | -0.11 | 0.67 | 0.67 | 0.22 | -0.01 | 0.14 | 0.15 | 0.13 | 0.11 | 0.10 | 0.08 |
| Shale Oil | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Gas/Diesel Oil | 24.75 | 50.72 | 84.07 | 90.00 | 95.26 | 111.40 | 129.16 | 166.36 | 181.87 | 178.42 | 182.22 | 176.17 |
| Residuel Fuel Oil | 12.99 | 15.83 | 24.72 | 12.03 | 14.32 | 14.09 | 3.16 | 11.29 | 6.10 | 4.07 | 6.07 | 4.91 |
| LPG | 4.03 | 5.97 | 5.46 | 6.22 | 6.49 | 6.76 | 6.96 | 6.03 | 5.68 | 5.37 | 6.26 | 5.22 |
| Ethane | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Naphtha | 0.09 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | -0.45 | -4.91 | 0.00 |
| Bitumen | 10.80 | 7.48 | 11.09 | 9.41 | 9.80 | 8.69 | 7.41 | 8.67 | 8.55 | 7.45 | 11.78 | 4.63 |
| Lubricants | 5.80 | 0.56 | -0.04 | -0.08 | -0.11 | -0.36 | -0.54 | -1.27 | -1.31 | -1.23 | -1.65 | -1.90 |
| Petroleum Coke | 2.61 | 0.88 | 1.45 | 2.07 | 1.89 | 1.78 | 3.31 | 3.61 | 4.55 | 3.28 | 2.36 | 2.20 |
| Refinery Feedstocks | 41.75 | 22.63 | 23.68 | 35.03 | 20.89 | 24.59 | 17.60 | 4.46 | 14.13 | 20.12 | 19.03 | 14.24 |
| OtherOil | 3.61 | -0.93 | -1.76 | -1.99 | -1.11 | -3.88 | -4.66 | -4.34 | 1.08 | -1.38 | 0.67 | -4.03 |
| **Liquid Fossil Totals** | **432.38** | **462.03** | **529.60** | **501.57** | **490.11** | **523.92** | **537.67** | **576.11** | **586.52** | **581.44** | **584.64** | **561.31** |

| Fuel Type | 1990 | 1995 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Anthracite | 0.45 | 0.48 | 0.06 | 0.06 | 0.08 | 0.06 | 0.22 | 0.11 | 0.20 | 0.14 | 2.55 | 0.00 |
| Coking Coal | 65.42 | 53.43 | 60.81 | 61.36 | 52.58 | 52.97 | 53.15 | 53.14 | 53.34 | 53.16 | 52.95 | 53.20 |
| Other Bit. Coal | 50.57 | 41.08 | 43.51 | 36.04 | 51.60 | 57.02 | 53.21 | 66.19 | 68.70 | 60.10 | 63.06 | 64.21 |
| Sub- Bit. Coal | 0.00 | 0.00 | 0.00 | 0.31 | 0.84 | 0.98 | 1.31 | 1.60 | 1.44 | 1.44 | 1.73 | 0.00 |
| Lignite | 27.29 | 19.00 | 8.57 | 15.18 | 13.18 | 15.51 | 14.71 | 15.29 | 11.25 | 11.83 | 7.37 | 2.24 |
| Oil Shale | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Peat | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| BKB & Patent Fuel | 5.91 | 3.32 | 2.07 | 2.13 | 2.13 | 2.10 | 1.28 | 1.42 | 1.15 | 1.00 | 1.00 | 1.06 |
| Coke Oven / Gas Coke | 19.10 | 25.55 | 18.77 | 17.54 | 29.62 | 26.10 | 33.67 | 31.71 | 31.34 | 38.43 | 39.21 | 38.18 |
| **Solid Fuel Totals** | **168.75** | **142.85** | **133.79** | **132.62** | **150.04** | **154.74** | **157.56** | **169.46** | **167.42** | **166.10** | **167.88** | **158.90** |
| **Gaseous Fossil** | 219.24 | 269.58 | 283.92 | 288.88 | 275.68 | 292.17 | 295.49 | 319.48 | 315.70 | 345.88 | 315.39 | 295.16 |
| **TOTAL** | **820.37** | **874.47** | **947.31** | **923.06** | **915.83** | **970.83** | **990.72** | **1 065.05** | **1 069.63** | **1 093.42** | **1 067.91** | **1 015.37** |
| **Biomass Total** | **94.67** | **108.23** | **110.48** | **126.25** | **119.19** | **131.55** | **136.61** | **143.67** | **143.66** | **152.39** | **168.18** | **170.62** |
| Solid Biomass | 94.67 | 107.39 | 109.21 | 125.16 | 117.92 | 130.48 | 133.64 | 142.61 | 142.47 | 151.10 | 166.55 | 168.92 |
| Liquid Biomass | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Gas Biomass | 0.00 | 0.85 | 1.27 | 1.09 | 1.28 | 1.07 | 2.97 | 1.06 | 1.19 | 1.29 | 1.63 | 1.70 |

Table A 61 present the carbon stored for each fuel type of the Reference Approach.

*Table A 61: Carbon Stored (Gg C)*

| Fuel Type | 1990 | 1995 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Crude Oil | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Orimulsion | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Natural Gas Liquids | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Gasoline | 0.00 | 0.00 | 1.58 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Jet Kerosene | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Other Kerosene | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Shale Oil | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Gas / Diesel Oil | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Residuel Fuel Oil | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| LPG | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Ethane | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Naphtha | 293.69 | 339.60 | 419.94 | 426.69 | 393.61 | 432.10 | 427.37 | 426.69 | 484.08 | 373.36 | 478.68 | 0.00 |
| Bitumen | 475.69 | 389.04 | 505.75 | 495.12 | 518.69 | 546.69 | 531.01 | 542.30 | 571.43 | 575.91 | 605.45 | 465.16 |
| Lubricants | 70.48 | 34.56 | 42.60 | 41.38 | 43.45 | 43.29 | 34.71 | 36.91 | 30.16 | 32.16 | 31.60 | 30.12 |
| Petroleum Coke | 76.50 | 20.43 | 31.84 | 42.11 | 47.35 | 50.17 | 53.53 | 62.37 | 62.36 | 48.39 | 35.30 | 38.07 |
| Refinery Feedstocks | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| OtherOil | 14.36 | 15.03 | 14.32 | 13.98 | 12.96 | 14.03 | 13.91 | 14.28 | 12.61 | 9.90 | 56.69 | 523.01 |

| Fuel Type | 1990 | 1995 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Liquid Fossil Totals** | **930.72** | **798.67** | **1 016.02** | **1 019.28** | **1 016.06** | **1 086.27** | **1 060.52** | **1 082.56** | **1 160.64** | **1 039.72** | **1 207.71** | **1 056.36** |
| Anthracite | 0.75 | 0.38 | 0.38 | 0.38 | 0.38 | 0.38 | 0.75 | 0.75 | 0.38 | 0.38 | 0.38 | 0.00 |
| Coking Coal | 38.85 | 51.96 | 38.17 | 35.67 | 60.24 | 53.09 | 68.48 | 64.49 | 63.73 | 78.17 | 79.74 | 77.65 |
| Other Bit. Coal | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Sub- Bit. Coal | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Lignite | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Oil Shale | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Peat | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| BKB & Patent Fuel | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Coke Oven/ Gas Coke | 4.77 | 5.88 | 5.50 | 5.43 | 6.04 | 5.97 | 6.50 | 6.16 | 5.72 | 7.37 | 6.96 | 6.82 |
| **Solid Fuel Totals** | **44.37** | **58.22** | **44.05** | **41.48** | **66.66** | **59.43** | **75.72** | **71.40** | **69.83** | **85.91** | **87.07** | **84.47** |
| **Gaseous Fossil** | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| **TOTAL** | **975.09** | **856.89** | **1 060.07** | **1 060.76** | **1 082.72** | **1 145.71** | **1 136.24** | **1 153.96** | **1 230.47** | **1 125.63** | **1 294.79** | **1 140.82** |
| **Biomass Total** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** |
| Solid Biomass | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Liquid Biomass | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Gas Biomass | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

Table A 62 present international bunker fuels for the relevant fuel types of the Reference Approach.

*Table A 62: International Bunkers [Gg fuel]*

| Fuel Type | 1990 | 1995 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Jet Kerosene | 275 | 409 | 488 | 475 | 522 | 509 | 475 | 447 | 531 | 604 | 631 | 670 |

Table A 63 present conversion factors, carbon emission factors and the fraction of carbon oxidised for all fuel types of the Reference Approach.

*Table A 63: Conversion factor, carbon emission factor and fraction of carbon oxidised.*

| Fuel Type | Conversion Factor [TJ/Gg] | Carbon emission factor [t C/TJ] | Fraction of carbon oxidised [t C/t C] |
|---|---|---|---|
| Crude Oil | 42.75 | 20.00 | 0.99 |
| Orimulsion | - | - | - |
| Natural Gas Liquids | 45.22 | 17.20 | 0.99 |
| Gasoline | 44.80 | 18.90 | 0.99 |
| Jet Kerosene | 44.59 | 19.50 | 0.99 |
| Other Kerosene | 44.75 | 19.60 | 0.99 |
| Shale Oil | - | - | - |

| Fuel Type | Conversion Factor [TJ/Gg] | Carbon emission factor [t C/TJ] | Fraction of carbon oxidised [t C/t C] |
|---|---|---|---|
| Gas / Diesel Oil | 43.33 | 20.20 | 0.99 |
| Residuel Fuel Oil | 40.19 | 21.10 | 0.99 |
| LPG | 47.31 | 17.20 | 0.99 |
| Ethane | - | - | - |
| Naphtha | 45.01 | 20.00 | 0.99 |
| Bitumen | 40.19 | 22.00 | 0.99 |
| Lubricants | 40.19 | 20.00 | 0.99 |
| Petroleum Coke | 31.00 | 27.50 | 0.99 |
| Refinery Feedstocks | 42.50 | 20.00 | 0.99 |
| OtherOil | 40.19 | 20.00 | 0.99 |
| Anthracite | 28.00 | 26.80 | 0.98 |
| Coking Coal | 28.00 | 25.80 | 0.98 |
| Other Bit. Coal | Country specific | 25.80 | 0.98 |
| Sub- Bit. Coal | 22.20 | 26.20 | 0.98 |
| Lignite | Country specific | 27.60 | 0.98 |
| Oil Shale | - | - | - |
| Peat | 8.80 | 28.90 | 0.98 |
| BKB & Patent Fuel | 19.30 | 25.80 | 0.98 |
| Coke Oven / Gas Coke | 28.20 | 29.50 | 0.98 |
| Natural Gas | - | 15.30 | 1.00 |
| Solid Biomass | - | 29.90 | 0.88 |
| Liquid Biomass | - | - | - |
| Gas Biomass | - | 29.90 | 0.99 |

Table A 64 present country specific conversion factors.

*Table A 64: Country specific conversion factors [TJ/Gg]*

| Fuel Type | 1990 | 1995 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Other Bit. Coal | 28.00 | 28.00 | 28.00 | 27.66 | 27.99 | 27.99 | 27.50 | 27.50 | 28.41 | 28.15 | 28.08 | 27.88 |
| Lignite | 10.90 | 10.90 | 9.90 | 9.77 | 9.82 | 9.79 | 9.82 | 9.82 | 9.96 | 9.82 | 10.92 | 20.45 |

# ANNEX 4: NATIONAL ENERGY BALANCE

The following tables present the data of the national energy balance by IEA categories. Calorific values for unit conversion are presented at the end of this Annex. Data was submitted to the Umweltbundesamt by STATISTIK AUSTRIA in November 2007.

Please note that for reasons of confidentiality energy consumption of autoproducers by sub sectors as quoted in ANNEX 2 are not published here.

# Coal

*Table A 65: National Energy Balance 1990-2007 Coking Coal [1000 tons].*

| 101A Coking Coal | 1990 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Indigenous Production | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total Imports (Balance) | 2 376 | 1 778 | 2 013 | 2 167 | 2 089 | 2 146 | 1 738 | 1 861 | 1 864 | 1 858 | 1 789 | 2 063 | 1 806 | 1 859 |
| Total Exports (Balance) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| International Marine Bunkers | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Stock Change (National Territory) | -39 | 130 | 80 | -57 | 83 | 45 | 139 | 30 | 34 | 40 | 115 | -164 | 86 | 41 |
| **Gross Inland Deliveries (Obs.)** | 2 337 | 1 908 | 2 093 | 2 111 | 2 172 | 2 191 | 1 878 | 1 892 | 1 898 | 1 898 | 1 905 | 1 899 | 1 891 | 1 900 |
| Statistical Difference | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Total Transformation Sector** | 2 337 | 1 908 | 2 093 | 2 111 | 2 172 | 2 191 | 1 878 | 1 892 | 1 898 | 1 898 | 1 905 | 1 899 | 1 891 | 1 900 |
| Public Electricity | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Public Combined Heat and Power | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Public Heat Plants | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Auto Producers of Electricity | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Auto Producers for CHP | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Auto Producer Heat Plants | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Gas Works (Transformation) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Coke Ovens (Transformation) | 2 337 | 1 908 | 2 093 | 2 111 | 2 172 | 2 191 | 1 878 | 1 892 | 1 898 | 1 898 | 1 905 | 1 899 | 1 891 | 1 900 |
| Blast Furnaces (Transformation) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Patent Fuel Plants | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| BKB (Transformation) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Non Specified (Transformation) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Total Energy Sector** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Coal Mines | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Patent Fuel Plants | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| Coke Ovens (Energy) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Blast Furnaces (Energy) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Gas Works (Energy) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| BKB (Transformation) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| Petroleum refineries | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Power Plants | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Non Specified (Energy) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Distribution Losses | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Final Consumption** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| Total Transport | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| Rail | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Inland Waterways | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Non Specified (Transport) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total Industry | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| Iron and Steel | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Chemical (incl.Petro-Chemical) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Non ferrous Metals | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Non metallic Mineral Products | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Transportation Equipment | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Machinery | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Mining and Quarrying | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Food, Beverages and Tobacco | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Pulp, Paper and Printing | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Wood and Wood Products | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Construction | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Textiles and Leather | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Non Specified (Industry) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total Other Sectors | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| Commerce - Public Services | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Residential | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Agriculture | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Non Specified (Others) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Total Non-Energy Use** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

*Table A 66: National Energy Balance 1990–2007 Bituminous Coal & Anthracite [1000 tons].*

| 102A Bitominous Coal & Anthracite | 1990 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Indigenous Production | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total Imports (Balance) | 1 233 | 1 216 | 1 724 | 1 616 | 1 653 | 1 211 | 1 672 | 1 862 | 2 167 | 2 101 | 2 659 | 2 276 | 2 316 | 2 569 |
| Total Exports (Balance) | 0 | 1 | 2 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 21 | 3 | 0 | 1 |
| International Marine Bunkers | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Stock Change (National Territory) | 589 | 268 | -21 | 348 | -97 | 94 | 176 | 180 | -225 | 310 | -212 | -119 | 40 | -265 |
| **Gross Inland Deliveries (Obs.)** | 1 822 | 1 484 | 1 701 | 1 959 | 1 555 | 1 305 | 1 848 | 2 042 | 1 942 | 2 411 | 2 426 | 2 155 | 2 356 | 2 303 |
| Statistical Difference | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Total Transformation Sector** | 1 421 | 1 082 | 1 238 | 1 437 | 1 061 | 907 | 1 422 | 1 670 | 1 618 | 2 136 | 2 147 | 1 885 | 2 001 | 1 978 |
| Public Electricity | 964 | 550 | 1 069 | 1 275 | 890 | 731 | 1 203 | 1 384 | 1 373 | 1 908 | 1 908 | 1 665 | 1 770 | 1 777 |
| Public Combined Heat and Power | 409 | 518 | 128 | 127 | 127 | 140 | 161 | 242 | 194 | 177 | 193 | 178 | 174 | 164 |
| Public Heat Plants | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Auto Producers of Electricity | 0 | 0 | 19 | 5 | 4 | 4 | 10 | 13 | 11 | 13 | 4 | 4 | 4 | 4 |
| Auto Producers for CHP | 48 | 14 | 22 | 31 | 40 | 32 | 48 | 31 | 39 | 38 | 42 | 39 | 53 | 32 |
| Auto Producer Heat Plants | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Gas Works (Transformation) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Coke Ovens (Transformation) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Blast Furnaces (Transformation) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Patent Fuel Plants | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| BKB (Transformation) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Non Specified (Transformation) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Total Energy Sector** | 0 | 0 | 0 | 0 | 0 | 7 | 33 | 2 | 0 | 0 | 0 | 0 | 0 | 0 |
| Coal Mines | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Patent Fuel Plants | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| Coke Ovens (Energy) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Blast Furnaces (Energy) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Gas Works (Energy) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| BKB (Transformation) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| Petroleum refineries | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Power Plants | 0 | 0 | 0 | 0 | 0 | 7 | 33 | 2 | 0 | 0 | 0 | 0 | 0 | 0 |
| Non Specified (Energy) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Distribution Losses | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Final Consumption** | 400 | 400 | 462 | 521 | 493 | 390 | 392 | 368 | 323 | 273 | 278 | 269 | 354 | 325 |
| Total Transport | 3 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 |
| Rail | 3 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 |
| Inland Waterways | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Non Specified (Transport) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total Industry | 208 | 251 | 306 | 400 | 383 | 290 | 313 | 291 | 254 | 208 | 218 | 208 | 296 | 280 |
| Iron and Steel | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 5 |
| Chemical (incl.Petro-Chemical) | 7 | 45 | 50 | 73 | 70 | 88 | 57 | 70 | 71 | 68 | 62 | 35 | 29 | 22 |
| Non ferrous Metals | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Non metallic Mineral Products | 199 | 164 | 196 | 208 | 199 | 131 | 170 | 151 | 98 | 74 | 72 | 86 | 140 | 156 |
| Transportation Equipment | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Machinery | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 |
| Mining and Quarrying | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Food, Beverages and Tobacco | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Pulp, Paper and Printing | 2 | 43 | 59 | 118 | 113 | 72 | 86 | 70 | 85 | 66 | 83 | 87 | 121 | 97 |
| Wood and Wood Products | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Construction | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Textiles and Leather | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Non Specified (Industry) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total Other Sectors | 189 | 148 | 155 | 120 | 109 | 98 | 78 | 77 | 69 | 64 | 60 | 60 | 58 | 44 |
| Commerce - Public Services | 11 | 10 | 12 | 10 | 11 | 18 | 8 | 7 | 8 | 7 | 4 | 4 | 4 | 1 |
| Residential | 177 | 137 | 142 | 108 | 98 | 80 | 69 | 69 | 61 | 56 | 55 | 56 | 54 | 43 |
| Agriculture | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Non Specified (Others) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Total Non-Energy Use** | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 2 | 1 | 1 | 1 | 1 |

*Table A 67: National Energy Balance 1990-2007. Patent Fuel [1000 tons].*

| 104A Patent Fuel | 1990 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Indigenous Production | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total Imports (Balance) | 0 | 0 | 0 | 7 | 4 | 4 | 4 | 1 | 1 | 2 | 1 | 1 | 1 | 9 |
| Total Exports (Balance) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| International Marine Bunkers | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Stock Change (National Territory) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Gross Inland Deliveries (Obs.)** | 0 | 0 | 0 | 7 | 4 | 4 | 4 | 1 | 1 | 2 | 1 | 1 | 1 | 9 |
| Statistical Difference | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Total Transformation Sector** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Public Electricity | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Public Combined Heat and Power | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Public Heat Plants | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Auto Producers of Electricity | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Auto Producers for CHP | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Auto Producer Heat Plants | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Gas Works (Transformation) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Coke Ovens (Transformation) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Blast Furnaces (Transformation) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Patent Fuel Plants | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| BKB (Transformation) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Non Specified (Transformation) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Total Energy Sector** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Coal Mines | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Patent Fuel Plants | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| Coke Ovens (Energy) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Blast Furnaces (Energy) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Gas Works (Energy) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| BKB (Transformation) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| Petroleum refineries | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Power Plants | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Non Specified (Energy) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Distribution Losses | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Final Consumption** | 0 | 0 | 0 | 7 | 4 | 4 | 4 | 1 | 1 | 2 | 1 | 1 | 1 | 9 |
| Total Transport | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Rail | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Inland Waterways | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Non Specified (Transport) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total Industry | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Iron and Steel | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Chemical (incl.Petro-Chemical) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Non ferrous Metals | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Non metallic Mineral Products | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Transportation Equipment | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Machinery | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Mining and Quarrying | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Food, Beverages and Tobacco | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Pulp, Paper and Printing | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Wood and Wood Products | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Construction | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Textiles and Leather | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Non Specified (Industry) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total Other Sectors | 0 | 0 | 0 | 7 | 4 | 4 | 4 | 1 | 1 | 2 | 1 | 1 | 1 | 9 |
| Commerce - Public Services | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 2 |
| Residential | 0 | 0 | 0 | 6 | 3 | 3 | 3 | 0 | 1 | 2 | 1 | 1 | 1 | 7 |
| Agriculture | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Non Specified (Others) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Total Non-Energy Use** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

*Table A 68: National Energy Balance 1990-2007. Lignite and Brown Coal [1000 tons].*

| 105A Lignite and brown coal | 1990 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Indigenous Production | 2 448 | 1 297 | 1 108 | 1 130 | 1 140 | 1 137 | 1 249 | 1 206 | 1 412 | 1 152 | 235 | 0 | 0 | 0 |
| Total Imports (Balance) | 36 | 29 | 43 | 23 | 13 | 14 | 54 | 73 | 59 | 70 | 88 | 113 | 140 | 137 |
| Total Exports (Balance) | 3 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| International Marine Bunkers | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Stock Change (National Territory) | 23 | 417 | 470 | 163 | -287 | 418 | 78 | 351 | 91 | 431 | 889 | 1 173 | 624 | -28 |
| **Gross Inland Deliveries (Obs.)** | 2 503 | 1 743 | 1 621 | 1 316 | 866 | 1 569 | 1 381 | 1 630 | 1 561 | 1 654 | 1 212 | 1 286 | 765 | 110 |
| Statistical Difference | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Total Transformation Sector** | 2 133 | 1 524 | 1 495 | 1 205 | 763 | 1 417 | 1 230 | 1 483 | 1 390 | 1 477 | 1 039 | 1 136 | 657 | 0 |
| Public Electricity | 1 182 | 1 081 | 1 358 | 1 164 | 737 | 1 372 | 1 168 | 1 391 | 1 316 | 1 393 | 967 | 1 061 | 620 | 0 |
| Public Combined Heat and Power | 881 | 339 | 48 | 13 | 3 | 9 | 26 | 59 | 43 | 52 | 41 | 54 | 37 | 0 |
| Public Heat Plants | 16 | 9 | 9 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Auto Producers of Electricity | 0 | 0 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Auto Producers for CHP | 54 | 95 | 76 | 23 | 22 | 35 | 35 | 33 | 31 | 32 | 31 | 20 | 1 | 0 |
| Auto Producer Heat Plants | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Gas Works (Transformation) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Coke Ovens (Transformation) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Blast Furnaces (Transformation) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Patent Fuel Plants | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| BKB (Transformation) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Non Specified (Transformation) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Total Energy Sector** | 6 | 0 | 0 | 1 | 0 | 15 | 2 | 0 | 1 | 0 | 0 | 0 | 0 | 0 |
| Coal Mines | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Patent Fuel Plants | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| Coke Ovens (Energy) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Blast Furnaces (Energy) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Gas Works (Energy) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| BKB (Transformation) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| Petroleum refineries | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Power Plants | 3 | 0 | 0 | 1 | 0 | 15 | 2 | 0 | 1 | 0 | 0 | 0 | 0 | 0 |
| Non Specified (Energy) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Distribution Losses | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Final Consumption** | 364 | 219 | 126 | 111 | 103 | 137 | 149 | 146 | 171 | 177 | 173 | 150 | 108 | 110 |
| Total Transport | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Rail | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Inland Waterways | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Non Specified (Transport) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total Industry | 147 | 115 | 33 | 46 | 45 | 84 | 105 | 100 | 133 | 142 | 144 | 125 | 88 | 92 |
| Iron and Steel | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Chemical (incl.Petro-Chemical) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Non ferrous Metals | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Non metallic Mineral Products | 11 | 4 | 6 | 3 | 3 | 15 | 39 | 44 | 59 | 72 | 68 | 70 | 84 | 87 |
| Transportation Equipment | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Machinery | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Mining and Quarrying | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Food, Beverages and Tobacco | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Pulp, Paper and Printing | 132 | 111 | 27 | 43 | 42 | 69 | 66 | 56 | 74 | 70 | 76 | 56 | 4 | 4 |
| Wood and Wood Products | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Construction | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Textiles and Leather | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Non Specified (Industry) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total Other Sectors | 217 | 104 | 93 | 65 | 58 | 53 | 43 | 47 | 38 | 35 | 29 | 25 | 20 | 18 |
| Commerce - Public Services | 9 | 5 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 1 | 1 | 1 | 1 |
| Residential | 208 | 99 | 90 | 62 | 55 | 50 | 41 | 44 | 36 | 33 | 28 | 24 | 19 | 17 |
| Agriculture | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Non Specified (Others) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 2 |
| **Total Non-Energy Use** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

*Table A 69: National Energy Balance 1990–2007. Brown Coal Briquettes [1000 tons].*

| 106A BKB-PB | 1990 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Indigenous Production | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total Imports (Balance) | 295 | 173 | 167 | 133 | 103 | 106 | 95 | 108 | 65 | 72 | 59 | 53 | 57 | 22 |
| Total Exports (Balance) | 0 | 2 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 2 | 1 | 1 |
| International Marine Bunkers | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Stock Change (National Territory) | 12 | 1 | 0 | 0 | 0 | 0 | 11 | 0 | 0 | 0 | 0 | 0 | -5 | 25 |
| **Gross Inland Deliveries (Obs.)** | 306 | 172 | 167 | 133 | 103 | 106 | 107 | 108 | 65 | 72 | 58 | 51 | 51 | 46 |
| Statistical Difference | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Total Transformation Sector** | 12 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Public Electricity | 7 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Public Combined Heat and Power | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Public Heat Plants | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Auto Producers of Electricity | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Auto Producers for CHP | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Auto Producer Heat Plants | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Gas Works (Transformation) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Coke Ovens (Transformation) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Blast Furnaces (Transformation) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Patent Fuel Plants | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| BKB (Transformation) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Non Specified (Transformation) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Total Energy Sector** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Coal Mines | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Patent Fuel Plants | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| Coke Ovens (Energy) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Blast Furnaces (Energy) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Gas Works (Energy) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| BKB (Transformation) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| Petroleum refineries | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Power Plants | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Non Specified (Energy) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Distribution Losses | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Final Consumption** | 295 | 172 | 167 | 133 | 103 | 106 | 107 | 108 | 65 | 72 | 58 | 51 | 51 | 46 |
| Total Transport | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Rail | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Inland Waterways | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Non Specified (Transport) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total Industry | 64 | 14 | 13 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Iron and Steel | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Chemical (incl.Petro-Chemical) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Non ferrous Metals | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Non metallic Mineral Products | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Transportation Equipment | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Machinery | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Mining and Quarrying | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Food, Beverages and Tobacco | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Pulp, Paper and Printing | 63 | 14 | 13 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Wood and Wood Products | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Construction | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Textiles and Leather | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Non Specified (Industry) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total Other Sectors | 230 | 158 | 154 | 132 | 103 | 106 | 107 | 108 | 65 | 72 | 58 | 51 | 51 | 46 |
| Commerce - Public Services | 8 | 6 | 6 | 20 | 11 | 11 | 34 | 41 | 14 | 30 | 14 | 3 | 3 | 3 |
| Residential | 214 | 146 | 142 | 108 | 88 | 91 | 70 | 65 | 49 | 40 | 42 | 46 | 46 | 42 |
| Agriculture | 8 | 6 | 6 | 5 | 4 | 4 | 3 | 3 | 2 | 2 | 2 | 2 | 2 | 2 |
| Non Specified (Others) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Total Non-Energy Use** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

*Table A 70: National Energy Balance 1990-2007. Coke Oven Coke [1000 tons].*

| 107A Coke Oven Coke | 1990 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Indigenous Production | 1 725 | 1 448 | 1 559 | 1 566 | 1 598 | 1 608 | 1 385 | 1 394 | 1 395 | 1 395 | 1 400 | 1 388 | 1 398 | 1 424 |
| Total Imports (Balance) | 815 | 718 | 652 | 764 | 642 | 654 | 981 | 1 091 | 1 073 | 1 173 | 1 266 | 1 402 | 1 282 | 1 438 |
| Total Exports (Balance) | 1 | 1 | 0 | 0 | 0 | 2 | 1 | 1 | 2 | 3 | 42 | 4 | 3 | 5 |
| International Marine Bunkers | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Stock Change (National Territory) | -136 | 189 | -10 | 39 | 24 | -30 | 71 | -164 | 124 | -45 | -113 | -35 | 111 | -79 |
| **Gross Inland Deliveries (Obs.)** | 2 402 | 2 354 | 2 200 | 2 369 | 2 264 | 2 230 | 2 435 | 2 320 | 2 589 | 2 519 | 2 511 | 2 751 | 2 788 | 2 778 |
| Statistical Difference | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Total Transformation Sector** | 623 | 711 | 652 | 758 | 830 | 783 | 909 | 899 | 1 049 | 1 019 | 1 059 | 1 035 | 1 154 | 1 183 |
| Public Electricity | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Public Combined Heat and Power | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Public Heat Plants | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Auto Producers of Electricity | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Auto Producers for CHP | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Auto Producer Heat Plants | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Gas Works (Transformation) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Coke Ovens (Transformation) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Blast Furnaces (Transformation) | 623 | 711 | 652 | 758 | 830 | 783 | 909 | 899 | 1 049 | 1 019 | 1 059 | 1 035 | 1 154 | 1 183 |
| Patent Fuel Plants | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| BKB (Transformation) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Non Specified (Transformation) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Total Energy Sector** | 107 | 77 | 88 | 73 | 68 | 48 | 53 | 52 | 58 | 55 | 50 | 65 | 62 | 61 |
| Coal Mines | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Patent Fuel Plants | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| Coke Ovens (Energy) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Blast Furnaces (Energy) | 107 | 77 | 88 | 73 | 68 | 48 | 53 | 52 | 58 | 55 | 50 | 65 | 62 | 61 |
| Gas Works (Energy) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| BKB (Transformation) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| Petroleum refineries | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Power Plants | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Non Specified (Energy) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Distribution Losses | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Final Consumption** | 853 | 557 | 528 | 469 | 422 | 466 | 436 | 344 | 366 | 388 | 420 | 386 | 378 | 364 |
| Total Transport | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Rail | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Inland Waterways | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Non Specified (Transport) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total Industry | 290 | 196 | 192 | 220 | 200 | 256 | 244 | 153 | 200 | 241 | 299 | 267 | 284 | 278 |
| Iron and Steel | 235 | 178 | 164 | 179 | 164 | 184 | 202 | 131 | 173 | 206 | 274 | 235 | 266 | 252 |
| Chemical (incl.Petro-Chemical) | 14 | 6 | 11 | 13 | 11 | 18 | 16 | 12 | 11 | 14 | 10 | 9 | 0 | 0 |
| Non ferrous Metals | 7 | 3 | 5 | 7 | 6 | 8 | 7 | 3 | 6 | 5 | 6 | 4 | 4 | 5 |
| Non metallic Mineral Products | 23 | 4 | 5 | 15 | 13 | 40 | 11 | 2 | 5 | 4 | 5 | 14 | 9 | 17 |
| Transportation Equipment | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Machinery | 5 | 2 | 3 | 3 | 2 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Mining and Quarrying | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Food, Beverages and Tobacco | 5 | 2 | 4 | 5 | 4 | 3 | 8 | 4 | 5 | 11 | 4 | 4 | 4 | 4 |
| Pulp, Paper and Printing | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Wood and Wood Products | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Construction | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Textiles and Leather | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Non Specified (Industry) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total Other Sectors | 563 | 361 | 335 | 248 | 222 | 209 | 192 | 191 | 167 | 147 | 121 | 118 | 94 | 86 |
| Commerce - Public Services | 13 | 9 | 8 | 6 | 5 | 7 | 8 | 11 | 12 | 11 | 9 | 18 | 17 | 15 |
| Residential | 537 | 345 | 320 | 237 | 212 | 198 | 180 | 176 | 152 | 133 | 110 | 99 | 76 | 69 |
| Agriculture | 12 | 8 | 7 | 5 | 5 | 5 | 4 | 4 | 3 | 3 | 2 | 2 | 1 | 2 |
| Non Specified (Others) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Total Non-Energy Use** | 820 | 1 010 | 932 | 1 069 | 944 | 933 | 1 037 | 1 025 | 1 115 | 1 058 | 982 | 1 265 | 1 195 | 1 171 |

*Table A 71: National Energy Balance 1990-2007. Peat [1000 tons].*

| 113A Peat | 1990 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Indigenous Production | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Total Imports (Balance) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total Exports (Balance) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| International Marine Bunkers | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Stock Change (National Territory) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Gross Inland Deliveries (Obs.)** | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Statistical Difference | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Total Transformation Sector** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Public Electricity | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Public Combined Heat and Power | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Public Heat Plants | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Auto Producers of Electricity | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Auto Producers for CHP | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Auto Producer Heat Plants | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Gas Works (Transformation) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Coke Ovens (Transformation) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Blast Furnaces (Transformation) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Patent Fuel Plants | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| BKB (Transformation) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Non Specified (Transformation) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Total Energy Sector** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Coal Mines | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Patent Fuel Plants | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| Coke Ovens (Energy) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Blast Furnaces (Energy) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Gas Works (Energy) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| BKB (Transformation) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| Petroleum refineries | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Power Plants | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Non Specified (Energy) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Distribution Losses | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Final Consumption** | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Total Transport | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Rail | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Inland Waterways | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Non Specified (Transport) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total Industry | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Iron and Steel | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Chemical (incl.Petro-Chemical) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Non ferrous Metals | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Non metallic Mineral Products | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Transportation Equipment | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Machinery | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Mining and Quarrying | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Food, Beverages and Tobacco | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Pulp, Paper and Printing | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Wood and Wood Products | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Construction | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Textiles and Leather | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Non Specified (Industry) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total Other Sectors | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Commerce - Public Services | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Residential | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Agriculture | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Non Specified (Others) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Total Non-Energy Use** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

*Table A 72: National Energy Balance 1990-2007. Coke Oven Gas [TJ].*

| 304A Coke Oven Gas | 1990 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Indigenous Production | 13 117 | 10 906 | 11 419 | 11 604 | 12 166 | 12 220 | 10 466 | 9 776 | 9 579 | 10 722 | 10 911 | 9 871 | 9 682 | 9 524 |
| Total Imports (Balance) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total Exports (Balance) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| International Marine Bunkers | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Stock Change (National Territory) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Gross Inland Deliveries (Obs.)** | 13 117 | 10 906 | 11 419 | 11 604 | 12 166 | 12 220 | 10 466 | 9 776 | 9 579 | 10 722 | 10 911 | 9 871 | 9 682 | 9 524 |
| Statistical Difference | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Total Transformation Sector** | 3 385 | 6 228 | 3 545 | 3 270 | 3 087 | 3 732 | 3 592 | 3 816 | 3 187 | 1 780 | 2 436 | 2 336 | 2 119 | 2 062 |
| Public Electricity | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Public Combined Heat and Power | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Public Heat Plants | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Auto Producers of Electricity | 0 | 0 | 2 183 | 2 002 | 2 033 | 2 649 | 3 256 | 3 449 | 2 778 | 1 255 | 2 193 | 2 027 | 1 915 | 1 848 |
| Auto Producers for CHP | 3 385 | 6 228 | 1 362 | 1 268 | 1 054 | 1 083 | 286 | 367 | 409 | 526 | 243 | 309 | 204 | 214 |
| Auto Producer Heat Plants | 0 | 0 | 0 | 0 | 0 | 0 | 50 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Gas Works (Transformation) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Coke Ovens (Transformation) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Blast Furnaces (Transformation) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Patent Fuel Plants | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| BKB (Transformation) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Non Specified (Transformation) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Total Energy Sector** | 4 136 | 3 439 | 3 601 | 3 659 | 3 836 | 3 853 | 3 300 | 3 083 | 3 020 | 4 187 | 4 326 | 4 171 | 4 091 | 4 091 |
| Coal Mines | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Patent Fuel Plants | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| Coke Ovens (Energy) | 1 072 | 892 | 934 | 949 | 995 | 999 | 856 | 799 | 783 | 708 | 595 | 699 | 644 | 576 |
| Blast Furnaces (Energy) | 3 064 | 2 547 | 2 667 | 2 710 | 2 841 | 2 854 | 2 444 | 2 283 | 2 237 | 3 479 | 3 730 | 3 472 | 3 447 | 3 514 |
| Gas Works (Energy) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| BKB (Transformation) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| Petroleum refineries | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Power Plants | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Non Specified (Energy) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Distribution Losses | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 023 | 1 171 | 1 204 | 841 | 728 | 628 |
| **Final Consumption** | 5 596 | 1 239 | 4 273 | 4 675 | 5 243 | 4 635 | 3 574 | 2 878 | 2 348 | 3 584 | 2 946 | 2 523 | 2 744 | 2 744 |
| Total Transport | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Rail | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Inland Waterways | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Non Specified (Transport) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total Industry | 5 596 | 1 239 | 4 273 | 4 675 | 5 243 | 4 635 | 3 574 | 2 878 | 2 348 | 3 584 | 2 946 | 2 523 | 2 744 | 2 744 |
| Iron and Steel | 5 596 | 1 239 | 4 273 | 4 675 | 5 243 | 4 635 | 3 574 | 2 878 | 2 348 | 3 584 | 2 946 | 2 523 | 2 744 | 2 744 |
| Chemical (incl.Petro-Chemical) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Non ferrous Metals | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Non metallic Mineral Products | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Transportation Equipment | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Machinery | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Mining and Quarrying | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Food, Beverages and Tobacco | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Pulp, Paper and Printing | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Wood and Wood Products | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Construction | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Textiles and Leather | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Non Specified (Industry) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total Other Sectors | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Commerce - Public Services | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Residential | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Agriculture | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Non Specified (Others) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Total Non-Energy Use** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

*Table A 73: National Energy Balance 1990–2007. Blast Furnace Gas [TJ].*

| 305A Blast Furnace Gas | 1990 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Indigenous Production | 17 094 | 16 232 | 19 503 | 17 719 | 20 582 | 22 528 | 21 873 | 25 385 | 25 098 | 29 309 | 28 463 | 29 577 | 28 902 | 28 969 |
| Total Imports (Balance) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total Exports (Balance) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| International Marine Bunkers | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Stock Change (National Territory) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Gross Inland Deliveries (Obs.)** | 17 094 | 16 232 | 19 503 | 17 719 | 20 582 | 22 528 | 21 873 | 25 385 | 25 098 | 29 309 | 28 463 | 29 577 | 28 902 | 28 969 |
| Statistical Difference | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Total Transformation Sector** | 4 822 | 4 352 | 6 213 | 6 259 | 7 906 | 7 625 | 6 802 | 6 014 | 7 630 | 8 226 | 7 958 | 11 128 | 11 936 | 11 389 |
| Public Electricity | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Public Combined Heat and Power | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Public Heat Plants | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Auto Producers of Electricity | 0 | 0 | 0 | 4 493 | 5 447 | 5 320 | 4 629 | 5 011 | 7 034 | 7 440 | 6 784 | 10 437 | 10 937 | 10 474 |
| Auto Producers for CHP | 4 822 | 4 352 | 6 213 | 1 766 | 2 459 | 2 305 | 2 173 | 1 003 | 596 | 786 | 1 174 | 690 | 998 | 916 |
| Auto Producer Heat Plants | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Gas Works (Transformation) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Coke Ovens (Transformation) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Blast Furnaces (Transformation) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Patent Fuel Plants | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| BKB (Transformation) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Non Specified (Transformation) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Total Energy Sector** | 9 682 | 9 164 | 11 685 | 10 613 | 12 332 | 13 536 | 13 156 | 15 254 | 15 077 | 17 613 | 17 325 | 16 175 | 16 290 | 16 732 |
| Coal Mines | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Patent Fuel Plants | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Coke Ovens (Energy) | 2 391 | 2 223 | 2 641 | 2 508 | 2 787 | 3 256 | 3 231 | 3 675 | 3 609 | 4 251 | 4 161 | 4 282 | 3 647 | 3 647 |
| Blast Furnaces (Energy) | 7 291 | 6 941 | 9 044 | 8 105 | 9 545 | 10 280 | 9 924 | 11 579 | 11 468 | 13 363 | 13 164 | 11 894 | 12 643 | 13 085 |
| Gas Works (Energy) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| BKB (Transformation) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Petroleum refineries | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Power Plants | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Non Specified (Energy) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Distribution Losses | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 111 | 653 | 967 | 676 | 847 |
| **Final Consumption** | 2 590 | 2 716 | 1 605 | 847 | 344 | 1 367 | 1 915 | 4 117 | 2 391 | 2 359 | 2 527 | 1 307 | 0 | 0 |
| Total Transport | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Rail | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Inland Waterways | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Non Specified (Transport) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total Industry | 2 590 | 2 716 | 1 605 | 847 | 344 | 1 367 | 1 915 | 4 117 | 2 391 | 2 359 | 2 527 | 1 307 | 0 | 0 |
| Iron and Steel | 2 590 | 2 716 | 1 605 | 847 | 344 | 1 367 | 1 915 | 4 117 | 2 391 | 2 359 | 2 527 | 1 307 | 0 | 0 |
| Chemical (incl.Petro-Chemical) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Non ferrous Metals | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Non metallic Mineral Products | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Transportation Equipment | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Machinery | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Mining and Quarrying | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Food, Beverages and Tobacco | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Pulp, Paper and Printing | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Wood and Wood Products | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Construction | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Textiles and Leather | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Non Specified (Industry) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total Other Sectors | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Commerce - Public Services | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Residential | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Agriculture | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Non Specified (Others) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Total Non-Energy Use** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

## Oil

*Table A 74: National Energy Balance 1990-2007. Crude Oil [1000 tons].*

| 201A Crude Oil | 1990 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Indigenous Production | 1 149 | 1 035 | 992 | 973 | 959 | 1 003 | 971 | 957 | 957 | 1 113 | 971 | 855 | 863 | 800 |
| Refinery Losses | 120 | 153 | 75 | 82 | 156 | 226 | 122 | 210 | 72 | 28 | 68 | 25 | 35 | 23 |
| Refinery Intake (Calculated) | 7 952 | 8 619 | 8 754 | 9 376 | 9 190 | 8 636 | 8 240 | 8 799 | 8 947 | 8 819 | 8 442 | 8 743 | 8 472 | 8 546 |
| Refinery Intake (Observed) | 7 952 | 8 619 | 8 754 | 9 376 | 9 190 | 8 636 | 8 240 | 8 799 | 8 947 | 8 819 | 8 442 | 8 743 | 8 472 | 8 496 |
| Refinery Fuel | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 |
| Total Imports (Balance) | 6 797 | 7 590 | 7 737 | 8 452 | 8 269 | 7 698 | 7 315 | 7 940 | 8 118 | 7 819 | 7 562 | 7 833 | 7 699 | 7 641 |
| Total Exports (Balance) | 0 | 0 | 51 | 25 | 44 | 51 | 61 | 63 | 0 | 0 | 0 | 0 | 0 | 0 |
| Stock Change (National Territory) | 6 | -6 | 75 | -23 | 6 | -14 | 16 | -36 | -128 | -114 | -91 | 55 | -90 | 105 |
| Statistical Difference | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 50 |

*Table A 75: National Energy Balance 1990-2007. Natural Gas Liquids [1000 tons].*

| 302A Natural Gas Liquids | 1990 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Indigenous Production | 41 | 43 | 53 | 55 | 88 | 60 | 101 | 55 | 53 | 92 | 88 | 76 | 86 | 128 |
| Refinery Losses | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Refinery Intake (Calculated) | 41 | 43 | 53 | 43 | 226 | 71 | 107 | 55 | 53 | 55 | 51 | 43 | 47 | 141 |
| Refinery Intake (Observed) | 41 | 43 | 53 | 43 | 226 | 71 | 107 | 55 | 53 | 55 | 51 | 43 | 47 | 141 |
| Refinery Fuel | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 38 | 38 | 33 | 39 | 38 |
| Total Imports (Balance) | 0 | 0 | 0 | 0 | 135 | 0 | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 50 |
| Total Exports (Balance) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Stock Change (National Territory) | 0 | 0 | 0 | -12 | 2 | 10 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Statistical Difference | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

*Table A 76: National Energy Balance 1990-2007. Refinery Feedstocks [1000 tons].*

| 217A Refinery Feedstocks | 1990 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Refinery Losses | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Refinery Intake (Calculated) | 1 069 | 582 | 858 | 853 | 564 | 876 | 541 | 616 | 440 | 152 | 354 | 471 | 468 | 348 |
| Refinery Intake (Observed) | 1 069 | 582 | 858 | 853 | 564 | 873 | 540 | 616 | 440 | 152 | 354 | 471 | 468 | 348 |
| Refinery Fuel | 0 | 0 | 0 | 0 | 0 | 2 | 1 | 14 | 26 | 5 | 45 | 65 | 43 | 53 |
| Total Imports (Balance) | 1 009 | 600 | 916 | 761 | 746 | 740 | 627 | 534 | 593 | 374 | 223 | 265 | 502 | 305 |
| Total Exports (Balance) | 0 | 39 | 62 | 14 | 7 | 64 | 125 | 80 | 32 | 72 | 12 | 18 | 35 | 28 |
| Stock Change (National Territory) | -26 | -28 | -88 | 92 | -182 | 148 | -10 | 125 | -146 | -198 | 122 | 227 | -20 | 58 |

*Table A 77: National Energy Balance 1990-2007. Residual Fuel Oil [1000 tons].*

| 203X; Residual Fuel Oil | 1990 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Refinery Gross Output | 1 913 | 1 502 | 1 441 | 1 540 | 1 347 | 1 308 | 979 | 1 047 | 1 012 | 978 | 1 031 | 1 045 | 915 | 879 |
| Refinery Fuel | 81 | 139 | 56 | 49 | 63 | 22 | 37 | 7 | 7 | 25 | 7 | 26 | 6 | 40 |
| Total Imports (Balance) | 602 | 531 | 386 | 449 | 671 | 468 | 262 | 317 | 241 | 328 | 306 | 182 | 199 | 183 |
| Total Exports (Balance) | 185 | 38 | 121 | 53 | 18 | 37 | 152 | 228 | 146 | 55 | 55 | 72 | 58 | 37 |
| International Marine Bunkers | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Stock Change (National Territory) | -93 | -100 | 119 | 1 | -38 | -131 | 246 | 262 | -17 | 8 | -99 | -8 | 10 | -23 |
| **Gross Inland Deliveries (Obs.)** | 2 156 | 1 757 | 1 770 | 1 888 | 1 899 | 1 586 | 1 298 | 1 391 | 1 083 | 1 234 | 1 176 | 1 066 | 1 060 | 872 |
| Statistical Difference | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Total Transformation Sector** | 608 | 573 | 537 | 636 | 732 | 559 | 380 | 449 | 265 | 361 | 366 | 350 | 370 | 237 |
| Public Electricity | 28 | 88 | 193 | 317 | 348 | 236 | 109 | 89 | 34 | 106 | 94 | 79 | 91 | 69 |
| Public Combined Heat and Power | 253 | 316 | 178 | 151 | 233 | 241 | 162 | 191 | 168 | 203 | 196 | 182 | 201 | 103 |
| Public Heat Plants | 99 | 70 | 109 | 128 | 106 | 54 | 88 | 149 | 47 | 32 | 65 | 72 | 66 | 60 |
| Auto Producers of Electricity | 0 | 0 | 22 | 11 | 10 | 5 | 5 | 3 | 2 | 10 | 1 | 3 | 3 | 0 |
| Auto Producers for CHP | 227 | 97 | 33 | 28 | 33 | 20 | 15 | 16 | 13 | 8 | 10 | 13 | 7 | 5 |
| Auto Producer Heat Plants | 1 | 1 | 1 | 1 | 1 | 2 | 1 | 1 | 1 | 2 | 0 | 0 | 0 | 0 |
| Gas Works (Transformation) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Coke Ovens (Transformation) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Blast Furnaces (Transformation) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Petrochemical Industry | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Patent Fuel Plants | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Non Specified (Transformation) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Total Energy Sector** | 116 | 150 | 110 | 143 | 191 | 191 | 231 | 256 | 154 | 159 | 203 | 234 | 227 | 274 |
| Coal Mines | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Oil and Gas Extraction | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Coke Ovens (Energy) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Blast Furnaces (Energy) | 116 | 150 | 110 | 143 | 191 | 191 | 231 | 256 | 154 | 159 | 203 | 234 | 227 | 274 |
| Gas Works (Energy) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Power Plants | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Non Specified (Energy) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Distribution Losses | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Final Consumption** | 1 432 | 1 035 | 1 123 | 1 109 | 976 | 836 | 687 | 686 | 664 | 714 | 606 | 483 | 463 | 361 |
| **Total Transport** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| International Civil Aviation | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Domestic Air Transport | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Road | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Rail | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Inland Waterways | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Pipeline Transport | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Non Specified (Transport) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Total Industry** | 518 | 550 | 557 | 749 | 611 | 335 | 277 | 242 | 214 | 221 | 215 | 240 | 258 | 225 |
| Iron and Steel | 19 | 23 | 26 | 11 | 9 | 10 | 21 | 13 | 8 | 6 | 10 | 10 | 16 | 6 |
| Chemical (incl.Petro-Chemical) | 23 | 27 | 28 | 40 | 33 | 19 | 11 | 10 | 9 | 10 | 13 | 11 | 11 | 12 |
| Non ferrous Metals | 4 | 7 | 10 | 18 | 15 | 9 | 9 | 7 | 7 | 7 | 7 | 6 | 6 | 5 |
| Non metallic Mineral Products | 115 | 135 | 127 | 195 | 159 | 80 | 51 | 37 | 35 | 38 | 40 | 45 | 46 | 47 |
| Transportation Equipment | 13 | 17 | 6 | 6 | 5 | 4 | 4 | 5 | 3 | 3 | 4 | 5 | 4 | 4 |
| Machinery | 29 | 32 | 42 | 66 | 54 | 31 | 30 | 27 | 25 | 28 | 27 | 30 | 31 | 25 |
| Mining and Quarrying | 6 | 7 | 10 | 11 | 9 | 13 | 12 | 12 | 11 | 11 | 8 | 10 | 11 | 9 |
| Food, Beverages and Tobacco | 78 | 89 | 68 | 85 | 69 | 39 | 38 | 36 | 34 | 34 | 34 | 35 | 42 | 37 |
| Pulp, Paper and Printing | 126 | 108 | 95 | 140 | 114 | 56 | 41 | 41 | 35 | 38 | 29 | 38 | 36 | 32 |
| Wood and Wood Products | 15 | 21 | 26 | 41 | 33 | 19 | 9 | 4 | 12 | 13 | 12 | 13 | 12 | 10 |
| Construction | 32 | 22 | 35 | 44 | 36 | 17 | 16 | 11 | 10 | 12 | 10 | 14 | 21 | 17 |
| Textiles and Leather | 27 | 25 | 35 | 48 | 39 | 17 | 12 | 16 | 12 | 9 | 8 | 10 | 9 | 8 |
| Non Specified (Industry) | 30 | 36 | 49 | 44 | 36 | 22 | 23 | 24 | 13 | 13 | 12 | 13 | 15 | 14 |
| **Total Other Sectors** | 914 | 485 | 566 | 359 | 365 | 501 | 409 | 444 | 450 | 493 | 391 | 243 | 205 | 136 |
| Commerce - Public Services | 316 | 239 | 288 | 71 | 58 | 172 | 116 | 155 | 146 | 111 | 103 | 99 | 88 | 30 |
| Residential | 471 | 194 | 219 | 227 | 241 | 259 | 232 | 229 | 241 | 303 | 229 | 114 | 93 | 84 |
| Agriculture | 127 | 53 | 59 | 61 | 65 | 70 | 60 | 60 | 63 | 79 | 59 | 30 | 24 | 22 |
| Non Specified (Others) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Total Non-Energy Use** | 116 | 150 | 110 | 143 | 191 | 191 | 231 | 256 | 154 | 159 | 203 | 234 | 227 | 274 |

*Table A 78: National Energy Balance 1990-2007. Heating and Oher Gas Oil [1000 tons].*

| 204A Heating and Other Gas Oil | 1990 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Refinery Gross Output | 1 239 | 1 454 | 1 598 | 1 604 | 1 280 | 1 245 | 1 062 | 1 301 | 1 062 | 1 103 | 928 | 997 | 1 004 | 612 |
| Refinery Fuel | 0 | 0 | 0 | 1 | 2 | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total Imports (Balance) | 0 | 165 | 376 | 355 | 577 | 615 | 533 | 626 | 734 | 860 | 805 | 926 | 950 | 743 |
| Total Exports (Balance) | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 3 | 0 | 0 | 17 | 20 | 34 | 10 |
| International Marine Bunkers | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Stock Change (National Territory) | 5 | 39 | -17 | -53 | 41 | 1 | 65 | -63 | -11 | 37 | 75 | -120 | -37 | 13 |
| **Gross Inland Deliveries (Obs.)** | 1 244 | 1 658 | 1 956 | 1 906 | 1 895 | 1 854 | 1 659 | 1 861 | 1 785 | 1 999 | 1 791 | 1 783 | 1 884 | 1 357 |
| Statistical Difference | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Total Transformation Sector** | 0 | 2 | 1 | 2 | 3 | 1 | 0 | 19 | 2 | 4 | 2 | 5 | 5 | 5 |
| Public Electricity | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 15 | 0 | 0 | 0 | 1 | 1 | 1 |
| Public Combined Heat and Power | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 4 | 2 | 1 | 0 | 3 | 1 | 2 |
| Public Heat Plants | 0 | 0 | 1 | 2 | 2 | 0 | 0 | 0 | 0 | 3 | 1 | 1 | 2 | 1 |
| Auto Producers of Electricity | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 |
| Auto Producers for CHP | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Auto Producer Heat Plants | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Gas Works (Transformation) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Coke Ovens (Transformation) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Blast Furnaces (Transformation) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Petrochemical Industry | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Patent Fuel Plants | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Non Specified (Transformation) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Total Energy Sector** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Coal Mines | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Oil and Gas Extraction | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Coke Ovens (Energy) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Blast Furnaces (Energy) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Gas Works (Energy) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Power Plants | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Non Specified (Energy) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Distribution Losses | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Final Consumption** | 1 244 | 1 656 | 1 955 | 1 904 | 1 893 | 1 853 | 1 659 | 1 843 | 1 783 | 1 996 | 1 789 | 1 778 | 1 878 | 1 353 |
| **Total Transport** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| International Civil Aviation | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Domestic Air Transport | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Road | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Rail | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Inland Waterways | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Pipeline Transport | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Non Specified (Transport) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Total Industry** | 1 | 5 | 11 | 28 | 24 | 24 | 38 | 68 | 64 | 68 | 65 | 90 | 107 | 95 |
| Iron and Steel | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Chemical (incl.Petro-Chemical) | 0 | 0 | 0 | 1 | 1 | 1 | 2 | 4 | 4 | 2 | 1 | 1 | 1 | 1 |
| Non ferrous Metals | 0 | 0 | 0 | 0 | 0 | 2 | 2 | 3 | 3 | 1 | 1 | 1 | 1 | 1 |
| Non metallic Mineral Products | 0 | 1 | 2 | 5 | 5 | 2 | 2 | 3 | 2 | 3 | 3 | 5 | 6 | 5 |
| Transportation Equipment | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 |
| Machinery | 0 | 1 | 3 | 7 | 6 | 4 | 5 | 10 | 9 | 9 | 7 | 10 | 13 | 12 |
| Mining and Quarrying | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 2 | 3 | 2 | 3 | 3 | 4 | 3 |
| Food, Beverages and Tobacco | 0 | 1 | 1 | 3 | 3 | 6 | 10 | 19 | 19 | 17 | 13 | 21 | 27 | 24 |
| Pulp, Paper and Printing | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 2 | 2 | 2 |
| Wood and Wood Products | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 2 | 2 | 3 | 3 | 6 | 7 | 7 |
| Construction | 0 | 1 | 3 | 6 | 6 | 5 | 10 | 18 | 17 | 23 | 28 | 32 | 34 | 30 |
| Textiles and Leather | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 2 | 2 | 2 | 2 | 3 | 4 | 3 |
| Non Specified (Industry) | 0 | 0 | 1 | 2 | 2 | 1 | 2 | 3 | 3 | 3 | 3 | 5 | 7 | 6 |
| **Total Other Sectors** | 1 243 | 1 651 | 1 944 | 1 876 | 1 868 | 1 828 | 1 622 | 1 775 | 1 718 | 1 927 | 1 724 | 1 688 | 1 771 | 1 257 |
| Commerce - Public Services | 26 | 92 | 222 | 538 | 471 | 417 | 204 | 340 | 288 | 255 | 142 | 143 | 347 | 93 |
| Residential | 1 216 | 1 558 | 1 720 | 1 337 | 1 396 | 1 410 | 1 416 | 1 433 | 1 429 | 1 671 | 1 581 | 1 544 | 1 423 | 1 163 |
| Agriculture | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Non Specified (Others) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Total Non-Energy Use** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

*Table A 79: National Energy Balance 1990-2007. Diesel [1000 tons].*

| 2050 Diesel | 1990 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Refinery Gross Output | 1 531 | 1 920 | 2 008 | 2 311 | 2 615 | 2 430 | 2 662 | 2 658 | 2 922 | 2 746 | 2 601 | 2 931 | 2 780 | 2 976 |
| Refinery Fuel | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 4 | 0 | 0 | 0 | 0 |
| Total Imports (Balance) | 576 | 937 | 1 777 | 1 159 | 1 898 | 1 877 | 2 075 | 2 433 | 2 728 | 3 491 | 4 078 | 4 129 | 4 054 | 4 273 |
| Total Exports (Balance) | 3 | 83 | 97 | 271 | 467 | 459 | 415 | 415 | 520 | 539 | 563 | 889 | 584 | 945 |
| International Marine Bunkers | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Stock Change (National Territory) | -7 | 112 | -106 | 195 | -108 | 44 | -59 | -8 | 49 | -9 | -179 | 91 | -145 | -8 |
| **Gross Inland Deliveries (Obs.)** | 2 097 | 2 885 | 3 581 | 3 394 | 3 937 | 3 892 | 4 263 | 4 668 | 5 180 | 5 685 | 5 936 | 6 262 | 6 106 | 6 296 |
| Statistical Difference | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Total Transformation Sector** | 0 | 8 | 4 | 7 | 1 | 2 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Public Electricity | 0 | 6 | 3 | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Public Combined Heat and Power | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Public Heat Plants | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Auto Producers of Electricity | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Auto Producers for CHP | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Auto Producer Heat Plants | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Gas Works (Transformation) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Coke Ovens (Transformation) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Blast Furnaces (Transformation) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Petrochemical Industry | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Patent Fuel Plants | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Non Specified (Transformation) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Total Energy Sector** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Coal Mines | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Oil and Gas Extraction | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Coke Ovens (Energy) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Blast Furnaces (Energy) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Gas Works (Energy) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Power Plants | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Non Specified (Energy) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Distribution Losses | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Final Consumption** | 2 096 | 2 877 | 3 578 | 3 388 | 3 936 | 3 890 | 4 262 | 4 668 | 5 179 | 5 685 | 5 935 | 6 262 | 6 106 | 6 296 |
| **Total Transport** | 1 766 | 2 507 | 3 178 | 2 997 | 3 522 | 3 484 | 3 830 | 4 245 | 4 760 | 5 255 | 5 486 | 5 740 | 5 506 | 5 681 |
| International Civil Aviation | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Domestic Air Transport | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Road | 1 705 | 2 456 | 3 131 | 2 949 | 3 475 | 3 436 | 3 782 | 4 197 | 4 713 | 5 205 | 5 436 | 5 667 | 5 437 | 5 612 |
| Rail | 54 | 45 | 41 | 41 | 41 | 42 | 42 | 42 | 41 | 44 | 44 | 52 | 54 | 54 |
| Inland Waterways | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 5 | 5 | 21 | 14 | 14 |
| Pipeline Transport | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Non Specified (Transport) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Total Industry** | 81 | 113 | 140 | 133 | 154 | 147 | 172 | 162 | 157 | 167 | 185 | 257 | 336 | 351 |
| Iron and Steel | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Chemical (incl.Petro-Chemical) | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| Non ferrous Metals | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Non metallic Mineral Products | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 1 |
| Transportation Equipment | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Machinery | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Mining and Quarrying | 2 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 4 | 3 | 4 | 4 | 4 | 5 |
| Food, Beverages and Tobacco | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Pulp, Paper and Printing | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Wood and Wood Products | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Construction | 77 | 108 | 134 | 127 | 147 | 141 | 165 | 155 | 151 | 161 | 179 | 251 | 329 | 343 |
| Textiles and Leather | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Non Specified (Industry) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Total Other Sectors** | 250 | 257 | 260 | 258 | 260 | 259 | 260 | 261 | 262 | 263 | 265 | 265 | 264 | 264 |
| Commerce - Public Services | 9 | 13 | 16 | 15 | 17 | 17 | 19 | 21 | 23 | 24 | 26 | 28 | 27 | 28 |
| Residential | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Agriculture | 241 | 245 | 244 | 243 | 242 | 242 | 241 | 240 | 240 | 239 | 238 | 238 | 237 | 237 |
| Non Specified (Others) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Total Non-Energy Use** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

*Table A 80: National Energy Balance 1990–2007. Other Kerosene [1000 tons].*

| 206A Other Kerosene | 1990 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Refinery Gross Output | 31 | 8 | 5 | 0 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 8 | 1 |
| Refinery Fuel | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total Imports (Balance) | 14 | 4 | 10 | 10 | 16 | 15 | 5 | 0 | 3 | 4 | 3 | 3 | 2 | 2 |
| Total Exports (Balance) | 21 | 6 | 5 | 2 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| International Marine Bunkers | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Stock Change (National Territory) | -7 | 0 | 1 | 2 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Gross Inland Deliveries (Obs.)** | 18 | 6 | 12 | 10 | 17 | 16 | 6 | 1 | 4 | 5 | 4 | 3 | 4 | 3 |
| Statistical Difference | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Total Transformation Sector** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Public Electricity | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Public Combined Heat and Power | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Public Heat Plants | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Auto Producers of Electricity | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Auto Producers for CHP | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Auto Producer Heat Plants | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Gas Works (Transformation) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Coke Ovens (Transformation) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Blast Furnaces (Transformation) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Petrochemical Industry | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Patent Fuel Plants | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Non Specified (Transformation) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Total Energy Sector** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Coal Mines | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Oil and Gas Extraction | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Coke Ovens (Energy) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Blast Furnaces (Energy) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Gas Works (Energy) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Power Plants | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Non Specified (Energy) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Distribution Losses | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Final Consumption** | 18 | 6 | 12 | 10 | 17 | 16 | 6 | 1 | 4 | 5 | 4 | 3 | 4 | 3 |
| **Total Transport** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| International Civil Aviation | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Domestic Air Transport | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Road | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Rail | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Inland Waterways | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Pipeline Transport | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Non Specified (Transport) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Total Industry** | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Iron and Steel | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Chemical (incl.Petro-Chemical) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Non ferrous Metals | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Non metallic Mineral Products | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Transportation Equipment | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Machinery | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Mining and Quarrying | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Food, Beverages and Tobacco | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Pulp, Paper and Printing | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Wood and Wood Products | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Construction | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Textiles and Leather | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Non Specified (Industry) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Total Other Sectors** | 18 | 6 | 12 | 10 | 17 | 15 | 6 | 1 | 4 | 4 | 4 | 3 | 3 | 3 |
| Commerce - Public Services | 18 | 6 | 12 | 10 | 17 | 15 | 6 | 1 | 4 | 4 | 4 | 3 | 3 | 3 |
| Residential | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Agriculture | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Non Specified (Others) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Total Non-Energy Use** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

*Table A 81: National Energy Balance 1990-2007. Kerosene Type Jet Fuel [1000 tons].*

| 206B Kerosene Type Jet Fuel | 1990 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Refinery Gross Output | 291 | 420 | 479 | 508 | 540 | 508 | 544 | 513 | 484 | 446 | 455 | 592 | 526 | 604 |
| Refinery Fuel | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total Imports (Balance) | 13 | 23 | 24 | 12 | 9 | 21 | 35 | 37 | 38 | 47 | 132 | 85 | 190 | 159 |
| Total Exports (Balance) | 5 | 0 | 0 | 0 | 6 | 5 | 5 | 1 | 1 | 5 | 4 | 2 | 1 | 1 |
| International Marine Bunkers | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Stock Change (National Territory) | 0 | 4 | -8 | -4 | -2 | 2 | -4 | 4 | -3 | 4 | -4 | -22 | -32 | -38 |
| **Gross Inland Deliveries (Obs.)** | 299 | 447 | 495 | 515 | 541 | 525 | 569 | 553 | 519 | 491 | 578 | 653 | 683 | 724 |
| Statistical Difference | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Total Transformation Sector** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Public Electricity | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Public Combined Heat and Power | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Public Heat Plants | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Auto Producers of Electricity | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Auto Producers for CHP | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Auto Producer Heat Plants | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Gas Works (Transformation) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Coke Ovens (Transformation) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Blast Furnaces (Transformation) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Petrochemical Industry | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Patent Fuel Plants | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Non Specified (Transformation) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Total Energy Sector** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Coal Mines | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Oil and Gas Extraction | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Coke Ovens (Energy) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Blast Furnaces (Energy) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Gas Works (Energy) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Power Plants | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Non Specified (Energy) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Distribution Losses | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Final Consumption** | 299 | 447 | 495 | 515 | 541 | 525 | 569 | 553 | 519 | 491 | 578 | 653 | 683 | 724 |
| **Total Transport** | 299 | 447 | 495 | 515 | 541 | 525 | 569 | 553 | 519 | 491 | 578 | 653 | 683 | 724 |
| International Civil Aviation | 269 | 425 | 466 | 493 | 511 | 489 | 537 | 447 | 484 | 414 | 486 | 549 | 575 | 552 |
| Domestic Air Transport | 30 | 22 | 29 | 22 | 30 | 36 | 32 | 106 | 34 | 77 | 92 | 104 | 108 | 172 |
| Road | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Rail | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Inland Waterways | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Pipeline Transport | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Non Specified (Transport) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Total Industry** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Iron and Steel | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Chemical (incl.Petro-Chemical) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Non ferrous Metals | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Non metallic Mineral Products | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Transportation Equipment | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Machinery | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Mining and Quarrying | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Food, Beverages and Tobacco | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Pulp, Paper and Printing | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Wood and Wood Products | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Construction | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Textiles and Leather | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Non Specified (Industry) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Total Other Sectors** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Commerce - Public Services | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Residential | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Agriculture | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Non Specified (Others) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Total Non-Energy Use** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

*Table A 82: National Energy Balance 1990-2007. Gasoline Type Jet Fuel [1000 tons].*

| 207A Gasoline Type Jet Fuel | 1990 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Refinery Gross Output | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Refinery Fuel | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total Imports (Balance) | 1 | 4 | 2 | 3 | 3 | 3 | 3 | 4 | 4 | 5 | 7 | 6 | 7 | 5 |
| Total Exports (Balance) | 0 | 0 | 1 | 1 | 0 | 1 | 1 | 1 | 2 | 3 | 3 | 3 | 3 | 3 |
| International Marine Bunkers | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Stock Change (National Territory) | 2 | -1 | 2 | 1 | 0 | 0 | 0 | -1 | 0 | 1 | -1 | 0 | -1 | 0 |
| **Gross Inland Deliveries (Obs.)** | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 3 | 2 | 3 | 3 | 3 |
| Statistical Difference | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Total Transformation Sector** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Public Electricity | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Public Combined Heat and Power | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Public Heat Plants | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Auto Producers of Electricity | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Auto Producers for CHP | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Auto Producer Heat Plants | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Gas Works (Transformation) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Coke Ovens (Transformation) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Blast Furnaces (Transformation) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Petrochemical Industry | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Patent Fuel Plants | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Non Specified (Transformation) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Total Energy Sector** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Coal Mines | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Oil and Gas Extraction | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Coke Ovens (Energy) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Blast Furnaces (Energy) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Gas Works (Energy) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Power Plants | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Non Specified (Energy) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Distribution Losses | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Final Consumption** | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 3 | 2 | 3 | 3 | 3 |
| **Total Transport** | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 3 | 2 | 3 | 3 | 3 |
| International Civil Aviation | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Domestic Air Transport | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 3 | 2 | 3 | 3 | 3 |
| Road | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Rail | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Inland Waterways | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Pipeline Transport | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Non Specified (Transport) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Total Industry** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Iron and Steel | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Chemical (incl.Petro-Chemical) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Non ferrous Metals | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Non metallic Mineral Products | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Transportation Equipment | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Machinery | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Mining and Quarrying | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Food, Beverages and Tobacco | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Pulp, Paper and Printing | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Wood and Wood Products | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Construction | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Textiles and Leather | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Non Specified (Industry) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Total Other Sectors** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Commerce - Public Services | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Residential | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Agriculture | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Non Specified (Others) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Total Non-Energy Use** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

*Table A 83: National Energy Balance 1990-2007. Motor Gasoline [1000 tons].*

| 2080 Motor Gasoline | 1990 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Refinery Gross Output | 2 631 | 2 271 | 2 297 | 2 410 | 2 232 | 2 141 | 1 815 | 1 922 | 1 927 | 1 799 | 1 715 | 1 798 | 1 615 | 1 702 |
| Refinery Fuel | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total Imports (Balance) | 259 | 698 | 612 | 547 | 759 | 762 | 670 | 603 | 706 | 879 | 1 043 | 1 090 | 959 | 884 |
| Total Exports (Balance) | 281 | 596 | 700 | 831 | 824 | 824 | 472 | 582 | 496 | 474 | 614 | 767 | 562 | 648 |
| International Marine Bunkers | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Stock Change (National Territory) | -55 | 20 | 11 | -21 | 37 | -24 | -32 | 47 | 8 | -8 | -7 | -43 | -5 | 5 |
| **Gross Inland Deliveries (Obs.)** | 2 545 | 2 394 | 2 219 | 2 106 | 2 204 | 2 054 | 1 981 | 1 991 | 2 144 | 2 196 | 2 137 | 2 078 | 2 008 | 1 943 |
| Statistical Difference | 9 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Total Transformation Sector** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Public Electricity | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Public Combined Heat and Power | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Public Heat Plants | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Auto Producers of Electricity | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Auto Producers for CHP | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Auto Producer Heat Plants | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Gas Works (Transformation) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Coke Ovens (Transformation) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Blast Furnaces (Transformation) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Petrochemical Industry | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Patent Fuel Plants | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Non Specified (Transformation) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Total Energy Sector** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Coal Mines | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Oil and Gas Extraction | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Coke Ovens (Energy) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Blast Furnaces (Energy) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Gas Works (Energy) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Power Plants | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Non Specified (Energy) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Distribution Losses | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Final Consumption** | 2 545 | 2 394 | 2 219 | 2 106 | 2 204 | 2 054 | 1 981 | 1 991 | 2 144 | 2 196 | 2 137 | 2 078 | 2 008 | 1 943 |
| **Total Transport** | 2 545 | 2 394 | 2 219 | 2 106 | 2 204 | 2 054 | 1 981 | 1 991 | 2 144 | 2 196 | 2 137 | 2 078 | 2 008 | 1 943 |
| International Civil Aviation | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Domestic Air Transport | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Road | 2 545 | 2 394 | 2 219 | 2 106 | 2 204 | 2 054 | 1 981 | 1 991 | 2 144 | 2 196 | 2 137 | 2 078 | 2 008 | 1 943 |
| Rail | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Inland Waterways | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Pipeline Transport | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Non Specified (Transport) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Total Industry** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Iron and Steel | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Chemical (incl.Petro-Chemical) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Non ferrous Metals | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Non metallic Mineral Products | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Transportation Equipment | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Machinery | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Mining and Quarrying | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Food, Beverages and Tobacco | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Pulp, Paper and Printing | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Wood and Wood Products | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Construction | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Textiles and Leather | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Non Specified (Industry) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Total Other Sectors** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Commerce - Public Services | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Residential | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Agriculture | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Non Specified (Others) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Total Non-Energy Use** | 0 | 0 | 0 | 0 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

*Table A 84: National Energy Balance 1990-2007. Lubricants [1000 tons].*

| 219A Lubricants | 1990 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Refinery Gross Output | 31 | 73 | 109 | 113 | 107 | 105 | 111 | 117 | 100 | 123 | 108 | 111 | 120 | 122 |
| Refinery Fuel | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total Imports (Balance) | 177 | 51 | 50 | 51 | 53 | 52 | 57 | 51 | 47 | 44 | 43 | 53 | 53 | 52 |
| Total Exports (Balance) | 32 | 41 | 49 | 57 | 53 | 51 | 58 | 65 | 62 | 80 | 70 | 85 | 91 | 102 |
| International Marine Bunkers | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Stock Change (National Territory) | -1 | 4 | -5 | 1 | -1 | -3 | -1 | 5 | 2 | 4 | -6 | 1 | -3 | 2 |
| **Gross Inland Deliveries (Obs.)** | 175 | 86 | 105 | 108 | 106 | 103 | 108 | 108 | 86 | 92 | 75 | 80 | 79 | 75 |
| Statistical Difference | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Total Transformation Sector** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Public Electricity | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Public Combined Heat and Power | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Public Heat Plants | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Auto Producers of Electricity | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Auto Producers for CHP | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Auto Producer Heat Plants | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Gas Works (Transformation) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Coke Ovens (Transformation) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Blast Furnaces (Transformation) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Petrochemical Industry | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Patent Fuel Plants | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Non Specified (Transformation) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Total Energy Sector** | 19 | 9 | 11 | 12 | 12 | 11 | 12 | 12 | 9 | 10 | 8 | 9 | 9 | 8 |
| Coal Mines | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Oil and Gas Extraction | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 |
| Coke Ovens (Energy) | 6 | 3 | 3 | 4 | 3 | 3 | 4 | 4 | 3 | 3 | 2 | 3 | 3 | 2 |
| Blast Furnaces (Energy) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Gas Works (Energy) | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Power Plants | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Non Specified (Energy) | 11 | 5 | 6 | 7 | 6 | 6 | 6 | 6 | 5 | 6 | 4 | 5 | 5 | 4 |
| Distribution Losses | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Final Consumption** | 156 | 77 | 94 | 96 | 94 | 92 | 96 | 96 | 77 | 82 | 67 | 71 | 70 | 67 |
| **Total Transport** | 71 | 35 | 43 | 44 | 43 | 42 | 44 | 44 | 36 | 38 | 31 | 32 | 32 | 30 |
| International Civil Aviation | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Domestic Air Transport | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Road | 70 | 34 | 42 | 43 | 42 | 41 | 43 | 43 | 35 | 37 | 30 | 32 | 31 | 30 |
| Rail | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Inland Waterways | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Pipeline Transport | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Non Specified (Transport) | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 |
| **Total Industry** | 82 | 40 | 49 | 50 | 49 | 48 | 50 | 50 | 40 | 42 | 35 | 38 | 37 | 35 |
| Iron and Steel | 15 | 7 | 9 | 9 | 9 | 9 | 9 | 9 | 7 | 7 | 7 | 7 | 7 | 7 |
| Chemical (incl.Petro-Chemical) | 7 | 3 | 4 | 4 | 4 | 4 | 4 | 4 | 3 | 4 | 3 | 3 | 3 | 3 |
| Non ferrous Metals | 2 | 1 | 1 | 2 | 1 | 1 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 |
| Non metallic Mineral Products | 11 | 5 | 6 | 7 | 6 | 6 | 7 | 7 | 5 | 6 | 5 | 5 | 5 | 5 |
| Transportation Equipment | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Machinery | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 4 | 3 | 3 | 3 | 3 | 3 | 3 |
| Mining and Quarrying | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 |
| Food, Beverages and Tobacco | 11 | 5 | 7 | 7 | 7 | 7 | 7 | 7 | 5 | 6 | 5 | 5 | 5 | 5 |
| Pulp, Paper and Printing | 9 | 4 | 5 | 5 | 5 | 5 | 5 | 5 | 4 | 5 | 4 | 4 | 4 | 4 |
| Wood and Wood Products | 3 | 1 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 |
| Construction | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Textiles and Leather | 5 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 2 | 2 |
| Non Specified (Industry) | 9 | 4 | 5 | 6 | 6 | 5 | 6 | 4 | 3 | 3 | 2 | 3 | 3 | 2 |
| **Total Other Sectors** | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 2 | 2 | 1 |
| Commerce - Public Services | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 |
| Residential | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Agriculture | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Non Specified (Others) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Total Non-Energy Use** | 175 | 86 | 105 | 108 | 106 | 103 | 108 | 108 | 86 | 92 | 75 | 80 | 79 | 75 |

*Table A 85: National Energy Balance 1990-2007. White Spirit [1000 tons].*

| 220A White Spirit | 1990 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Refinery Gross Output | 0 | 7 | 5 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 18 | 12 | 0 |
| Refinery Fuel | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total Imports (Balance) | 11 | 9 | 8 | 8 | 11 | 12 | 12 | 7 | 6 | 9 | 11 | 10 | 11 | 13 |
| Total Exports (Balance) | 0 | 2 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 |
| International Marine Bunkers | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Stock Change (National Territory) | 0 | 0 | -1 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | -18 | -12 | 0 |
| **Gross Inland Deliveries (Obs.)** | 11 | 14 | 12 | 12 | 11 | 11 | 13 | 7 | 6 | 8 | 10 | 10 | 12 | 12 |
| Statistical Difference | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Total Transformation Sector** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Public Electricity | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Public Combined Heat and Power | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Public Heat Plants | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Auto Producers of Electricity | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Auto Producers for CHP | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Auto Producer Heat Plants | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Gas Works (Transformation) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Coke Ovens (Transformation) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Blast Furnaces (Transformation) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Petrochemical Industry | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Patent Fuel Plants | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Non Specified (Transformation) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Total Energy Sector** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Coal Mines | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Oil and Gas Extraction | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Coke Ovens (Energy) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Blast Furnaces (Energy) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Gas Works (Energy) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Power Plants | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Non Specified (Energy) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Distribution Losses | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Final Consumption** | 11 | 14 | 12 | 12 | 11 | 11 | 13 | 7 | 6 | 8 | 10 | 10 | 12 | 12 |
| **Total Transport** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| International Civil Aviation | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Domestic Air Transport | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Road | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Rail | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Inland Waterways | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Pipeline Transport | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Non Specified (Transport) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Total Industry** | 11 | 14 | 12 | 12 | 11 | 11 | 13 | 7 | 6 | 8 | 10 | 10 | 12 | 12 |
| Iron and Steel | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Chemical (incl.Petro-Chemical) | 11 | 14 | 10 | 9 | 8 | 5 | 4 | 4 | 4 | 4 | 5 | 4 | 4 | 3 |
| Non ferrous Metals | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Non metallic Mineral Products | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Transportation Equipment | 0 | 0 | 2 | 3 | 3 | 6 | 9 | 3 | 2 | 4 | 6 | 6 | 8 | 9 |
| Machinery | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Mining and Quarrying | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Food, Beverages and Tobacco | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Pulp, Paper and Printing | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Wood and Wood Products | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Construction | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Textiles and Leather | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Non Specified (Industry) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Total Other Sectors** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Commerce - Public Services | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Residential | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Agriculture | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Non Specified (Others) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Total Non-Energy Use** | 11 | 14 | 12 | 12 | 11 | 11 | 13 | 7 | 6 | 8 | 10 | 10 | 12 | 12 |

*Table A 86: National Energy Balance 1990-2007. Bitumen [1000 tons].*

| 222A Bitumen | 1990 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Refinery Gross Output | 269 | 254 | 263 | 299 | 300 | 326 | 343 | 402 | 416 | 398 | 433 | 466 | 392 | 411 |
| Refinery Fuel | 0 | 0 | 2 | 0 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total Imports (Balance) | 292 | 187 | 250 | 242 | 279 | 231 | 292 | 296 | 248 | 296 | 295 | 335 | 415 | 268 |
| Total Exports (Balance) | 1 | 5 | 11 | 6 | 1 | 1 | 45 | 78 | 62 | 82 | 81 | 147 | 122 | 151 |
| International Marine Bunkers | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Stock Change (National Territory) | -23 | 4 | -7 | 7 | -2 | 4 | -3 | -1 | -1 | 1 | -2 | -3 | 1 | -2 |
| **Gross Inland Deliveries (Obs.)** | 538 | 440 | 493 | 542 | 572 | 560 | 587 | 618 | 601 | 613 | 646 | 651 | 685 | 526 |
| Statistical Difference | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Total Transformation Sector** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Public Electricity | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Public Combined Heat and Power | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Public Heat Plants | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Auto Producers of Electricity | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Auto Producers for CHP | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Auto Producer Heat Plants | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Gas Works (Transformation) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Coke Ovens (Transformation) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Blast Furnaces (Transformation) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Petrochemical Industry | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Patent Fuel Plants | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Non Specified (Transformation) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Total Energy Sector** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Coal Mines | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Oil and Gas Extraction | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Coke Ovens (Energy) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Blast Furnaces (Energy) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Gas Works (Energy) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Power Plants | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Non Specified (Energy) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Distribution Losses | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Final Consumption** | 538 | 440 | 493 | 542 | 572 | 560 | 587 | 618 | 601 | 613 | 646 | 651 | 685 | 526 |
| **Total Transport** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| International Civil Aviation | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Domestic Air Transport | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Road | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Rail | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Inland Waterways | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Pipeline Transport | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Non Specified (Transport) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Total Industry** | 538 | 440 | 493 | 542 | 572 | 560 | 587 | 618 | 601 | 613 | 646 | 651 | 685 | 526 |
| Iron and Steel | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Chemical (incl.Petro-Chemical) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Non ferrous Metals | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Non metallic Mineral Products | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Transportation Equipment | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Machinery | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Mining and Quarrying | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Food, Beverages and Tobacco | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Pulp, Paper and Printing | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Wood and Wood Products | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Construction | 538 | 440 | 493 | 542 | 572 | 560 | 587 | 618 | 601 | 613 | 646 | 651 | 685 | 526 |
| Textiles and Leather | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Non Specified (Industry) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Total Other Sectors** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Commerce - Public Services | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Residential | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Agriculture | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Non Specified (Others) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Total Non-Energy Use** | 538 | 440 | 493 | 542 | 572 | 560 | 587 | 618 | 601 | 613 | 646 | 651 | 685 | 526 |

*Table A 87: National Energy Balance 1990-2007. Other Oil Products [1000 tons].*

| 224A Other Oil Products | 1990 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Refinery Gross Output | 499 | 761 | 923 | 953 | 960 | 927 | 859 | 988 | 1 030 | 1 048 | 1 044 | 851 | 1 186 | 1 217 |
| Refinery Fuel | 164 | 212 | 264 | 277 | 264 | 213 | 223 | 226 | 254 | 278 | 344 | 229 | 282 | 241 |
| Total Imports (Balance) | 126 | 13 | -14 | 121 | 77 | 69 | 111 | 47 | 45 | 43 | 95 | 45 | 78 | 51 |
| Total Exports (Balance) | 3 | 39 | 54 | 6 | 137 | 131 | 139 | 162 | 168 | 149 | 163 | 93 | 180 | 157 |
| International Marine Bunkers | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Stock Change (National Territory) | -42 | -3 | 14 | -10 | 6 | 0 | -7 | 11 | -1 | -13 | 104 | -8 | -2 | -7 |
| **Gross Inland Deliveries (Obs.)** | 471 | 518 | 605 | 780 | 641 | 651 | 601 | 659 | 652 | 651 | 734 | 566 | 800 | 864 |
| Statistical Difference | -56 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Total Transformation Sector** | 23 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Public Electricity | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Public Combined Heat and Power | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Public Heat Plants | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Auto Producers of Electricity | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Auto Producers for CHP | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Auto Producer Heat Plants | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Gas Works (Transformation) | 23 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Coke Ovens (Transformation) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Blast Furnaces (Transformation) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Petrochemical Industry | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Patent Fuel Plants | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Non Specified (Transformation) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Total Energy Sector** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Coal Mines | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Oil and Gas Extraction | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Coke Ovens (Energy) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Blast Furnaces (Energy) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Gas Works (Energy) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Power Plants | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Non Specified (Energy) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Distribution Losses | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Final Consumption** | 448 | 518 | 605 | 780 | 641 | 651 | 601 | 659 | 652 | 651 | 734 | 566 | 800 | 864 |
| **Total Transport** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| International Civil Aviation | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Domestic Air Transport | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Road | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Rail | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Inland Waterways | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Pipeline Transport | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Non Specified (Transport) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Total Industry** | 448 | 518 | 605 | 780 | 641 | 651 | 601 | 659 | 652 | 651 | 734 | 566 | 800 | 864 |
| Iron and Steel | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Chemical (incl.Petro-Chemical) | 448 | 518 | 605 | 780 | 641 | 651 | 601 | 659 | 652 | 651 | 734 | 566 | 800 | 864 |
| Non ferrous Metals | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Non metallic Mineral Products | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Transportation Equipment | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Machinery | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Mining and Quarrying | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Food, Beverages and Tobacco | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Pulp, Paper and Printing | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Wood and Wood Products | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Construction | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Textiles and Leather | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Non Specified (Industry) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Total Other Sectors** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Commerce - Public Services | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Residential | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Agriculture | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Non Specified (Others) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Total Non-Energy Use** | 448 | 518 | 605 | 780 | 641 | 651 | 601 | 659 | 652 | 651 | 734 | 566 | 800 | 864 |

*Table A 88: National Energy Balance 1990-2007. LPG [1000 tons].*

| 303A LPG | 1990 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Refinery Gross Output | 47 | 60 | 20 | 45 | 30 | 19 | 34 | 0 | 23 | 50 | 57 | 107 | 50 | 70 |
| Refinery Fuel | 8 | 19 | 6 | 0 | 1 | 4 | 20 | 0 | 2 | 1 | 3 | 49 | 3 | 22 |
| Total Imports (Balance) | 97 | 149 | 184 | 148 | 132 | 152 | 159 | 140 | 155 | 137 | 132 | 133 | 155 | 129 |
| Total Exports (Balance) | 14 | 42 | 42 | 55 | 19 | 20 | 17 | 4 | 7 | 9 | 17 | 20 | 21 | 21 |
| International Marine Bunkers | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Stock Change (National Territory) | 2 | 20 | -3 | -5 | 3 | 0 | -5 | 6 | -2 | -1 | 5 | 0 | -2 | 3 |
| **Gross Inland Deliveries (Obs.)** | 125 | 166 | 152 | 132 | 144 | 147 | 150 | 143 | 168 | 176 | 174 | 172 | 179 | 158 |
| Statistical Difference | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Total Transformation Sector** | 1 | 3 | 3 | 2 | 1 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 |
| Public Electricity | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Public Combined Heat and Power | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 |
| Public Heat Plants | 1 | 3 | 3 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Auto Producers of Electricity | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Auto Producers for CHP | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Auto Producer Heat Plants | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Gas Works (Transformation) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Coke Ovens (Transformation) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Blast Furnaces (Transformation) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Petrochemical Industry | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Patent Fuel Plants | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Non Specified (Transformation) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Total Energy Sector** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Coal Mines | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Oil and Gas Extraction | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Coke Ovens (Energy) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Blast Furnaces (Energy) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Gas Works (Energy) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Power Plants | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Non Specified (Energy) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Distribution Losses | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Final Consumption** | 124 | 163 | 150 | 130 | 143 | 147 | 150 | 143 | 168 | 176 | 174 | 171 | 179 | 158 |
| **Total Transport** | 9 | 11 | 15 | 11 | 13 | 13 | 16 | 18 | 20 | 17 | 18 | 18 | 18 | 17 |
| International Civil Aviation | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Domestic Air Transport | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Road | 9 | 11 | 15 | 11 | 13 | 13 | 16 | 18 | 20 | 17 | 18 | 18 | 18 | 17 |
| Rail | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Inland Waterways | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Pipeline Transport | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Non Specified (Transport) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Total Industry** | 65 | 62 | 67 | 60 | 66 | 49 | 55 | 48 | 41 | 39 | 31 | 36 | 46 | 39 |
| Iron and Steel | 4 | 3 | 12 | 12 | 13 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Chemical (incl.Petro-Chemical) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 |
| Non ferrous Metals | 8 | 6 | 6 | 4 | 5 | 4 | 4 | 4 | 4 | 5 | 4 | 4 | 4 | 4 |
| Non metallic Mineral Products | 12 | 23 | 21 | 13 | 14 | 15 | 15 | 14 | 10 | 11 | 2 | 4 | 5 | 5 |
| Transportation Equipment | 1 | 3 | 2 | 10 | 11 | 0 | 1 | 1 | 1 | 1 | 3 | 2 | 2 | 2 |
| Machinery | 11 | 13 | 12 | 10 | 11 | 11 | 14 | 13 | 13 | 11 | 8 | 10 | 12 | 10 |
| Mining and Quarrying | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 2 | 2 |
| Food, Beverages and Tobacco | 3 | 3 | 2 | 2 | 2 | 5 | 4 | 5 | 3 | 3 | 4 | 5 | 6 | 4 |
| Pulp, Paper and Printing | 1 | 1 | 2 | 1 | 1 | 2 | 2 | 1 | 2 | 1 | 1 | 1 | 1 | 1 |
| Wood and Wood Products | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Construction | 23 | 9 | 8 | 7 | 7 | 9 | 13 | 6 | 5 | 5 | 5 | 6 | 9 | 6 |
| Textiles and Leather | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 |
| Non Specified (Industry) | 0 | 1 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| **Total Other Sectors** | 50 | 90 | 68 | 59 | 64 | 84 | 79 | 77 | 106 | 120 | 125 | 118 | 115 | 102 |
| Commerce - Public Services | 32 | 61 | 34 | 19 | 21 | 36 | 23 | 12 | 28 | 23 | 41 | 43 | 53 | 45 |
| Residential | 16 | 26 | 31 | 36 | 39 | 43 | 51 | 61 | 73 | 89 | 77 | 69 | 58 | 53 |
| Agriculture | 2 | 3 | 3 | 4 | 4 | 4 | 5 | 5 | 6 | 7 | 6 | 6 | 5 | 4 |
| Non Specified (Others) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Total Non-Energy Use** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

*Table A 89: National Energy Balance 1990-2007. Refinery Gas [1000 tons].*

| 308A Refinery Gas | 1990 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Refinery Gross Output | 373 | 305 | 359 | 351 | 348 | 341 | 312 | 328 | 306 | 235 | 255 | 309 | 390 | 417 |
| Refinery Fuel | 373 | 305 | 359 | 351 | 348 | 338 | 310 | 327 | 308 | 273 | 293 | 343 | 429 | 454 |
| Total Imports (Balance) | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Total Exports (Balance) | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| International Marine Bunkers | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Stock Change (National Territory) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Gross Inland Deliveries (Obs.)** | 0 | 0 | 0 | 0 | 0 | 2 | 2 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| Statistical Difference | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Total Transformation Sector** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Public Electricity | 0 | 0 | 0 | 0 | 0 | 2 | 2 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| Public Combined Heat and Power | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Public Heat Plants | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Auto Producers of Electricity | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Auto Producers for CHP | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Auto Producer Heat Plants | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Gas Works (Transformation) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Coke Ovens (Transformation) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Blast Furnaces (Transformation) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Petrochemical Industry | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Patent Fuel Plants | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Non Specified (Transformation) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Total Energy Sector** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Coal Mines | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Oil and Gas Extraction | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Coke Ovens (Energy) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Blast Furnaces (Energy) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Gas Works (Energy) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Power Plants | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Non Specified (Energy) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Distribution Losses | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Final Consumption** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Total Transport** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| International Civil Aviation | 0 | 0 | 0 | 0 | 0 | 2 | 2 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| Domestic Air Transport | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Road | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Rail | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Inland Waterways | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Pipeline Transport | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Non Specified (Transport) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Total Industry** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Iron and Steel | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Chemical (incl.Petro-Chemical) | 0 | 0 | 0 | 0 | 0 | 2 | 2 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| Non ferrous Metals | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Non metallic Mineral Products | 0 | 0 | 0 | 0 | 0 | 2 | 2 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| Transportation Equipment | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Machinery | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Mining and Quarrying | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Food, Beverages and Tobacco | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Pulp, Paper and Printing | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Wood and Wood Products | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Construction | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Textiles and Leather | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Non Specified (Industry) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Total Other Sectors** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Commerce - Public Services | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Residential | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Agriculture | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Non Specified (Others) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Total Non-Energy Use** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

## Natural Gas

*Table A 90: National Energy Balance 1990-2007. Natural Gas [PJ NCV].*

| | 1990 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Indigenous Production | 46.4 | 53.3 | 53.7 | 51.4 | 56.4 | 62.5 | 64.8 | 62.2 | 67.5 | 75.1 | 70.5 | 59.3 | 66.1 | 67.2 |
| Total Imports (Balance) | 187.9 | 229.1 | 236.6 | 216.9 | 224.0 | 219.5 | 222.8 | 225.6 | 234.8 | 288.4 | 301.2 | 339.6 | 372.5 | 345.1 |
| Total Exports (Balance) | 0.0 | 0.6 | 0.0 | 0.0 | 0.7 | 0.0 | 0.6 | 14.7 | 19.1 | 36.9 | 53.7 | 35.0 | 95.9 | 106.1 |
| Stock Change (National Territory) | -15.1 | -12.3 | -3.3 | 8.2 | 4.2 | 6.9 | -11.3 | 19.1 | 12.3 | -7.2 | -2.3 | -18.1 | -27.4 | -11.0 |
| **Gross Inland Deliveries (Obs.)** | 219.2 | 269.6 | 286.9 | 276.6 | 283.9 | 288.9 | 275.7 | 292.2 | 295.5 | 319.5 | 315.7 | 345.9 | 315.4 | 295.2 |
| Statistical Difference | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| **Total Transformation Sector** | 74.7 | 95.8 | 108.7 | 96.9 | 100.6 | 102.7 | 82.9 | 86.4 | 89.4 | 105.4 | 102.4 | 117.8 | 101.0 | 91.7 |
| Public Electricity | 28.1 | 21.7 | 36.9 | 28.7 | 35.4 | 37.7 | 25.4 | 29.7 | 24.8 | 30.0 | 23.8 | 41.0 | 24.4 | 19.3 |
| Public Combined Heat and Power | 23.8 | 30.8 | 33.8 | 31.1 | 29.4 | 30.7 | 27.7 | 31.0 | 34.4 | 42.7 | 50.9 | 47.0 | 51.3 | 47.1 |
| Public Heat Plants | 7.6 | 9.6 | 9.0 | 8.6 | 8.8 | 7.4 | 8.9 | 5.8 | 9.6 | 7.7 | 7.0 | 8.9 | 6.9 | 5.5 |
| Auto Producers of Electricity | 9.6 | 21.2 | 18.2 | 20.7 | 19.2 | 16.8 | 12.0 | 13.8 | 7.1 | 11.0 | 7.4 | 7.2 | 3.7 | 4.1 |
| Auto Producers for CHP | 5.7 | 12.5 | 10.7 | 7.8 | 7.9 | 9.6 | 8.6 | 5.9 | 13.5 | 12.7 | 12.9 | 13.2 | 14.4 | 15.1 |
| Auto Producer Heat Plants | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.6 | 0.4 | 0.2 | 0.0 | 1.2 | 0.4 | 0.5 | 0.4 | 0.6 |
| Gas Works (Transformation) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Coke Ovens (Transformation) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Blast Furnaces (Transformation) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Conversion to Liquids | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Non Specified (Transformation) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| **Total Energy Sector** | 15.8 | 18.4 | 11.5 | 12.4 | 12.8 | 13.6 | 11.5 | 12.9 | 15.6 | 12.7 | 14.7 | 20.0 | 13.2 | 11.2 |
| Coal Mines | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Oil and Gas Extraction | 6.6 | 10.8 | 4.3 | 4.5 | 5.5 | 6.3 | 5.2 | 5.6 | 9.0 | 6.9 | 9.9 | 9.1 | 11.6 | 9.7 |
| Inputs to Oil Refineries | 6.8 | 7.6 | 7.2 | 7.9 | 7.3 | 7.3 | 6.4 | 7.4 | 6.7 | 5.7 | 4.8 | 10.9 | 1.6 | 1.6 |
| Coke Ovens (Energy) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Gas Works (Energy) | 2.4 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Power Plants | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Non Specified (Energy) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Distribution Losses | 0.3 | 0.2 | 0.2 | 0.2 | 0.2 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 |
| **Final Consumption** | 113.5 | 144.6 | 155.8 | 156.4 | 159.8 | 161.7 | 170.6 | 182.7 | 180.0 | 190.1 | 188.3 | 197.2 | 189.6 | 182.1 |
| **Total Transport** | 4.1 | 4.1 | 4.2 | 4.2 | 6.3 | 7.8 | 9.7 | 8.2 | 5.0 | 6.6 | 8.0 | 9.8 | 8.2 | 8.1 |
| Road | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Pipeline Transport | 4.1 | 4.1 | 4.2 | 4.2 | 6.3 | 7.8 | 9.7 | 8.2 | 5.0 | 6.6 | 8.0 | 9.8 | 8.2 | 8.1 |
| Non Specified (Transport) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| **Total Industry** | 69.0 | 73.5 | 77.8 | 82.6 | 80.3 | 76.8 | 88.7 | 87.3 | 94.0 | 90.4 | 90.2 | 101.1 | 100.9 | 98.9 |
| Iron and Steel | 10.5 | 11.2 | 12.1 | 14.6 | 14.2 | 13.8 | 13.6 | 13.3 | 12.6 | 13.9 | 13.4 | 16.2 | 16.7 | 15.7 |
| Chemical (incl.Petro-Chemical) | 7.7 | 8.3 | 8.3 | 10.1 | 9.8 | 12.6 | 14.4 | 14.9 | 14.7 | 14.8 | 13.8 | 15.6 | 15.0 | 14.2 |
| Non ferrous Metals | 1.4 | 2.2 | 2.0 | 2.4 | 2.3 | 2.2 | 2.3 | 2.6 | 2.6 | 2.9 | 2.9 | 3.1 | 3.2 | 3.8 |
| Non metallic Mineral Products | 10.1 | 11.1 | 11.9 | 13.2 | 12.9 | 11.0 | 11.7 | 11.9 | 13.5 | 13.1 | 13.1 | 13.9 | 13.8 | 13.9 |
| Transportation Equipment | 1.5 | 2.6 | 2.4 | 1.2 | 1.1 | 1.0 | 1.3 | 1.5 | 1.2 | 1.7 | 2.2 | 2.2 | 2.3 | 2.1 |
| Machinery | 4.3 | 6.1 | 6.3 | 5.5 | 5.4 | 4.4 | 4.8 | 5.1 | 5.1 | 5.1 | 5.3 | 6.4 | 7.0 | 6.4 |
| Mining and Quarrying | 2.6 | 2.5 | 2.6 | 2.5 | 2.5 | 1.7 | 2.4 | 2.6 | 2.7 | 2.6 | 2.6 | 2.7 | 2.8 | 3.0 |
| Food, Beverages and Tobacco | 8.9 | 9.4 | 9.2 | 9.6 | 9.4 | 9.7 | 11.5 | 11.2 | 15.0 | 11.2 | 10.3 | 11.4 | 11.4 | 11.1 |
| Pulp, Paper and Printing | 12.9 | 9.8 | 10.9 | 16.9 | 16.4 | 13.7 | 19.5 | 16.3 | 19.0 | 18.0 | 20.0 | 20.8 | 20.1 | 20.2 |
| Wood and Wood Products | 1.7 | 2.0 | 2.3 | 1.7 | 1.6 | 1.8 | 1.7 | 1.9 | 1.9 | 2.1 | 1.8 | 3.3 | 2.9 | 2.8 |
| Construction | 0.7 | 1.5 | 1.5 | 0.6 | 0.5 | 1.7 | 1.5 | 1.8 | 1.8 | 1.5 | 1.2 | 1.6 | 2.0 | 1.7 |
| Textiles and Leather | 3.5 | 3.4 | 3.7 | 2.4 | 2.3 | 2.2 | 2.9 | 3.0 | 2.6 | 2.2 | 1.9 | 2.1 | 2.0 | 2.0 |
| Non Specified (Industry) | 3.1 | 3.4 | 4.5 | 2.0 | 1.9 | 1.1 | 1.2 | 1.3 | 1.3 | 1.5 | 1.6 | 1.7 | 1.7 | 1.9 |
| **Total Other Sectors** | 40.4 | 67.0 | 73.8 | 69.7 | 73.2 | 77.0 | 72.2 | 87.2 | 81.1 | 93.0 | 90.1 | 86.3 | 80.6 | 75.1 |
| Commerce - Public Services | 7.7 | 23.4 | 24.6 | 19.2 | 18.6 | 13.7 | 14.1 | 23.1 | 18.1 | 25.2 | 27.8 | 20.7 | 21.3 | 20.6 |
| Residential | 32.3 | 43.2 | 48.6 | 49.9 | 54.0 | 62.7 | 57.5 | 63.5 | 62.3 | 67.1 | 61.6 | 64.9 | 58.7 | 53.9 |
| Agriculture | 0.4 | 0.5 | 0.5 | 0.6 | 0.6 | 0.6 | 0.6 | 0.6 | 0.6 | 0.7 | 0.6 | 0.7 | 0.6 | 0.5 |
| Non Specified (Others) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| **Total Non-Energy Use** | 14.9 | 10.5 | 10.8 | 10.7 | 10.6 | 10.6 | 10.5 | 9.9 | 10.3 | 11.3 | 10.3 | 10.8 | 11.5 | 10.1 |

## Renewable Fuels

*Table A 91: National Energy Balance 1990-2007. Fuel Wood [PJ].*

| 111A Fuel Wood | 1990 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Indigenous Production | 61.40 | 65.76 | 70.73 | 65.36 | 63.42 | 64.52 | 58.55 | 66.85 | 68.03 | 72.15 | 68.95 | 69.87 | 66.11 | 61.72 |
| Total Imports (Balance) | 2.30 | 1.62 | 2.42 | 2.02 | 1.60 | 1.49 | 1.80 | 1.80 | 2.10 | 2.53 | 3.32 | 3.51 | 4.21 | 3.36 |
| Total Exports (Balance) | 0.04 | 0.22 | 0.11 | 0.11 | 0.14 | 0.03 | 0.18 | 0.18 | 0.38 | 0.93 | 1.32 | 0.84 | 0.69 | 0.62 |
| Stock Change (National Territory) | -0.55 | 0.19 | 0.24 | -0.05 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| **Gross Inland Deliveries (Obs.)** | 63.12 | 67.35 | 73.29 | 67.21 | 64.88 | 65.97 | 60.17 | 68.48 | 69.75 | 73.75 | 70.95 | 72.54 | 69.63 | 64.46 |
| Statistical Difference | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| **Total Transformation Sector** | 0.00 | 0.00 | 0.00 | 0.00 | 0.21 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.05 | 0.05 | 0.05 | 0.03 |
| Public Electricity | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Public Combined Heat and Power | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Public Heat Plants | 0.00 | 0.00 | 0.00 | 0.00 | 0.21 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.05 | 0.05 | 0.05 | 0.03 |
| Auto Producers of Electricity | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Auto Producers for CHP | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Auto Producer Heat Plants | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| **Total Energy Sector** | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Coal Mines | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Patent Fuel Plants | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Coke Ovens (Energy) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Blast Furnaces (Energy) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Gas Works (Energy) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| BKB (Transformation) | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Petroleum refineries | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Power Plants | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Non Specified (Energy) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Distribution Losses | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| **Final Consumption** | 63.12 | 67.35 | 73.29 | 67.21 | 64.67 | 65.97 | 60.17 | 68.48 | 69.75 | 73.75 | 70.90 | 72.48 | 69.58 | 64.43 |
| **Total Transport** | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Rail | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Inland Waterways | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Non Specified (Transport) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| **Total Industry** | 0.66 | 1.08 | 0.78 | 0.27 | 0.15 | 1.87 | 0.95 | 1.15 | 1.42 | 1.07 | 0.89 | 1.35 | 2.32 | 3.40 |
| Iron and Steel | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Chemical (incl.Petro-Chemical) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 |
| Non ferrous Metals | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Non metallic Mineral Products | 0.05 | 0.06 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.01 | 0.01 | 0.02 | 0.02 |
| Transportation Equipment | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Machinery | 0.05 | 0.06 | 0.01 | 0.02 | 0.01 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.04 | 0.06 | 0.06 |
| Mining and Quarrying | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Food, Beverages and Tobacco | 0.12 | 0.09 | 0.02 | 0.02 | 0.01 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.03 | 0.04 | 0.03 |
| Pulp, Paper and Printing | 0.01 | 0.00 | 0.05 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.02 |
| Wood and Wood Products | 0.23 | 0.30 | 0.32 | 0.08 | 0.04 | 1.62 | 0.71 | 0.86 | 1.15 | 0.78 | 0.61 | 0.84 | 1.60 | 2.71 |
| Construction | 0.00 | 0.29 | 0.14 | 0.08 | 0.05 | 0.12 | 0.11 | 0.13 | 0.13 | 0.13 | 0.13 | 0.21 | 0.29 | 0.27 |
| Textiles and Leather | 0.02 | 0.02 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Non Specified (Industry) | 0.19 | 0.25 | 0.22 | 0.08 | 0.05 | 0.08 | 0.08 | 0.10 | 0.09 | 0.09 | 0.08 | 0.20 | 0.31 | 0.28 |
| **Total Other Sectors** | 62.45 | 66.28 | 72.50 | 66.93 | 64.52 | 64.10 | 59.22 | 67.33 | 68.33 | 72.69 | 70.02 | 71.14 | 67.26 | 61.03 |
| Commerce - Public Services | 1.33 | 1.17 | 1.06 | 0.87 | 0.49 | 0.48 | 0.34 | 0.49 | 0.48 | 0.48 | 0.52 | 0.50 | 0.49 | 0.45 |
| Residential | 57.50 | 61.25 | 67.20 | 62.14 | 60.24 | 59.85 | 55.38 | 62.88 | 63.83 | 67.93 | 65.38 | 66.45 | 62.81 | 56.99 |
| Agriculture | 3.63 | 3.86 | 4.24 | 3.92 | 3.80 | 3.77 | 3.49 | 3.96 | 4.02 | 4.28 | 4.12 | 4.19 | 3.96 | 3.59 |
| Non Specified (Others) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

*Table A 92: National Energy Balance 1990-2007. Wood Waste [PJ].*

| 116A Wood waste; Other | 1990 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Indigenous Production | 13.69 | 18.77 | 20.60 | 24.80 | 23.25 | 38.77 | 36.99 | 42.28 | 43.20 | 51.75 | 57.48 | 61.86 | 68.55 | 80.81 |
| Total Imports (Balance) | 2.14 | 2.49 | 2.12 | 3.01 | 3.20 | 2.90 | 3.14 | 4.41 | 4.77 | 4.61 | 7.09 | 6.99 | 17.46 | 16.51 |
| Total Exports (Balance) | 2.07 | 2.62 | 2.82 | 5.18 | 5.03 | 6.14 | 6.51 | 7.98 | 6.86 | 10.47 | 16.05 | 13.13 | 11.85 | 15.44 |
| Stock Change (National Territory) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | -0.36 |
| **Gross Inland Deliveries (Obs.)** | 13.76 | 18.64 | 19.90 | 22.63 | 21.41 | 35.53 | 33.62 | 38.70 | 41.11 | 45.88 | 48.53 | 55.71 | 74.16 | 81.51 |
| Statistical Difference | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| **Total Transformation Sector** | 2.27 | 8.64 | 9.78 | 10.19 | 9.18 | 12.38 | 12.97 | 13.64 | 17.35 | 17.93 | 21.29 | 24.68 | 34.02 | 43.43 |
| Public Electricity | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.06 | 0.01 | 0.53 | 0.92 | 1.17 | 2.45 | 3.02 | 6.45 | 8.93 |
| Public Combined Heat and Power | 0.00 | 0.00 | 0.07 | 0.16 | 0.10 | 0.38 | 0.35 | 1.01 | 0.74 | 1.26 | 3.24 | 5.07 | 9.52 | 14.26 |
| Public Heat Plants | 2.04 | 4.33 | 5.99 | 5.98 | 6.69 | 6.32 | 8.06 | 9.50 | 11.93 | 12.02 | 11.63 | 12.37 | 12.03 | 12.28 |
| Auto Producers of Electricity | 0.00 | 0.19 | 2.49 | 2.86 | 0.27 | 2.65 | 1.51 | 0.81 | 2.20 | 2.35 | 1.67 | 1.31 | 2.01 | 2.73 |
| Auto Producers for CHP | 0.22 | 4.11 | 1.23 | 1.19 | 2.10 | 2.87 | 2.96 | 1.59 | 1.43 | 0.93 | 2.21 | 2.81 | 4.00 | 5.24 |
| Auto Producer Heat Plants | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.09 | 0.08 | 0.21 | 0.13 | 0.18 | 0.09 | 0.09 | 0.00 | 0.00 |
| **Total Energy Sector** | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 |
| Coal Mines | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Patent Fuel Plants | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Coke Ovens (Energy) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Blast Furnaces (Energy) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Gas Works (Energy) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| BKB (Transformation) | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Petroleum refineries | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 |
| Power Plants | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Non Specified (Energy) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Distribution Losses | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| **Final Consumption** | 11.49 | 10.00 | 10.12 | 12.45 | 12.23 | 23.16 | 20.65 | 25.06 | 23.75 | 27.95 | 27.24 | 31.02 | 40.14 | 38.06 |
| **Total Transport** | 0.08 | 0.23 | 0.25 | 0.27 | 0.29 | 0.34 | 0.37 | 0.40 | 0.43 | 0.44 | 0.46 | 0.46 | 0.46 | 0.45 |
| Rail | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Inland Waterways | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Non Specified (Transport) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| **Total Industry** | 9.43 | 6.89 | 6.77 | 7.79 | 7.30 | 15.29 | 11.70 | 12.49 | 10.71 | 11.38 | 10.24 | 12.92 | 19.24 | 19.42 |
| Iron and Steel | 0.00 | 0.00 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Chemical (incl.Petro-Chemical) | 2.90 | 1.72 | 2.06 | 2.41 | 1.58 | 3.60 | 2.52 | 1.26 | 1.12 | 1.33 | 1.11 | 1.35 | 1.23 | 1.38 |
| Non ferrous Metals | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Non metallic Mineral Products | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.07 | 0.05 | 0.05 | 0.20 | 0.25 |
| Transportation Equipment | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.03 | 0.02 |
| Machinery | 0.00 | 0.00 | 0.02 | 0.02 | 0.02 | 0.04 | 0.05 | 0.14 | 0.15 | 0.22 | 0.25 | 0.27 | 0.22 | 0.22 |
| Mining and Quarrying | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.01 | 0.01 | 0.01 |
| Food, Beverages and Tobacco | 0.01 | 0.01 | 0.01 | 0.00 | 0.00 | 0.19 | 0.21 | 0.24 | 0.23 | 0.15 | 0.06 | 0.11 | 0.16 | 0.15 |
| Pulp, Paper and Printing | 3.66 | 3.90 | 2.50 | 2.76 | 3.75 | 4.73 | 1.95 | 4.12 | 2.87 | 3.06 | 2.92 | 3.80 | 4.64 | 4.05 |
| Wood and Wood Products | 2.76 | 1.16 | 2.00 | 2.28 | 1.75 | 5.93 | 6.09 | 5.59 | 5.30 | 5.51 | 4.72 | 5.51 | 10.20 | 11.04 |
| Construction | 0.04 | 0.03 | 0.05 | 0.07 | 0.05 | 0.31 | 0.36 | 0.41 | 0.40 | 0.39 | 0.40 | 0.66 | 0.83 | 0.81 |
| Textiles and Leather | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.01 | 0.02 | 0.03 | 0.02 |
| Non Specified (Industry) | 0.07 | 0.07 | 0.11 | 0.24 | 0.15 | 0.49 | 0.52 | 0.74 | 0.62 | 0.64 | 0.70 | 1.15 | 1.69 | 1.48 |
| **Total Other Sectors** | 1.98 | 2.88 | 3.10 | 4.39 | 4.64 | 7.53 | 8.58 | 12.16 | 12.62 | 16.14 | 16.54 | 17.64 | 20.44 | 18.20 |
| Commerce - Public Services | 0.64 | 0.60 | 0.54 | 1.09 | 1.06 | 1.83 | 2.27 | 2.36 | 2.33 | 2.98 | 3.71 | 3.94 | 3.71 | 3.38 |
| Residential | 0.77 | 1.40 | 1.58 | 2.09 | 2.50 | 4.06 | 4.50 | 7.07 | 7.42 | 9.56 | 8.23 | 8.59 | 11.40 | 9.53 |
| Agriculture | 0.57 | 0.87 | 0.98 | 1.21 | 1.08 | 1.64 | 1.81 | 2.73 | 2.87 | 3.60 | 4.60 | 5.11 | 5.34 | 5.28 |
| Non Specified (Others) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

*Table A 93: National Energy Balance 1990-2007. Black Liquor [PJ].*

| 215A Black Liquor | 1990 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Indigenous Production | 17.80 | 21.39 | 21.17 | 21.67 | 22.92 | 23.65 | 24.12 | 23.30 | 22.78 | 22.97 | 24.26 | 24.40 | 24.68 | 25.07 |
| Total Imports (Balance) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Total Exports (Balance) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Stock Change (National Territory) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| **Gross Inland Deliveries (Obs.)** | 17.80 | 21.39 | 21.17 | 21.67 | 22.92 | 23.65 | 24.12 | 23.30 | 22.78 | 22.97 | 24.26 | 24.40 | 24.68 | 25.07 |
| Statistical Difference | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| **Total Transformation Sector** | 5.26 | 9.27 | 9.51 | 8.58 | 11.35 | 10.18 | 7.62 | 7.61 | 9.96 | 11.04 | 10.73 | 11.74 | 11.40 | 9.78 |
| Public Electricity | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Public Combined Heat and Power | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Public Heat Plants | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Auto Producers of Electricity | 2.62 | 5.27 | 5.41 | 5.48 | 8.87 | 6.16 | 2.00 | 3.12 | 2.78 | 6.65 | 6.19 | 6.56 | 6.69 | 4.95 |
| Auto Producers for CHP | 2.64 | 4.00 | 4.10 | 3.10 | 2.49 | 4.02 | 5.62 | 4.50 | 7.18 | 4.39 | 4.54 | 5.18 | 4.70 | 4.84 |
| Auto Producer Heat Plants | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| **Total Energy Sector** | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Coal Mines | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Patent Fuel Plants | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Coke Ovens (Energy) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Blast Furnaces (Energy) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Gas Works (Energy) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| BKB (Transformation) | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Petroleum refineries | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Power Plants | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Non Specified (Energy) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Distribution Losses | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| **Final Consumption** | 12.54 | 12.12 | 11.67 | 13.09 | 11.56 | 13.47 | 16.50 | 15.69 | 12.82 | 11.94 | 13.52 | 12.66 | 13.28 | 15.28 |
| **Total Transport** | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Rail | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Inland Waterways | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Non Specified (Transport) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| **Total Industry** | 12.54 | 12.12 | 11.67 | 13.09 | 11.56 | 13.47 | 16.50 | 15.69 | 12.82 | 11.94 | 13.52 | 12.66 | 13.28 | 15.28 |
| Iron and Steel | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Chemical (incl.Petro-Chemical) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Non ferrous Metals | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Non metallic Mineral Products | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Transportation Equipment | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Machinery | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Mining and Quarrying | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.01 | 0.00 | 0.00 |
| Food, Beverages and Tobacco | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Pulp, Paper and Printing | 12.54 | 12.12 | 11.67 | 13.09 | 11.56 | 13.38 | 16.44 | 15.63 | 12.76 | 11.88 | 13.51 | 12.64 | 13.28 | 15.28 |
| Wood and Wood Products | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.09 | 0.06 | 0.06 | 0.06 | 0.06 | 0.00 | 0.00 | 0.00 | 0.00 |
| Construction | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Textiles and Leather | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Non Specified (Industry) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.01 | 0.00 | 0.00 |
| **Total Other Sectors** | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Commerce - Public Services | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Residential | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Agriculture | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Non Specified (Others) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

*Table A 94: National Energy Balance 1990-2007. Biogas [TJ].*

| 309A Biogas | 1990 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Indigenous Production | 0.00 | 0.04 | 0.04 | 0.05 | 0.03 | 0.22 | 0.36 | 0.27 | 2.56 | 0.33 | 0.48 | 0.68 | 1.06 | 1.25 |
| Total Imports (Balance) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Total Exports (Balance) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Stock Change (National Territory) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| **Gross Inland Deliveries (Obs.)** | 0.00 | 0.04 | 0.04 | 0.05 | 0.03 | 0.22 | 0.36 | 0.27 | 2.56 | 0.33 | 0.48 | 0.68 | 1.06 | 1.25 |
| Statistical Difference | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| **Total Transformation Sector** | 0.00 | 0.04 | 0.04 | 0.05 | 0.03 | 0.12 | 0.22 | 0.17 | 0.20 | 0.20 | 0.28 | 0.47 | 0.84 | 1.02 |
| Public Electricity | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.08 | 0.13 | 0.12 | 0.15 |
| Public Combined Heat and Power | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.09 | 0.20 | 0.24 | 0.32 |
| Public Heat Plants | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.22 | 0.29 |
| Auto Producers of Electricity | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.03 | 0.12 | 0.07 | 0.11 | 0.11 | 0.06 | 0.05 | 0.16 | 0.11 |
| Auto Producers for CHP | 0.00 | 0.04 | 0.04 | 0.05 | 0.03 | 0.09 | 0.10 | 0.10 | 0.10 | 0.09 | 0.06 | 0.09 | 0.11 | 0.14 |
| Auto Producer Heat Plants | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| **Total Energy Sector** | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Coal Mines | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Patent Fuel Plants | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Coke Ovens (Energy) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Blast Furnaces (Energy) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Gas Works (Energy) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| BKB (Transformation) | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Petroleum refineries | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Power Plants | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Non Specified (Energy) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Distribution Losses | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| **Final Consumption** | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.11 | 0.15 | 0.10 | 2.36 | 0.13 | 0.20 | 0.21 | 0.22 | 0.24 |
| **Total Transport** | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Rail | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Inland Waterways | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Non Specified (Transport) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| **Total Industry** | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.10 | 0.15 | 0.10 | 2.36 | 0.13 | 0.20 | 0.21 | 0.22 | 0.24 |
| Iron and Steel | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Chemical (incl.Petro-Chemical) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.31 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Non ferrous Metals | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Non metallic Mineral Products | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Transportation Equipment | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Machinery | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Mining and Quarrying | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Food, Beverages and Tobacco | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.02 | 0.03 | 0.08 | 0.09 | 0.13 | 0.16 |
| Pulp, Paper and Printing | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.10 | 0.12 | 0.10 | 2.02 | 0.11 | 0.11 | 0.11 | 0.10 | 0.08 |
| Wood and Wood Products | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.03 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Construction | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Textiles and Leather | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Non Specified (Industry) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| **Total Other Sectors** | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Commerce - Public Services | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Residential | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Agriculture | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Non Specified (Others) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

*Table A 95: National Energy Balance 1990-2007. Sewage Sludge Gas [PJ].*

| 309B Sewage sludge gas | 1990 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Indigenous Production | 0.00 | 0.62 | 0.67 | 0.69 | 0.71 | 0.37 | 0.47 | 0.33 | 0.06 | 0.24 | 0.25 | 0.27 | 0.19 | 0.24 |
| Total Imports (Balance) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Total Exports (Balance) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Stock Change (National Territory) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| **Gross Inland Deliveries (Obs.)** | 0.00 | 0.62 | 0.67 | 0.69 | 0.71 | 0.37 | 0.47 | 0.33 | 0.06 | 0.24 | 0.25 | 0.27 | 0.19 | 0.24 |
| Statistical Difference | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| **Total Transformation Sector** | 0.00 | 0.62 | 0.67 | 0.69 | 0.71 | 0.02 | 0.11 | 0.03 | 0.06 | 0.05 | 0.10 | 0.11 | 0.04 | 0.08 |
| Public Electricity | 0.00 | 0.01 | 0.03 | 0.05 | 0.05 | 0.00 | 0.08 | 0.00 | 0.06 | 0.05 | 0.06 | 0.05 | 0.00 | 0.00 |
| Public Combined Heat and Power | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.04 | 0.04 |
| Public Heat Plants | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Auto Producers of Electricity | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.02 | 0.03 | 0.03 | 0.00 | 0.00 | 0.01 | 0.02 | 0.00 | 0.01 |
| Auto Producers for CHP | 0.00 | 0.61 | 0.64 | 0.63 | 0.66 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.02 | 0.04 | 0.00 | 0.03 |
| Auto Producer Heat Plants | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| **Total Energy Sector** | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Coal Mines | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Patent Fuel Plants | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Coke Ovens (Energy) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Blast Furnaces (Energy) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Gas Works (Energy) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| BKB (Transformation) | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Petroleum refineries | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Power Plants | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Non Specified (Energy) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Distribution Losses | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| **Final Consumption** | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.35 | 0.36 | 0.30 | 0.00 | 0.19 | 0.15 | 0.15 | 0.15 | 0.16 |
| **Total Transport** | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Rail | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Inland Waterways | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Non Specified (Transport) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| **Total Industry** | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.35 | 0.36 | 0.30 | 0.00 | 0.19 | 0.15 | 0.15 | 0.15 | 0.16 |
| Iron and Steel | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Chemical (incl.Petro-Chemical) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.35 | 0.36 | 0.30 | 0.00 | 0.19 | 0.15 | 0.15 | 0.15 | 0.16 |
| Non ferrous Metals | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Non metallic Mineral Products | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Transportation Equipment | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Machinery | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Mining and Quarrying | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Food, Beverages and Tobacco | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Pulp, Paper and Printing | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Wood and Wood Products | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Construction | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Textiles and Leather | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Non Specified (Industry) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| **Total Other Sectors** | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Commerce - Public Services | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Residential | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Agriculture | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Non Specified (Others) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

*Table A 96: National Energy Balance 1990-2007. Landfill Gas [PJ].*

| 310A Landfill Gas | 1990 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Indigenous Production | 0.00 | 0.20 | 0.31 | 0.52 | 0.53 | 0.50 | 0.44 | 0.47 | 0.36 | 0.49 | 0.46 | 0.35 | 0.38 | 0.20 |
| Total Imports (Balance) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Total Exports (Balance) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Stock Change (National Territory) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| **Gross Inland Deliveries (Obs.)** | 0.00 | 0.20 | 0.31 | 0.52 | 0.53 | 0.50 | 0.44 | 0.47 | 0.36 | 0.49 | 0.46 | 0.35 | 0.38 | 0.20 |
| Statistical Difference | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| **Total Transformation Sector** | 0.00 | 0.15 | 0.27 | 0.52 | 0.52 | 0.50 | 0.44 | 0.47 | 0.36 | 0.49 | 0.46 | 0.35 | 0.38 | 0.20 |
| Public Electricity | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.02 | 0.01 | 0.07 | 0.06 | 0.21 | 0.05 | 0.04 | 0.04 | 0.05 |
| Public Combined Heat and Power | 0.00 | 0.03 | 0.03 | 0.03 | 0.03 | 0.00 | 0.00 | 0.00 | 0.00 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 |
| Public Heat Plants | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Auto Producers of Electricity | 0.00 | 0.12 | 0.24 | 0.49 | 0.49 | 0.48 | 0.43 | 0.41 | 0.30 | 0.27 | 0.40 | 0.23 | 0.33 | 0.15 |
| Auto Producers for CHP | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.08 | 0.01 | 0.00 |
| Auto Producer Heat Plants | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| **Total Energy Sector** | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Coal Mines | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Patent Fuel Plants | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Coke Ovens (Energy) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Blast Furnaces (Energy) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Gas Works (Energy) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| BKB (Transformation) | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Petroleum refineries | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Power Plants | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Non Specified (Energy) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Distribution Losses | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| **Final Consumption** | 0.00 | 0.05 | 0.04 | 0.01 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| **Total Transport** | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Rail | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Inland Waterways | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Non Specified (Transport) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| **Total Industry** | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Iron and Steel | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Chemical (incl.Petro-Chemical) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Non ferrous Metals | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Non metallic Mineral Products | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Transportation Equipment | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Machinery | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Mining and Quarrying | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Food, Beverages and Tobacco | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Pulp, Paper and Printing | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Wood and Wood Products | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Construction | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Textiles and Leather | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Non Specified (Industry) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| **Total Other Sectors** | 0.00 | 0.05 | 0.04 | 0.01 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Commerce - Public Services | 0.00 | 0.05 | 0.04 | 0.01 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Residential | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Agriculture | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Non Specified (Others) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

*Table A 97: National Energy Balance 1990-2007. Municipal Solid Waste [PJ].*

| 114B Municipal Solid Waste | 1990 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Indigenous Production | 2.41 | 3.91 | 4.77 | 4.89 | 4.78 | 4.74 | 4.51 | 4.65 | 4.91 | 5.77 | 7.58 | 7.17 | 11.07 | 10.37 |
| Total Imports (Balance) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Total Exports (Balance) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Stock Change (National Territory) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| **Gross Inland Deliveries (Obs.)** | 2.41 | 3.91 | 4.77 | 4.89 | 4.78 | 4.74 | 4.51 | 4.65 | 4.91 | 5.77 | 7.58 | 7.17 | 11.07 | 10.37 |
| Statistical Difference | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| **Total Transformation Sector** | 2.41 | 3.91 | 4.77 | 4.89 | 4.78 | 4.74 | 4.51 | 4.65 | 4.91 | 5.77 | 7.58 | 7.17 | 11.07 | 10.37 |
| Public Electricity | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.73 | 0.58 | 0.63 | 0.67 | 1.55 | 2.89 | 2.78 | 2.31 | 1.40 |
| Public Combined Heat and Power | 1.72 | 2.32 | 2.50 | 2.59 | 2.58 | 2.34 | 2.23 | 2.24 | 2.28 | 2.41 | 2.60 | 2.41 | 2.26 | 2.94 |
| Public Heat Plants | 0.69 | 1.59 | 2.27 | 2.30 | 2.20 | 1.67 | 1.69 | 1.78 | 1.96 | 1.81 | 1.89 | 1.97 | 2.86 | 1.95 |
| Auto Producers of Electricity | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.07 | 0.00 | 3.35 | 3.83 |
| Auto Producers for CHP | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.14 | 0.00 | 0.30 | 0.25 |
| Auto Producer Heat Plants | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| **Total Energy Sector** | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Coal Mines | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Patent Fuel Plants | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Coke Ovens (Energy) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Blast Furnaces (Energy) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Gas Works (Energy) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| BKB (Transformation) | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Petroleum refineries | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Power Plants | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Non Specified (Energy) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Distribution Losses | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| **Final Consumption** | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| **Total Transport** | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Rail | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Inland Waterways | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Non Specified (Transport) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| **Total Industry** | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Iron and Steel | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Chemical (incl.Petro-Chemical) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Non ferrous Metals | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Non metallic Mineral Products | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Transportation Equipment | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Machinery | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Mining and Quarrying | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Food, Beverages and Tobacco | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Pulp, Paper and Printing | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Wood and Wood Products | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Construction | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Textiles and Leather | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Non Specified (Industry) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| **Total Other Sectors** | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Commerce - Public Services | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Residential | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Agriculture | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Non Specified (Others) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

*Table A 98: National Energy Balance 1990-2007. Industrial Waste [PJ].*

| 115A Industrial Waste | 1990 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Indigenous Production | 6.58 | 7.00 | 9.25 | 8.23 | 7.50 | 6.76 | 7.67 | 9.74 | 11.36 | 12.47 | 14.53 | 13.24 | 17.54 | 19.90 |
| Total Imports (Balance) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Total Exports (Balance) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Stock Change (National Territory) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| **Gross Inland Deliveries (Obs.)** | 6.58 | 7.00 | 9.25 | 8.23 | 7.50 | 6.76 | 7.67 | 9.74 | 11.36 | 12.47 | 14.53 | 13.24 | 17.54 | 19.90 |
| Statistical Difference | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| **Total Transformation Sector** | 2.54 | 1.93 | 4.74 | 3.61 | 2.15 | 2.32 | 1.59 | 1.78 | 2.72 | 2.88 | 3.17 | 2.51 | 2.69 | 3.48 |
| Public Electricity | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.13 | 0.03 | 0.80 | 1.16 | 0.99 | 0.67 | 0.74 | 0.51 |
| Public Combined Heat and Power | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.94 | 1.05 | 0.81 | 0.81 | 0.67 | 0.74 | 0.92 |
| Public Heat Plants | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Auto Producers of Electricity | 0.00 | 0.00 | 1.61 | 1.27 | 0.54 | 1.12 | 0.44 | 0.34 | 0.31 | 0.28 | 0.18 | 0.18 | 0.16 | 0.93 |
| Auto Producers for CHP | 2.54 | 1.93 | 3.12 | 2.34 | 1.61 | 1.20 | 1.02 | 0.47 | 0.57 | 0.62 | 1.18 | 0.99 | 1.05 | 1.12 |
| Auto Producer Heat Plants | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| **Total Energy Sector** | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Coal Mines | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Patent Fuel Plants | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Coke Ovens (Energy) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Blast Furnaces (Energy) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Gas Works (Energy) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| BKB (Transformation) | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Petroleum refineries | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Power Plants | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Non Specified (Energy) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Distribution Losses | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| **Final Consumption** | 4.03 | 5.08 | 4.51 | 4.61 | 5.35 | 4.45 | 6.08 | 7.95 | 8.64 | 9.60 | 11.36 | 10.73 | 14.85 | 16.42 |
| **Total Transport** | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Rail | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Inland Waterways | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Non Specified (Transport) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| **Total Industry** | 2.92 | 4.56 | 3.96 | 4.03 | 4.74 | 3.84 | 5.52 | 7.33 | 8.02 | 8.95 | 10.68 | 10.04 | 14.13 | 15.69 |
| Iron and Steel | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Chemical (incl.Petro-Chemical) | 1.57 | 1.91 | 0.99 | 1.17 | 1.10 | 0.09 | 1.64 | 1.92 | 2.41 | 2.98 | 4.11 | 3.81 | 4.35 | 5.76 |
| Non ferrous Metals | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Non metallic Mineral Products | 1.31 | 1.98 | 2.17 | 2.10 | 2.66 | 2.88 | 3.56 | 4.55 | 4.96 | 5.31 | 5.34 | 5.01 | 6.55 | 7.27 |
| Transportation Equipment | 0.00 | 0.01 | 0.01 | 0.01 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Machinery | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.01 | 0.03 | 0.01 | 0.01 |
| Mining and Quarrying | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Food, Beverages and Tobacco | 0.00 | 0.00 | 0.01 | 0.01 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Pulp, Paper and Printing | 0.00 | 0.00 | 0.06 | 0.07 | 0.07 | 0.14 | 0.00 | 0.11 | 0.09 | 0.11 | 0.13 | 0.12 | 0.13 | 0.13 |
| Wood and Wood Products | 0.04 | 0.55 | 0.65 | 0.59 | 0.79 | 0.69 | 0.28 | 0.69 | 0.50 | 0.47 | 1.03 | 0.99 | 3.00 | 2.43 |
| Construction | 0.00 | 0.01 | 0.01 | 0.01 | 0.01 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.03 | 0.03 | 0.03 | 0.04 |
| Textiles and Leather | 0.00 | 0.01 | 0.01 | 0.01 | 0.01 | 0.00 | 0.00 | 0.01 | 0.01 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 |
| Non Specified (Industry) | 0.01 | 0.09 | 0.07 | 0.08 | 0.09 | 0.02 | 0.02 | 0.03 | 0.03 | 0.04 | 0.04 | 0.05 | 0.05 | 0.04 |
| **Total Other Sectors** | 1.11 | 0.52 | 0.55 | 0.58 | 0.61 | 0.61 | 0.56 | 0.63 | 0.62 | 0.65 | 0.68 | 0.69 | 0.73 | 0.73 |
| Commerce - Public Services | 1.11 | 0.52 | 0.55 | 0.58 | 0.61 | 0.61 | 0.56 | 0.63 | 0.62 | 0.65 | 0.68 | 0.69 | 0.73 | 0.73 |
| Residential | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Agriculture | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Non Specified (Others) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

## Net Calorific Values

The selected net calorific values of each fuel are presented below.

Table A 99 presents the net calorific values (IEA JQ 2008) used for unit conversion.

*Table A 99: Net calorific values for 1990-2007 in [MJ/kg], [MJ/m³] taken from (IEA JQ 2008).*

| Fuel Code | Fuel Name | | 1990 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 101A | Coking Coal | T | 29.07 | 29.07 | 29.07 | 29.07 | 29.07 | 29.07 | 29.07 | 29.07 | 29.07 | 29.07 | 29.07 | 29.07 | 29.07 | 29.07 |
| 102A | Hard Coal | FC | 28.00 | 28.00 | 28.00 | 28.00 | 28.00 | 27.66 | 27.99 | 27.99 | 27.50 | 27.50 | 28.41 | 28.15 | 28.08 | 27.88 |
| | | T | 28.00 | 28.00 | 28.00 | 28.00 | 28.00 | 27.56 | 26.74 | 27.72 | 27.37 | 27.43 | 28.42 | 27.92 | 27.78 | 27.79 |
| 104A | Hard Coal Briquettes | A | 0.00 | 0.00 | 0.00 | 31.00 | 31.00 | 31.00 | 31.00 | 31.00 | 31.00 | 31.00 | 31.00 | 31.00 | 31.00 | 31.00 |
| 105A | Brown Coal | FC | 10.90 | 10.90 | 9.90 | 9.90 | 9.90 | 9.77 | 9.82 | 9.79 | 9.82 | 9.82 | 9.96 | 15.32 | 19.76 | 20.45 |
| | | T | 10.90 | 10.90 | 9.90 | 9.90 | 9.90 | 9.79 | 9.86 | 10.08 | 9.74 | 9.48 | 9.29 | 9.09 | 9.48 | 9.48 |
| 106A | Brown Coal Briquettes | T | 19.30 | 19.30 | 19.30 | 19.30 | 19.30 | 19.30 | 19.30 | 19.30 | 19.30 | 19.30 | 19.30 | 19.30 | 19.30 | 19.30 |
| 107A | Coke Oven Coke | T | 28.50 | 28.50 | 28.20 | 28.20 | 28.20 | 29.00 | 29.00 | 29.00 | 29.00 | 29.00 | 29.00 | 29.00 | 29.00 | 29.00 |
| 113A | Peat | FC | 8.80 | 8.80 | 8.80 | 8.80 | 8.80 | 8.80 | 8.80 | 8.80 | 8.80 | 8.80 | 8.80 | 8.80 | 8.80 | 8.80 |
| 304A | Coke Oven Gas | P | 17.90 | 17.90 | 17.90 | 17.90 | 17.90 | 17.90 | 17.90 | 17.90 | 17.60 | 17.90 | 17.90 | 17.90 | 17.59 | 17.36 |
| 305A | Blast Furnace Gas | P | 3.10 | 3.10 | 3.10 | 3.10 | 3.10 | 4.10 | 4.10 | 4.10 | 4.27 | 3.70 | 3.69 | 3.65 | 3.79 | 3.99 |
| 110A | Petrol Coke | A | 34.30 | 28.40 | 32.20 | 32.80 | 34.00 | 33.92 | 33.92 | 33.92 | 31.33 | 31.33 | 31.33 | 31.33 | 30.89 | 31.54 |
| 201A | Crude Oil | A | 42.50 | 42.50 | 42.50 | 42.50 | 42.50 | 42.52 | 42.52 | 42.50 | 42.50 | 42.52 | 42.52 | 42.69 | 42.72 | 42.71 |
| 203X | Residual Fuel Oil | A | 41.00 | 40.50 | 40.30 | 40.30 | 40.30 | 41.50 | 41.49 | 41.69 | 41.49 | 41.44 | 41.31 | 41.61 | 41.19 | 41.89 |
| 204A | Gasoil | A | 42.60 | 42.70 | 42.80 | 42.80 | 42.80 | 42.80 | 42.80 | 42.82 | 42.80 | 42.80 | 42.80 | 42.80 | 42.80 | 42.80 |
| 2050 | Diesel | A | 42.60 | 42.70 | 42.70 | 42.70 | 42.70 | 42.80 | 42.80 | 42.80 | 42.80 | 42.80 | 42.80 | 42.80 | 42.80 | 42.80 |
| 206A | Petroleum | A | 43.60 | 43.30 | 43.40 | 43.40 | 43.40 | 43.31 | 43.30 | 43.30 | 43.30 | 43.30 | 43.30 | 43.30 | 43.30 | 43.30 |
| 206B | Kerosene | A | 43.60 | 43.30 | 43.40 | 43.40 | 43.40 | 43.31 | 43.30 | 43.30 | 43.30 | 43.30 | 43.30 | 43.30 | 43.30 | 43.30 |
| 207A | Aviation Gasoline | A | 41.60 | 42.50 | 42.50 | 42.50 | 42.50 | 42.50 | 42.50 | 42.51 | 42.49 | 42.49 | 42.49 | 42.49 | 43.21 | 43.18 |
| 2080 | Motor Gasoline | A | 41.60 | 42.50 | 42.50 | 42.50 | 42.50 | 42.50 | 42.50 | 42.51 | 42.49 | 42.49 | 42.49 | 42.49 | 43.21 | 43.18 |
| 217A | Refinery Feedstocks | A | 41.87 | 42.56 | 42.63 | 42.68 | 42.25 | 42.27 | 42.56 | 42.65 | 42.77 | 42.05 | 42.72 | 42.28 | 42.57 | 34.25 |
| 219A | Lubricants | A | 41.40 | 41.10 | 41.30 | 41.40 | 40.90 | 41.80 | 41.80 | 41.80 | 41.80 | 41.80 | 41.80 | 41.80 | 41.80 | 41.80 |
| 220A | White Spirit | A | 41.60 | 42.50 | 42.50 | 42.50 | 42.50 | 44.10 | 44.10 | 44.10 | 44.10 | 44.10 | 44.10 | 44.10 | 44.10 | 44.10 |
| 222A | Bitumen | A | 41.80 | 41.80 | 41.80 | 41.80 | 41.80 | 44.04 | 43.62 | 43.47 | 44.15 | 43.95 | 43.16 | 44.02 | 44.49 | 43.92 |
| 224A | Other Petroleum Products | FC | 34.30 | 28.40 | 32.20 | 32.80 | 34.00 | 33.92 | 33.92 | 33.92 | 31.33 | 31.33 | 31.33 | 31.33 | 30.89 | 31.54 |
| | | NE | 41.80 | 41.80 | 41.80 | 41.80 | 41.80 | 44.04 | 43.62 | 43.47 | 44.15 | 43.95 | 43.16 | 44.02 | 44.49 | 43.92 |
| 302A | NGL | A | 42.50 | 42.50 | 42.50 | 42.50 | 42.50 | 42.52 | 42.52 | 42.50 | 42.50 | 42.52 | 42.52 | 42.69 | 42.72 | 42.71 |
| 303A | LPG | A | 46.30 | 46.30 | 46.30 | 46.30 | 46.30 | 46.00 | 46.00 | 46.00 | 46.00 | 46.00 | 46.00 | 46.00 | 46.00 | 46.00 |
| 308A | Refinery Gas | A | 49.00 | 49.00 | 49.00 | 49.00 | 49.00 | 42.23 | 45.93 | 45.93 | 45.93 | 45.93 | 45.93 | 45.93 | 45.93 | 45.93 |
| 301A | Natural Gas | A | 36.00 | 36.00 | 36.00 | 36.00 | 36.00 | 35.85 | 35.85 | 35.85 | 35.85 | 35.85 | 35.85 | 36.36 | 36.36 | 36.36 |

*Legend: A…Average; T…Transformation; FC…Final Consumption; P…Production; NE…Non Energy use; NGL…Natural Gas Liquids; LPG…Liquified Petroleum Gas*

Table A 100 presents the net calorific values from STATISTIK AUSTRIA, which are used for default unit conversion.

*Table A 100: Default net calorific values from STATISTIK AUSTRIA.*

| Fuel Name | NCV | Unit |
|---|---|---|
| Municipal Waste / renewable | 8.93 | MJ/kg |
| Municipal Waste / non renewable | 9.14 | MJ/kg |
| Industrial Waste | 15.76 | MJ/kg |
| Fuel Wood | 15.50 | MJ/kg |
| Wood Wastes | 11.36 | MJ/kg |
| Bark | 7.54 | MJ/kg |
| Sewage Sludge (wet substance) | 3.64 | MJ/kg |
| Black Liquor | 7.92 | MJ/kg |
| Carcass meal | 17.30 | MJ/kg |
| Adipose | 36.59 | MJ/kg |
| Liquid Biofuels | 42.00 | MJ/kg |
| Biogas | 22.06 | $MJ/m^3$ |
| Gas from Waste Disposal Site | 17.00 | $MJ/m^3$ |

Table A 101 presents the IPCC default values of net calorific values of gaseous biofuels which are used for default unit conversion.

*Table A 101: Default net calorific values from IPCC Guidelines.*

| Fuel Name | NCV | Unit |
|---|---|---|
| Sewage Sludge Gas | 27.00 | $MJ/m^3$ |

# ANNEX 5: RECALCULATIONS

This Annex presents the implication of recalculations for emission levels by category for $CO_2$, $CH_4$, $N_2O$ and FCs and the recalculation differences of national total emissions by gas.

*Table A 102: IPCC codes and names of categories*

| Category | Name | Category | Name |
|---|---|---|---|
| Total | National Total without LULUCF | 3 | SOLVENT AND OTHER PRODUCT USE |
| 1 | ENERGY | 3 A | PAINT APPLICATION |
| 1 A 1 | Energy Industries | 3 B | DEGREASING AND DRY CLEANING |
| 1 A 2 | Manufacturing Industries and Construction | 3 C | CHEMICAL PRODUCTS, MANUFACTURE AND PROCESSING |
| 1 A 3 | Transport | 3 D 5 | Other Solvent Use |
| 1 A 4 | Other Sectors | 4 | AGRICULTURE |
| 1 A 5 | Other | 4 A 1 | Cattle |
| 1 B | Fugitive Emissions From Fuels | 4 A 9 | Poultry |
| 2 | INDUSTRIAL PROCESSES | 4 B 1 | Cattle |
| 2 A 3 | Limestone and Dolomite Use | 4 F | FIELD BURNING OF AGRICULTURAL RESIDUES |
| 2 A 4 | Soda Ash Production and use | 5 | LAND USE, LAND USE CHANGE AND FORESTRY |
| 2 B 1 | Ammonia Production | 6 | WASTE |
| 2 B 5 | Other | 6 B 1 | Industrial Wastewater |
| 2 C 1 | Iron and Steel Production | 6 B 2 | Domestic and Commercial Wastewater |
| 2 C 2 | Ferroalloys Production | 6 D 2 | Compost production |

## Recalculation of $CO_2$ Emissions by Categories

Explanations are provided in Chapter 9 Recalculations and Improvements and in the sector specific chapters of this report.

*Table A 103: Recalculation Difference of $CO_2$ Emissions 1990-1999.*

| IPCC Cat. | $CO_2$ [Gg] Differences with respect to Submission 2008 | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 |
| Total | -3.40 | -3.34 | -2.56 | -1.30 | -0.77 | 0.09 | 0.32 | 1.85 | 1.64 | 13.48 |
| 1 | -0.03 | -0.06 | 0.03 | 0.07 | 0.01 | 0.02 | -0.03 | 0.06 | 0.06 | 12.09 |
| 1 A 1 | 0 | 0 | 0 | 0.07 | 0.01 | -0.02 | -0.03 | 0.03 | 0.03 | 0.00 |
| 1 A 2 | -758.71 | -766.14 | -760.16 | -710.22 | -723.50 | -678.38 | -562.97 | -603.52 | -550.50 | -817.02 |
| 1 A 3 | 1 343.20 | 1 213.21 | 1 243.15 | 1 200.66 | 1 289.91 | 1 186.82 | 1 161.59 | 1 258.04 | 1 166.35 | 1 200.78 |
| 1 A 4 | -584.51 | -447.12 | -482.94 | -490.42 | -566.39 | -508.37 | -598.58 | -654.44 | -615.77 | -371.61 |
| 1 A 5 | -0.01 | -0.02 | -0.02 | -0.02 | -0.03 | -0.03 | -0.04 | -0.05 | -0.05 | -0.05 |
| 1 B | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2 A 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2 A 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2 B 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2 B 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2 C 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2 C 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 3 | -3.37 | -3.28 | -2.59 | -1.37 | -0.78 | 0.07 | 0.36 | 1.79 | 1.58 | 1.39 |
| 3 A | -1.99 | -1.39 | -0.68 | -0.37 | -0.15 | -0.17 | -0.10 | 0.03 | 0.09 | 0.08 |
| 3 B | -0.60 | -0.43 | -0.21 | -0.12 | -0.05 | -0.05 | -0.03 | 0.02 | 0.05 | 0.04 |
| 3 C | -14.31 | -13.48 | -12.00 | -11.86 | -11.21 | -11.83 | -10.73 | -10.90 | -10.18 | -9.49 |
| 3 D 5 | 13.52 | 12.01 | 10.30 | 10.98 | 10.62 | 12.13 | 11.21 | 12.63 | 11.63 | 10.77 |
| 4 | NA= | NA= | NA= | NA= | NA= | NA= | NA= | NA= | NA= | NA= |
| 5 | 1 162.74 | 1 173.70 | 1 193.63 | 1 198.93 | 1 177.70 | 1 102.71 | 1 205.61 | 1 018.41 | 1 089.87 | 1 036.42 |
| 6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

*Table A 104: Recalculation Difference of $CO_2$ Emissions 2000-2006.*

| IPCC Cat. | $CO_2$ [Gg] Differences with respect to Submission 2008 | | | | | | |
|---|---|---|---|---|---|---|---|
| | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 |
| Total | 22.88 | -143.97 | -100.16 | -216.34 | 61.74 | -506.67 | 303.39 |
| 1 | 11.34 | -132.95 | -94.57 | -224.76 | 83.99 | -542.42 | 171.69 |
| 1 A 1 | 0.00 | 0.00 | 0 | 0 | 0.53 | -0.61 | 118.93 |
| 1 A 2 | -749.06 | -874.00 | -694.57 | -761.70 | -844.99 | -223.60 | 153.49 |
| 1 A 3 | 1 047.71 | 1 122.35 | 1 171.02 | 1 060.89 | 1 065.51 | 981.55 | 844.72 |
| 1 A 4 | -283.17 | -379.59 | -571.04 | -477.11 | -73.49 | -1 223.20 | -864.05 |
| 1 A 5 | -4.15 | -1.71 | 0.01 | -46.84 | -63.56 | -76.56 | -81.40 |
| 1 B | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2 | 0 | 0 | 0 | 0 | -2.18 | 5.96 | 104.82 |
| 2 A 3 | 0 | 0 | 0 | 0 | 0 | -0.14 | -0.48 |
| 2 A 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0.07 |

| IPCC Cat. | CO2 [Gg] Differences with respect to Submission 2008 | | | | | | |
|---|---|---|---|---|---|---|---|
| | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 |
| 2 B 1 | 0 | 0 | 0 | 0 | -2.18 | 0 | 0 |
| 2 B 5 | 0 | 0 | 0 | 0 | 0 | 6.10 | 0 |
| 2 C 1 | 0 | 0 | 0 | 0 | 0 | 0 | 103.38 |
| 2 C 2 | 0 | 0 | 0 | 0 | 0 | 0 | 1.85 |
| 3 | 11.54 | -11.02 | -5.59 | 8.42 | -20.06 | 29.79 | 26.87 |
| 3 A | 2.78 | -5.33 | -3.93 | 0.89 | -7.40 | 9.05 | 7.38 |
| 3 B | 1.19 | -1.57 | -0.14 | 2.78 | -0.45 | 7.77 | 7.54 |
| 3 C | -9.14 | -9.09 | -8.02 | -7.33 | -10.03 | -7.34 | -7.04 |
| 3 D 5 | 16.71 | 4.97 | 6.49 | 12.08 | -2.18 | 20.31 | 18.99 |
| 4 | NA= | NA= | NA= | NA= | NA= | NA= | NA= |
| 5 | 1 050.98 | 1 083.76 | 1 047.15 | 1 024.36 | 1 137.21 | 966.43 | 987.78 |
| 6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

## Recalculation of $CH_4$ Emissions by Categories

Explanations are provided in Chapter 9 Recalculations and Improvements and in the sector specific chapters of this report.

*Table A 105: Recalculation Difference of $CH_4$ Emissions 1990-1999.*

| IPCC Cat. | CH4 [Gg] Differences with respect to Submission 2008 | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 |
| Total | -0.05 | -0.03 | -0.05 | -0.05 | -0.07 | -0.06 | -0.08 | -0.10 | -0.09 | -0.05 |
| 1 | -0.14 | -0.13 | -0.14 | -0.14 | -0.16 | -0.15 | -0.16 | -0.20 | -0.19 | -0.14 |
| 1 A 1 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1 A 2 | -0.06 | -0.06 | -0.06 | -0.06 | -0.06 | -0.06 | -0.05 | -0.05 | -0.05 | -0.05 |
| 1 A 3 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.01 | 0.02 | 0.01 | 0.01 |
| 1 A 4 | -0.10 | -0.09 | -0.10 | -0.10 | -0.12 | -0.11 | -0.12 | -0.16 | -0.15 | -0.11 |
| 1 A 5 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1 B | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 3 | NA= | NA= | NA= | NA= | NA= | NA= | NA= | NA= | NA= | NA= |
| 4 | 0.09 | 0.09 | 0.09 | 0.09 | 0.09 | 0.09 | 0.09 | 0.10 | 0.09 | 0.10 |
| 4 A 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 4 A 9 | 0.09 | 0.09 | 0.09 | 0.09 | 0.09 | 0.09 | 0.08 | 0.09 | 0.09 | 0.09 |
| 4 B 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 4 F | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 5 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 6 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0 | 0 | 0 | 0 |
| 6 A 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 6 B 2 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 6 D 2 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

*Table A 106: Recalculation Difference of $CH_4$ Emissions 2000-2006.*

| IPCC Cat. | $CH_4$ [Gg] Differences with respect to Submission 2008 | | | | | | |
|---|---|---|---|---|---|---|---|
| | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 |
| Total | -0.01 | 0.94 | 1.52 | 3.70 | 4.22 | 5.06 | 6.83 |
| 1 | -0.09 | 0.86 | 1.59 | 2.64 | 2.71 | 2.46 | 2.70 |
| 1 A 1 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1 A 2 | -0.04 | -0.04 | -0.04 | -0.04 | -0.03 | -0.01 | 0.03 |
| 1 A 3 | 0.01 | 0.01 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1 A 4 | -0.06 | 0.89 | 1.62 | 2.68 | 2.75 | 2.48 | 2.67 |
| 1 A 5 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1 B | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 3 | NA= | NA= | NA= | NA= | NA= | NA= | NA= |
| 4 | 0.08 | 0.08 | 0.08 | -0.05 | -0.17 | -0.30 | -0.42 |
| 4 A 1 | 0 | 0 | 0 | -0.13 | -0.25 | -0.37 | -0.48 |
| 4 A 9 | 0.08 | 0.08 | 0.08 | 0.08 | 0.08 | 0.08 | 0.08 |
| 4 B 1 | 0 | 0 | 0 | -0.01 | -0.01 | -0.02 | -0.02 |
| 4 F | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 5 | 0 | 0 | 0 | 0.01 | 0.00 | 0.00 | 0.00 |
| 6 | 0.00 | 0.00 | -0.15 | 1.11 | 1.68 | 2.90 | 4.55 |
| 6 A 1 | 0 | 0 | -0.13 | 1.12 | 1.67 | 2.89 | 5.01 |
| 6 B 2 | 0 | 0.01 | 0.00 | 0.01 | 0.01 | 0.01 | -0.49 |
| 6 D 2 | 0.00 | -0.01 | -0.02 | -0.03 | 0.00 | 0.00 | 0.03 |

## Recalculation of $N_2O$ Emissions by Categories

Explanations are provided in Chapter 9 Recalculations and in the sector specific chapters of this report.

*Table A 107: Recalculation Difference of $N_2O$ Emissions 1990-1999.*

| IPCC Cat. | $N_2O$ [Gg] Differences with respect to Submission 2008 | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 |
| Total | -0.42 | -0.38 | -0.39 | -0.37 | -0.41 | -0.38 | -0.36 | -0.41 | -0.37 | -0.34 |
| 1 | -0.42 | -0.38 | -0.39 | -0.37 | -0.41 | -0.38 | -0.36 | -0.41 | -0.37 | -0.34 |
| 1 A 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1 A 2 | -0.26 | -0.27 | -0.26 | -0.25 | -0.26 | -0.24 | -0.19 | -0.22 | -0.20 | -0.18 |
| 1 A 3 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 |
| 1 A 4 | -0.19 | -0.14 | -0.16 | -0.16 | -0.18 | -0.17 | -0.20 | -0.22 | -0.20 | -0.19 |
| 1 A 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.00 | 0.00 |
| 1 B | IE= | IE= | IE= | IE= | IE= | IE= | IE= | IE= | IE= | IE= |

| IPCC Cat. | $N_2O$ [Gg] Differences with respect to Submission 2008 | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 |
| 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 4 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 6 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0 | 0 | 0 | 0 |
| 6 B 1 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 6 B 2 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 6 D 2 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0 | 0 | 0 | 0 |

*Table A 108: Recalculation Difference of $N_2O$ Emissions 2000-2006.*

| IPCC Cat. | $N_2O$ [Gg] Differences with respect to Submission 2008 | | | | | | |
|---|---|---|---|---|---|---|---|
| | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 |
| Total | -0.26 | -0.23 | -0.22 | -0.16 | -0.12 | -0.09 | -0.07 |
| 1 | -0.26 | -0.23 | -0.21 | -0.16 | -0.12 | -0.09 | -0.07 |
| 1 A 1 | 0 | 0 | 0 | 0 | 0.00 | 0.00 | 0.00 |
| 1 A 2 | -0.13 | -0.13 | -0.13 | -0.09 | -0.08 | -0.06 | -0.05 |
| 1 A 3 | 0.03 | 0.03 | 0.03 | 0.02 | 0.03 | 0.03 | 0.02 |
| 1 A 4 | -0.15 | -0.13 | -0.11 | -0.08 | -0.07 | -0.05 | -0.04 |
| 1 A 5 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1 B | IE= | IE= | IE= | IE= | IE= | IE= | IE= |
| 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 4 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 5 | 0 | 0 | 0 | 0.00 | 0.00 | 0.00 | 0.00 |
| 6 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 6 B 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0.01 |
| 6 B 2 | 0 | 0 | 0 | 0 | 0 | 0 | -0.01 |
| 6 D 2 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

## Recalculation of National Total GHG Emissions

Table A 109 compares national total GHG emissions of UNFCCC submission 2009 with UNFCCC submission 2008. Explanations are provided in Chapter 9 Recalculations and in the sector specific chapters of this report.

*Table A 109: Recalculation Difference of National Total GHG Emissions.*

| Year | National Total GHG emissions without LUCF | | |
|---|---|---|---|
| | Submission 2008 [Gg $CO_2$e] | Submission 2009 [Gg $CO_2$e] | Recalculation Difference [%] |
| 1990* | 79 171.53 | 79 036.84 | -0.17% |
| 1991 | 83 242.82 | 83 121.20 | -0.15% |
| 1992 | 76 524.83 | 76 400.94 | -0.16% |
| 1993 | 76 425.47 | 76 307.31 | -0.15% |
| 1994 | 77 339.51 | 77 209.93 | -0.17% |
| 1995 | 80 623.93 | 80 506.24 | -0.15% |
| 1996 | 83 694.84 | 83 581.17 | -0.14% |
| 1997 | 83 259.18 | 83 132.73 | -0.15% |
| 1998 | 82 614.39 | 82 499.73 | -0.14% |
| 1999 | 81 017.65 | 80 925.20 | -0.11% |
| 2000 | 81 135.90 | 81 078.39 | -0.07% |
| 2001 | 85 279.15 | 85 082.78 | -0.23% |
| 2002 | 87 165.97 | 87 030.88 | -0.15% |
| 2003 | 93 299.76 | 93 111.98 | -0.20% |
| 2004 | 91 662.54 | 91 774.79 | 0.12% |
| 2005 | 93 259.62 | 92 832.10 | -0.46% |
| 2006 | 91 090.25 | 91 518.47 | 0.47% |

**Base year is 1990 for all gases*

Table A 110 and Table A 111 present recalculation differences per gas.

*Table A 110: Recalculation Difference of National $CO_2$ and $CH_4$ Emissions.*

| Year | $CO_2$ [Gg $CO_2$e] | | | $CH_4$ [Gg $CO_2$e] | | |
|---|---|---|---|---|---|---|
| | Submission 2008 | Submission 2009 | Recalc. Difference [%] | Submission 2008 | Submission 2009 | Recalc. Difference [%] |
| 1990* | 62 084.94 | 62 081.53 | -0.01% | 9 184.05 | 9 183.05 | -0.01% |
| 1991 | 65 674.44 | 65 671.09 | -0.01% | 9 162.64 | 9 161.93 | -0.01% |
| 1992 | 60 228.81 | 60 226.24 | 0.00% | 8 875.04 | 8 874.04 | -0.01% |
| 1993 | 60 544.14 | 60 542.84 | 0.00% | 8 852.11 | 8 851.12 | -0.01% |
| 1994 | 60 930.40 | 60 929.63 | 0.00% | 8 659.92 | 8 658.55 | -0.02% |
| 1995 | 63 965.22 | 63 965.30 | 0.00% | 8 543.04 | 8 541.81 | -0.01% |
| 1996 | 67 406.76 | 67 407.08 | 0.00% | 8 353.70 | 8 352.11 | -0.02% |

| Year | $CO_2$ [Gg $CO_2$e] | | | $CH_4$ [Gg $CO_2$e] | | |
|---|---|---|---|---|---|---|
| | Submission 2008 | Submission 2009 | Recalc. Difference [%] | Submission 2008 | Submission 2009 | Recalc. Difference [%] |
| 1997 | 67 198.47 | 67 200.32 | 0.00% | 8 076.73 | 8 074.58 | -0.03% |
| 1998 | 66 773.24 | 66 774.88 | 0.00% | 7 955.03 | 7 953.10 | -0.02% |
| 1999 | 65 540.51 | 65 553.99 | 0.02% | 7 781.04 | 7 780.01 | -0.01% |
| 2000 | 65 928.38 | 65 951.25 | 0.03% | 7 621.74 | 7 621.43 | 0.00% |
| 2001 | 70 200.00 | 70 056.03 | -0.21% | 7 507.02 | 7 526.83 | 0.26% |
| 2002 | 72 115.08 | 72 014.92 | -0.14% | 7 380.94 | 7 412.94 | 0.43% |
| 2003 | 78 271.39 | 78 055.04 | -0.28% | 7 382.76 | 7 460.41 | 1.05% |
| 2004 | 77 529.03 | 77 590.77 | 0.08% | 7 224.40 | 7 312.98 | 1.23% |
| 2005 | 79 515.42 | 79 008.75 | -0.64% | 7 071.42 | 7 177.58 | 1.50% |
| 2006 | 77 282.75 | 77 586.14 | 0.39% | 6 936.59 | 7 080.04 | 2.07% |

**Base year is 1990 for all gases*

*Table A 111: Recalculation Difference of National $N_2O$ and HFC, PFC, $SF_6$ Emissions.*

| Year | $N_2O$ [Gg $CO_2$e] | | | HFC, PFC, $SF_6$ [Gg $CO_2$e] | | |
|---|---|---|---|---|---|---|
| | Submission 2008 | Submission 2009 | Recalc. Difference [%] | Submission 2008 | Submission 2009 | Recalc. Difference [%] |
| 1990* | 6 297.68 | 6 167.40 | -2.07% | 1 604.86 | 1 604.86 | 0.00% |
| 1991 | 6 620.09 | 6 502.52 | -1.78% | 1 785.66 | 1 785.66 | 0.00% |
| 1992 | 6 211.79 | 6 091.46 | -1.94% | 1 209.19 | 1 209.19 | 0.00% |
| 1993 | 6 025.27 | 5 909.39 | -1.92% | 1 003.95 | 1 003.95 | 0.00% |
| 1994 | 6 498.06 | 6 370.62 | -1.96% | 1 251.14 | 1 251.14 | 0.00% |
| 1995 | 6 640.48 | 6 523.93 | -1.76% | 1 475.19 | 1 475.19 | 0.00% |
| 1996 | 6 303.29 | 6 190.88 | -1.78% | 1 631.10 | 1 631.10 | 0.00% |
| 1997 | 6 339.64 | 6 213.50 | -1.99% | 1 644.33 | 1 644.33 | 0.00% |
| 1998 | 6 438.58 | 6 324.22 | -1.78% | 1 447.54 | 1 447.54 | 0.00% |
| 1999 | 6 405.50 | 6 300.60 | -1.64% | 1 290.60 | 1 290.60 | 0.00% |
| 2000 | 6 284.00 | 6 203.92 | -1.27% | 1 301.78 | 1 301.78 | 0.00% |
| 2001 | 6 159.04 | 6 086.84 | -1.17% | 1 413.09 | 1 413.09 | 0.00% |
| 2002 | 6 161.31 | 6 094.24 | -1.09% | 1 508.64 | 1 508.78 | 0.01% |
| 2003 | 6 086.95 | 6 037.66 | -0.81% | 1 558.66 | 1 558.87 | 0.01% |
| 2004 | 5 373.74 | 5 335.53 | -0.71% | 1 535.37 | 1 535.51 | 0.01% |
| 2005 | 5 353.37 | 5 326.14 | -0.51% | 1 319.40 | 1 319.62 | 0.02% |
| 2006 | 5 397.21 | 5 375.65 | -0.40% | 1 473.71 | 1 476.65 | 0.20% |

**Base year is 1990 for all gases*

# ANNEX 6: UNCERTAINTY ASSESSMENT

This Annex includes the Tier 1 and Tier 2 uncertainty assessments following Tables 6.1 and 6.2 of the IPCC 2000 Good Practice Guideance.

*Table A 112: Tier 1 Uncertainty Analysis (Table 6.1 GPG)*

| A | B | C | D | E | F | G | H | I | J | K | L | M |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| IPCC Source category | Gas | Base year emissions 1990 | Year 2006 emissions | Activity data uncertainty | Emission factor uncertainty | Combined uncertainty | Combined uncertainty as % of total national emissions in year t | Type A sensitivity | Type B sensitivity | Uncertainty in trend in national emissions introduced by emission factor uncertainty | Uncertainty in trend in national emissions introduced by activiyt data uncertainty | Uncertainty introduced into the trend in total national emissions |
| | | Input data | Input data | Input data | Input data | | | Note B | | Note C | Note D | |
| | | Gg CO2 equivalent | Gg CO2 equivalent | % | % | % | % | % | % | % | % | % |
| 1.A.1.a liquid: Public Electricity and Heat Prod. | CO2 | 1 228.7 | 765.7 | 0.5 | 0.5 | 0.7 | 0.01 | - 0.01 | 0.01 | - 0.00393 | 0.00706 | 0.01 |
| 1.A 1.a other: Public Electricity and Heat Prod. | CO2 | 118.0 | 655.4 | 10.0 | 20.0 | 22.4 | 0.17 | 0.01 | 0.01 | 0.13666 | 0.12088 | 0.18 |
| 1.A 1.a solid: Public Electricity and Heat Prod. | CO2 | 6 247.0 | 5 066.5 | 0.5 | 0.5 | 0.7 | 0.04 | - 0.02 | 0.07 | - 0.01232 | 0.04672 | 0.05 |
| 1.A 1.b liquid: Petroleum refining | CO2 | 1 957.7 | 2 725.3 | 0.5 | 0.3 | 0.6 | 0.02 | 0.01 | 0.04 | 0.00213 | 0.02513 | 0.03 |
| 1.A.2 mobile-liquid: Manuf. Industries and Cons | CO2 | 257.3 | 715.3 | 3.0 | 0.5 | 3.0 | 0.03 | 0.01 | 0.01 | 0.00280 | 0.03957 | 0.04 |
| 1.A.2 other: Manuf. Industries and Constr. | CO2 | 264.1 | 943.6 | 10.0 | 20.0 | 22.4 | 0.25 | 0.01 | 0.01 | 0.16937 | 0.17402 | 0.24 |
| 1.A.2 solid: Manuf. Industries and Constr. | CO2 | 5 016.3 | 5 410.1 | 1.0 | 0.5 | 1.1 | 0.07 | - 0.00 | 0.07 | - 0.00115 | 0.09977 | 0.10 |
| 1.A.2 stat-liquid: Manuf. Industries and Constr. | CO2 | 2 883.6 | 2 114.2 | 3.0 | 0.5 | 3.0 | 0.08 | - 0.01 | 0.03 | - 0.00715 | 0.11697 | 0.12 |
| 1.A.3.a jet kerosene: Civil Aviation | CO2 | 24.2 | 64.7 | 3.0 | 3.0 | 4.2 | 0.00 | 0.00 | 0.00 | 0.00148 | 0.00358 | 0.00 |
| 1.A.3.b diesel oil: Road Transportation | CO2 | 5 344.0 | 17 157.7 | 3.0 | 3.0 | 4.2 | 0.85 | 0.15 | 0.22 | 0.43809 | 0.94928 | 1.05 |
| 1.A.3.b gasoline: Road Transportation | CO2 | 7 941.7 | 6 009.5 | 3.0 | 3.0 | 4.2 | 0.30 | - 0.04 | 0.08 | - 0.11081 | 0.33249 | 0.35 |
| 1.A.4 biomass: Other Sectors | CH4 | 315.9 | 254.4 | 10.0 | 50.0 | 51.0 | 0.15 | - 0.00 | 0.00 | - 0.06353 | 0.04691 | 0.08 |
| 1.A.4 mobile-diesel: Other Sectors | CO2 | 737.2 | 761.4 | 3.0 | 0.5 | 3.0 | 0.03 | - 0.00 | 0.01 | - 0.00039 | 0.04213 | 0.04 |
| 1.A.4 other: Other Sectors | CO2 | 349.6 | 153.4 | 10.0 | 20.0 | 22.4 | 0.04 | - 0.00 | 0.00 | - 0.06153 | 0.02830 | 0.07 |
| 1.A.4 solid: Other Sectors | CO2 | 2 654.1 | 496.4 | 1.0 | 0.5 | 1.1 | 0.01 | - 0.03 | 0.01 | - 0.01603 | 0.00916 | 0.02 |
| 1.A.4 stat-liquid: Other Sectors | CO2 | 7 319.1 | 4 839.4 | 3.0 | 0.5 | 3.0 | 0.17 | - 0.04 | 0.06 | - 0.02158 | 0.26775 | 0.27 |
| 1.A gaseous: Fuel Combustion (stationary) | CO2 | 11 300.5 | 15 812.4 | 2.0 | 0.5 | 2.1 | 0.38 | 0.04 | 0.21 | 0.02101 | 0.58323 | 0.58 |
| 1.B.2.b: Natural gas | CH4 | 272.7 | 581.7 | 4.2 | 14.1 | 14.7 | 0.10 | 0.00 | 0.01 | 0.05111 | 0.04505 | 0.07 |
| 2.A.1: Cement Production | CO2 | 2 033.4 | 2 130.8 | 5.0 | 2.0 | 5.4 | 0.13 | - 0.00 | 0.03 | - 0.00349 | 0.19648 | 0.20 |
| 2.A.2: Lime Production | CO2 | 396.2 | 595.7 | 20.0 | 5.0 | 20.6 | 0.14 | 0.00 | 0.01 | 0.01007 | 0.21971 | 0.22 |
| 2.A.3: Limestone and Dolomite Use | CO2 | 222.4 | 302.5 | 19.6 | 2.0 | 19.7 | 0.07 | 0.00 | 0.00 | 0.00143 | 0.10923 | 0.11 |
| 2.A.7.b: Sinter Production | CO2 | 481.2 | 329.5 | 2.0 | 5.0 | 5.4 | 0.02 | - 0.00 | 0.00 | - 0.01346 | 0.01215 | 0.02 |
| 2.B.1: Ammonia Production | CO2 | 516.6 | 473.4 | 2.0 | 4.6 | 5.0 | 0.03 | - 0.00 | 0.01 | - 0.00612 | 0.01746 | 0.02 |
| 2.B.2: Nitric Acid Production | N2O | 912.0 | 270.0 | 0.0 | 5.0 | 5.0 | 0.02 | - 0.01 | 0.00 | - 0.04862 | - | 0.05 |
| 2.C.1: Iron and Steel Production | CO2 | 3 545.7 | 5 482.0 | 0.5 | 0.5 | 0.7 | 0.05 | 0.02 | 0.07 | 0.00999 | 0.05055 | 0.05 |
| 2.C.3: Aluminium production | CO2 | 1 050.2 | 0.0 | 2.0 | 0.5 | 2.1 | 0.00 | - 0.02 | 0.00 | - 0.00763 | - | 0.01 |
| 2.C.3: Aluminium production | PFCs | 158.4 | 0.0 | 0.0 | 50.0 | 50.0 | 0.00 | - 0.00 | 0.00 | - 0.11505 | - | 0.12 |
| 2.C.4: SF6 Used in Al and Mg Foundries | SF6 | 253.3 | 0.0 | 0.0 | 5.0 | 5.0 | 0.00 | - 0.00 | 0.00 | - 0.01841 | - | 0.02 |
| 2.F.1/2/3/4./5: ODS Substitutes | HFCs | 133.1 | 288.7 | 20.0 | 50.0 | 53.9 | 0.18 | 0.00 | 0.00 | 0.09160 | 0.10649 | 0.14 |
| 2.F.7: Semiconductor Manufacture | FCs | 126.6 | 269.8 | 5.0 | 10.0 | 11.2 | 0.04 | 0.00 | 0.00 | 0.01680 | 0.02487 | 0.03 |
| 2.F.9: Other Sources of SF6 | SF6 | 21.1 | 853.7 | 25.0 | 50.0 | 55.9 | 0.56 | 0.01 | 0.01 | 0.54133 | 0.39361 | 0.67 |
| 3: SOLVENT AND OTHER PRODUCT USE | CO2 | 279.3 | 248.5 | 5.0 | 10.0 | 11.2 | 0.03 | - 0.00 | 0.00 | - 0.00815 | 0.02292 | 0.02 |
| 4.A.1: Cattle | CH4 | 3 560.9 | 3 000.8 | 10.0 | 20.0 | 22.4 | 0.79 | - 0.01 | 0.04 | - 0.25160 | 0.55342 | 0.61 |
| 4.B.1: Cattle | N2O | 908.1 | 788.5 | 10.0 | 100.0 | 100.5 | 0.93 | - 0.00 | 0.01 | - 0.29074 | 0.14541 | 0.33 |
| 4.B.1: Cattle | CH4 | 587.1 | 452.4 | 10.0 | 70.0 | 70.7 | 0.37 | - 0.00 | 0.01 | - 0.18386 | 0.08344 | 0.20 |
| 4.B.8: Swine | CH4 | 447.7 | 407.5 | 10.0 | 70.0 | 70.7 | 0.34 | - 0.00 | 0.01 | - 0.08325 | 0.07515 | 0.11 |
| 4.D.1: Direct Soil Emissions | N2O | 1 804.9 | 1 633.3 | 5.0 | 150.0 | 150.1 | 2.87 | - 0.00 | 0.02 | - 0.73696 | 0.15061 | 0.75 |
| 4.D.2: Pasture, Range and Paddock Manure | N2O | 218.5 | 223.0 | 5.0 | 150.0 | 150.1 | 0.39 | - 0.00 | 0.00 | - 0.03981 | 0.02056 | 0.04 |
| 4.D.3: Indirect Emissions | N2O | 1 309.7 | 1 104.8 | 5.0 | 150.0 | 150.1 | 1.94 | - 0.00 | 0.01 | - 0.69210 | 0.10188 | 0.70 |
| 6.A: Solid Waste Disposal on Land | CH4 | 3 376.6 | 1 744.2 | 12.0 | 25.0 | 27.7 | 0.57 | - 0.03 | 0.02 | - 0.65712 | 0.38600 | 0.76 |
| 6.B: Wastewater Handling | N2O | 108.4 | 279.4 | 20.0 | 50.0 | 53.9 | 0.18 | 0.00 | 0.00 | 0.10343 | 0.10306 | 0.15 |
| | | 76683 | 85406 | | | | **3.97** | | | | | **2.13** |
| | | 97.0% | 97.1% | | | | | | | | | |
| **National Total without LULUCF** | | **79 036.8** | **87 958.3** | | | | | | | | | |

*Table A 113: Tier 2 Uncertainty Analysis (Table 6.2 GPG)*

| A | B | C | D | E | F | G | H | I | J | K |
|---|---|---|---|---|---|---|---|---|---|---|
| IPCC Source category | Gas | Base year emissions 1990 | Year 2007 emissions | Uncertainty in year t emissions as % of emissions in the category | | Uncertainty introduced on national total in year 2007 | % change in emissions between 2007 and base year | Range of likely % change between 2007 and base year | | Uncertainty introduced into the trend in total national emissions |
| | | Gg CO2 equivalent | Gg CO2 equivalent | % below (2.5 percentile) | % above (97.5 percentile) | % | % | Lower % (2.5 percentile) | Upper % (97.5 percentile) | %-points |
| 1.A.1.a liquid: Public Electricity and Heat Prod. | CO2 | 1229 | 766 | 0.7 | 0.7 | 0.01 | -37.7 | -38.8 | -36.2 | 0.01 |
| 1 A 1 a other: Public Electricity and Heat Product | CO2 | 118 | 656 | 21.7 | 22.9 | 0.2 | 455.5 | 262.2 | 671.7 | 0.2 |
| 1 A 1 a solid: Public Electricity and Heat Producti | CO2 | 6247 | 5067 | 0.7 | 0.7 | 0.0 | -18.9 | -20.1 | -17.5 | 0.1 |
| 1 A 1 b liquid: Petroleum refining | CO2 | 1958 | 2725 | 0.6 | 0.6 | 0.02 | 39.2 | 37.7 | 40.7 | 0.02 |
| 1 A 2 mobile-liquid: Manufacturing Industries and | CO2 | 257 | 715 | 3.0 | 3.0 | 0.02 | 178.0 | 160.6 | 195.6 | 0.03 |
| 1 A 2 other: Manufacturing Industries and Constr | CO2 | 264 | 945 | 21.6 | 23.2 | 0.24 | 257.4 | 132.8 | 391.5 | 0.22 |
| 1 A 2 solid: Manufacturing Industries and Constr | CO2 | 5016 | 5410 | 1.1 | 1.1 | 0.07 | 7.8 | 3.9 | 11.3 | 0.11 |
| 1 A 2 stat-liquid: Manufacturing Industries and C | CO2 | 2884 | 2115 | 2.7 | 2.7 | 0.07 | -26.7 | -33.0 | -19.8 | 0.12 |
| 1 A 3 a jet kerosene: Civil Aviation | CO2 | 24 | 65 | 4.2 | 4.3 | 0.00 | 167.7 | 150.6 | 186.7 | 0.00 |
| 1 A 3 b diesel oil: Road Transportation | CO2 | 5345 | 17157 | 4.2 | 4.3 | 0.83 | 221.0 | 199.8 | 244.4 | 0.82 |
| 1 A 3 b gasoline: Road Transportation | CO2 | 7943 | 6009 | 4.2 | 4.3 | 0.29 | -24.3 | -31.2 | -17.5 | 0.38 |
| 1 A 4 biomass: Other Sectors | CH4 | 316 | 254 | 49.3 | 49.8 | 0.15 | -19.4 | -56.9 | 4.7 | 0.06 |
| 1 A 4 mobile-diesel: Other Sectors | CO2 | 801 | 820 | 3.0 | 3.0 | 0.03 | 2.4 | -5.7 | 11.5 | 0.04 |
| 1 A 4 other: Other Sectors | CO2 | 350 | 154 | 21.6 | 23.2 | 0.04 | -56.1 | -92.9 | -28.3 | 0.07 |
| 1 A 4 solid: Other Sectors | CO2 | 2654 | 496 | 1.1 | 1.1 | 0.01 | -81.3 | -83.3 | -79.4 | 0.04 |
| 1 A 4 stat-liquid: Other Sectors | CO2 | 7321 | 4840 | 2.8 | 2.8 | 0.16 | -33.9 | -40.6 | -26.8 | 0.32 |
| 1 A gaseous: Fuel Combustion (stationary) | CO2 | 11301 | 15812 | 3.4 | 3.4 | 0.62 | 39.9 | 28.1 | 51.2 | 0.82 |
| 1 B 2 b: Natural gas | CH4 | 273 | 581 | 14.5 | 14.7 | 0.10 | 113.3 | 82.8 | 149.2 | 0.06 |
| 2 A 1: Cement Production | CO2 | 2034 | 2131 | 5.2 | 5.3 | 0.13 | 4.8 | -9.9 | 18.9 | 0.19 |
| 2 A 2: Lime Production | CO2 | 396 | 596 | 20.2 | 20.7 | 0.14 | 50.6 | -12.5 | 118.0 | 0.18 |
| 2 A 3: Limestone and Dolomite Use | CO2 | 222 | 308 | 19.6 | 19.1 | 0.07 | 38.6 | -30.1 | 103.4 | 0.09 |
| 2 A 7 b: Sinter Production | CO2 | 481 | 330 | 5.3 | 5.3 | 0.02 | -31.5 | -37.2 | -25.9 | 0.02 |
| 2 B 1: Ammonia Production | CO2 | 517 | 473 | 4.9 | 5.0 | 0.03 | -8.4 | -14.1 | -3.5 | 0.02 |
| 2 B 2: Nitric Acid Production | N2O | 912 | 270 | 19.6 | 20.3 | 0.06 | -70.4 | -95.4 | -42.5 | 0.17 |
| 2 C 1: Iron and Steel Production | CO2 | 3546 | 5482 | 0.7 | 0.7 | 0.04 | 54.6 | 52.9 | 56.5 | 0.04 |
| 2 C 3: Aluminium production | CO2 | 158 | 0 | 0.0 | 0.0 | 0.00 | -100.0 | -103.6 | -95.1 | 0.00 |
| 2C3: Aluminium production | PFC | 1051 | 0 | 0.0 | 0.0 | 0.00 | -100.0 | -186.8 | 2.2 | 0.66 |
| 2C4: SF6 Used in Al and Mg Foundries | SF6 | 253 | 0 | 0.0 | 0.0 | 0.00 | -100.0 | -109.3 | -89.6 | 0.02 |
| 2F1/2/3/4/5: ODS Substitutes | HFC | 21 | 852 | 52.3 | 53.5 | 0.53 | 3935.4 | -692.0 | 8239.1 | 0.59 |
| 2F7: Semiconductor Manufacture | FCs | 133 | 289 | 10.9 | 10.8 | 0.04 | 117.0 | 60.3 | 174.6 | 0.04 |
| 2F9: Other Sources of SF6 | SF6 | 127 | 270 | 54.5 | 54.4 | 0.17 | 112.7 | -147.6 | 357.1 | 0.21 |
| 3: SOLVENT AND OTHER PRODUCT USE | CO2 | 279 | 248 | 4.9 | 4.9 | 0.01 | -11.0 | -22.0 | -0.8 | 0.02 |
| 4 A 1: Cattle | CH4 | 3559 | 2999 | 20.5 | 21.4 | 0.72 | -15.7 | -35.6 | 1.3 | 0.44 |
| 4 B 1: Cattle | CH4 | 584 | 450 | 71.4 | 68.2 | 0.37 | -23.0 | -73.6 | 6.1 | 0.14 |
| 4 B 1: Cattle | N2O | 906 | 787 | 50.5 | 99.5 | 0.70 | -13.2 | -73.4 | 5.9 | 0.16 |
| 4 B 8: Swine | CH4 | 445 | 405 | 71.2 | 67.9 | 0.33 | -9.0 | -40.3 | 8.0 | 0.07 |
| 4 D 1: Direct Soil Emissions | N2O | 1834 | 1658 | 70.2 | 196.2 | 2.89 | -9.6 | -131.7 | 2.6 | 0.41 |
| 4 D 2: Pasture, Range and Paddock Manure | N2O | 222 | 226 | 70.2 | 196.2 | 0.39 | 2.0 | -42.4 | 63.3 | 0.03 |
| 4 D 3: Indirect Emissions | N2O | 1331 | 1122 | 70.2 | 196.2 | 1.95 | -15.7 | -186.6 | -1.1 | 0.44 |
| 6 A: Solid Waste Disposal on Land | CH4 | 3363 | 1738 | 26.3 | 28.3 | 0.55 | -48.3 | -85.2 | -18.7 | 0.77 |
| 6 B: Wastewater Handling | N2O | 109 | 280 | 41.4 | 45.9 | 0.14 | 157.5 | 39.3 | 285.3 | 0.09 |
| | Total | 76784 | 85501 | | | | | | | |
| | | 97.1% | 97.2% | | | | | | | |
| **National Total without LULUCF** | | **79 036.8** | **87 958.3** | | | **5.65** | | | | **2.28** |

# ANNEX 7: CRF FOR 2007

This Annex includes the CRF-tables for the year 2007 as included in Austria’s data submission 2009 to the UNFCCC.

# TABLE 1 SECTORAL REPORT FOR ENERGY
## (Sheet 1 of 2)

Inventory 2007

Submission 2009 v1.1

AUSTRIA

| GREENHOUSE GAS SOURCE AND SINK CATEGORIES | $CO_2$ | $CH_4$ | $N_2O$ | $NO_X$ | CO | NMVOC | $SO_2$ |
|---|---|---|---|---|---|---|---|
| | (Gg) | | | | | | |
| **Total Energy** | 64 380.52 | 48.35 | 2.42 | 212.19 | 735.93 | 68.50 | 24.24 |
| **A. Fuel Combustion Activities (Sectoral Approach)** | 64 143.48 | 14.76 | 2.42 | 212.19 | 735.93 | 65.76 | 24.05 |
| **1. Energy Industries** | 13 928.60 | 0.29 | 0.26 | 14.60 | 4.38 | 0.68 | 5.97 |
| a. Public Electricity and Heat Production | 10 434.17 | 0.28 | 0.24 | 9.85 | 3.88 | 0.67 | 2.74 |
| b. Petroleum Refining | 2 867.63 | IE,NO | 0.02 | 3.05 | 0.39 | IE | 3.23 |
| c. Manufacture of Solid Fuels and Other Energy Industries | 626.80 | 0.02 | 0.00 | 1.70 | 0.11 | 0.01 | NA |
| **2. Manufacturing Industries and Construction** | 15 667.82 | 0.67 | 0.46 | 32.29 | 166.12 | 2.19 | 11.17 |
| a. Iron and Steel | 6 224.79 | 0.10 | 0.06 | 5.11 | 138.86 | 0.31 | 5.59 |
| b. Non-Ferrous Metals | 254.16 | 0.01 | 0.00 | 0.22 | 0.04 | 0.00 | 0.10 |
| c. Chemicals | 1 528.13 | 0.14 | 0.02 | 1.48 | 2.15 | 0.37 | 0.79 |
| d. Pulp, Paper and Print | 2 191.15 | 0.14 | 0.07 | 4.96 | 1.82 | 0.23 | 1.17 |
| e. Food Processing, Beverages and Tobacco | 899.27 | 0.02 | 0.01 | 0.90 | 0.15 | 0.02 | 0.36 |
| f. Other *(as specified in table 1.A(a) sheet 2)* | 4 570.33 | 0.26 | 0.29 | 19.62 | 23.09 | 1.25 | 3.15 |
| Other non-specified | 4 570.33 | 0.26 | 0.29 | 19.62 | 23.09 | 1.25 | 3.15 |
| **3. Transport** | 23 922.60 | 0.99 | 0.91 | 140.62 | 220.62 | 20.63 | 0.23 |
| a. Civil Aviation | 73.71 | 0.00 | 0.00 | 0.29 | 2.40 | 0.12 | 0.02 |
| b. Road Transportation | 23 167.21 | 0.96 | 0.86 | 137.05 | 215.20 | 19.89 | 0.13 |
| c. Railways | 163.23 | 0.00 | 0.01 | 1.34 | 0.35 | 0.17 | 0.06 |
| d. Navigation | 69.45 | 0.01 | 0.02 | 0.73 | 2.58 | 0.45 | 0.02 |
| e. Other Transportation *(as specified in table 1.A(a) sheet 3)* | 449.00 | 0.01 | 0.00 | 1.22 | 0.08 | 0.00 | NA |
| Pipeline transport | 449.00 | 0.01 | 0.00 | 1.22 | 0.08 | 0.00 | NA |

**TABLE 1 SECTORAL REPORT FOR ENERGY**
**(Sheet 2 of 2)**

Inventory 2007
Submission 2009 v1.1
AUSTRIA

| GREENHOUSE GAS SOURCE AND SINK CATEGORIES | $CO_2$ | $CH_4$ | $N_2O$ | $NO_X$ | CO | NMVOC | $SO_2$ |
|---|---|---|---|---|---|---|---|
| | (Gg) | | | | | | |
| **4. Other Sectors** | 10 579.85 | 12.81 | 0.80 | 24.60 | 344.54 | 42.24 | 6.66 |
| a. Commercial/Institutional | 1 951.54 | 0.67 | 0.05 | 1.98 | 14.11 | 1.74 | 0.91 |
| b. Residential | 7 709.25 | 11.05 | 0.44 | 12.37 | 291.54 | 34.28 | 5.51 |
| c. Agriculture/Forestry/Fisheries | 919.07 | 1.09 | 0.31 | 10.25 | 38.89 | 6.22 | 0.23 |
| **5. Other** *(as specified in table 1.A(a) sheet 4)* | 44.61 | 0.00 | 0.00 | 0.09 | 0.27 | 0.02 | 0.01 |
| a. Stationary | NA | NA | NA | NA | NA | NA | NA |
| b. Mobile | 44.61 | 0.00 | 0.00 | 0.09 | 0.27 | 0.02 | 0.01 |
| Military use | 44.61 | 0.00 | 0.00 | 0.09 | 0.27 | 0.02 | 0.01 |
| **B. Fugitive Emissions from Fuels** | 237.04 | 33.59 | IE,NA | IE,NA | IE,NA | 2.74 | 0.18 |
| **1. Solid Fuels** | IE,NA,NO | IE,NA,NO | IE,NA | IE,NA | IE,NA | IE,NA | IE,NA |
| a. Coal Mining and Handling | IE,NA,NO | IE,NO | NA | NA | NA | NA | |
| b. Solid Fuel Transformation | IE | IE | IE | IE | IE | IE | IE |
| c. Other *(as specified in table 1.B.1)* | NA | NA | NA | NA | NA | NA | NA |
| **2. Oil and Natural Gas** | 237.04 | 33.59 | IE,NA | IE,NA | IE,NA | 2.74 | 0.18 |
| a. Oil | 142.00 | 5.89 | IE,NA | NA | NA | 2.47 | NA |
| b. Natural Gas | 95.04 | 27.70 | | | | 0.26 | 0.18 |
| c. Venting and Flaring | IE | IE | IE | IE | IE | IE | IE |
| Venting | IE | IE | | | | IE | IE |
| Flaring | IE | IE | IE | IE | IE | IE | IE |
| d. Other *(as specified in table 1.B.2)* | NA | NA | NA | NA | NA | NA | NA |
| **Memo Items:** [(1)] | | | | | | | |
| **International Bunkers** | 2 175.79 | 0.04 | 0.07 | 8.87 | 2.39 | 0.95 | 0.69 |
| Aviation | 2 175.79 | 0.04 | 0.07 | 8.87 | 2.39 | 0.95 | 0.69 |
| Marine | NA,NO | NA,NO | NA,NO | NO | NO | NO | NO |
| **Multilateral Operations** | NO | NO | NO | NO | NO | NO | NO |
| **$CO_2$ Emissions from Biomass** | 18 660.74 | | | | | | |

[(1)] Countries are asked to report emissions from international aviation and marine bunkers and multilateral operations, as well as $CO_2$ emissions from biomass, under Memo Items. These emissions should not be included in the national total emissions from the Energy sector. Amounts of biomass used as fuel are included in the national energy consumption but the corresponding $CO_2$ emissions are not included in the national total as it is assumed that the biomass is produced in a sustainable manner. If the biomass is harvested at an unsustainable rate, net $CO_2$ emissions are accounted for as a loss of biomass stocks in the Land Use, Land-Use Change and Forestry sector.

**Documentation Box:**
Parties should provide detailed explanations on the Energy sector in Chapter 3: Energy (CRF sector 1) of the NIR. Use this documentation box to provide references to relevant sections of the NIR if any additional information and/or further details are needed to understand the content of this table.

**TABLE 1.A(a) SECTORAL BACKGROUND DATA FOR ENERGY** Inventory 2007

**Fuel Combustion Activities - Sectoral Approach** Submission 2009 v1.1

**(Sheet 1 of 4)** AUSTRIA

| GREENHOUSE GAS SOURCE AND SINK CATEGORIES | AGGREGATE ACTIVITY DATA | | IMPLIED EMISSION FACTORS [2] | | | EMISSIONS | | |
|---|---|---|---|---|---|---|---|---|
| | Consumption | | $CO_2$ | $CH_4$ | $N_2O$ | $CO_2$ | $CH_4$ | $N_2O$ |
| | (TJ) | NCV/GCV[1] | (t/TJ) | (kg/TJ) | | (Gg) | | |
| **1.A. Fuel Combustion** | 1 103 152.78 | NCV | | | | 64 143.48 | 14.76 | 2.42 |
| Liquid Fuels | 498 433.29 | NCV | 71.43 | 2.34 | 2.97 | 35 605.08 | 1.17 | 1.48 |
| Solid Fuels | 113 485.78 | NCV | 96.70 | 5.52 | 0.94 | 10 973.53 | 0.63 | 0.11 |
| Gaseous Fuels | 285 501.25 | NCV | 55.38 | 1.04 | 0.45 | 15 812.41 | 0.30 | 0.13 |
| Biomass | 175 464.45 | NCV | 106.35 | 70.15 | 3.77 [3] | | 12.31 | 0.66 |
| Other Fuels | 30 268.01 | NCV | 57.90 | 12.00 | 1.40 | 1 752.47 | 0.36 | 0.04 |
| **1.A.1. Energy Industries** | 233 893.64 | NCV | | | | 13 928.60 | 0.29 | 0.26 |
| Liquid Fuels | 46 160.56 | NCV | 75.63 | 0.25 | 0.65 | 3 490.99 | 0.01 | 0.03 |
| Solid Fuels | 54 463.28 | NCV | 93.03 | 0.11 | 0.51 | 5 066.51 | 0.01 | 0.03 |
| Gaseous Fuels | 85 120.08 | NCV | 55.40 | 0.63 | 0.49 | 4 715.65 | 0.05 | 0.04 |
| Biomass | 36 354.37 | NCV | 110.04 | 2.22 | 3.87 [3] | 4 000.34 | 0.08 | 0.14 |
| Other Fuels | 11 795.35 | NCV | 55.57 | 12.00 | 1.40 | 655.44 | 0.14 | 0.02 |
| a. Public Electricity and Heat Production | 183 562.21 | NCV | | | | 10 434.17 | 0.28 | 0.24 |
| Liquid Fuels | 9 712.75 | NCV | 78.84 | 1.18 | 1.29 | 765.72 | 0.01 | 0.01 |
| Solid Fuels | 54 463.28 | NCV | 93.03 | 0.11 | 0.51 | 5 066.51 | 0.01 | 0.03 |
| Gaseous Fuels | 71 236.46 | NCV | 55.40 | 0.51 | 0.57 | 3 946.50 | 0.04 | 0.04 |
| Biomass | 36 354.37 | NCV | 110.04 | 2.22 | 3.87 [3] | 4 000.34 | 0.08 | 0.14 |
| Other Fuels | 11 795.35 | NCV | 55.57 | 12.00 | 1.40 | 655.44 | 0.14 | 0.02 |
| b. Petroleum Refining | 39 017.35 | NCV | | | | 2 867.63 | IE,NO | 0.02 |
| Liquid Fuels | 36 447.81 | NCV | 74.77 | IE | 0.48 | 2 725.28 | IE | 0.02 |
| Solid Fuels | NO | NCV | NO | NO | NO | NO | NO | NO |
| Gaseous Fuels | 2 569.54 | NCV | 55.40 | IE | 0.10 | 142.35 | IE | 0.00 |
| Biomass | NO | NCV | NO | NO | NO [3] | NO | NO | NO |
| Other Fuels | NO | NCV | NO | NO | NO | NO | NO | NO |
| c. Manufacture of Solid Fuels and Other Energy Industries | 11 314.08 | NCV | | | | 626.80 | 0.02 | 0.00 |
| Liquid Fuels | NO | NCV | NO | NO | NO | NO | NO | NO |
| Solid Fuels | NO | NCV | NO | NO | NO | NO | NO | NO |
| Gaseous Fuels | 11 314.08 | NCV | 55.40 | 1.50 | 0.10 | 626.80 | 0.02 | 0.00 |
| Biomass | NO | NCV | NO | NO | NO [3] | NO | NO | NO |
| Other Fuels | NO | NCV | NO | NO | NO | NO | NO | NO |

**Note:** All footnotes for this table are given at the end of the table on sheet 4.

**Note:** For the coverage of fuel categories, refer to the IPCC Guidelines (Volume 1. Reporting Instructions - Common Reporting Framework, section 1.2, p. 1.19). If some derived gases (e.g. gas works, gas, coke oven gas, blast furnace gas) are considered, Parties should provide information on the allocation of these derived gases under the above fuel categories (liquid, solid, gaseous, biomass and other fuels) in the NIR (see also documentation box at the end of sheet 4 of this table).

**TABLE 1.A(a) SECTORAL BACKGROUND DATA FOR ENERGY** Inventory 2007

**Fuel Combustion Activities - Sectoral Approach** Submission 2009 v1.1

**(Sheet 2 of 4)** AUSTRIA

| GREENHOUSE GAS SOURCE AND SINK CATEGORIES | AGGREGATE ACTIVITY DATA | | IMPLIED EMISSION FACTORS [2] | | | EMISSIONS | | |
|---|---|---|---|---|---|---|---|---|
| | Consumption | | $CO_2$ | $CH_4$ | $N_2O$ | $CO_2$ | $CH_4$ | $N_2O$ |
| | (TJ) | NCV/GCV [1] | (t/TJ) | (kg/TJ) | | (Gg) | | |
| **1.A.2 Manufacturing Industries and Construction** | 283 187.03 | NCV | | | | 15 667.82 | 0.67 | 0.46 |
| Liquid Fuels | 37 637.70 | NCV | 75.18 | 1.51 | 5.34 | 2 829.46 | 0.06 | 0.20 |
| Solid Fuels | 53 750.24 | NCV | 100.65 | 2.23 | 1.25 | 5 410.06 | 0.12 | 0.07 |
| Gaseous Fuels | 117 131.06 | NCV | 55.36 | 1.47 | 0.10 | 6 484.70 | 0.17 | 0.01 |
| Biomass | 57 668.21 | NCV | 109.44 | 2.00 | 2.71 [3] | 6 311.46 | 0.12 | 0.16 |
| Other Fuels | 16 999.81 | NCV | 55.51 | 12.00 | 1.40 | 943.60 | 0.20 | 0.02 |
| a. Iron and Steel | 72 368.28 | NCV | | | | 6 224.79 | 0.10 | 0.06 |
| Liquid Fuels | 11 043.46 | NCV | 77.98 | 1.61 | 1.00 | 861.22 | 0.02 | 0.01 |
| Solid Fuels | 41 690.59 | NCV | 102.66 | 1.39 | 1.20 | 4 280.14 | 0.06 | 0.05 |
| Gaseous Fuels | 19 634.24 | NCV | 55.18 | 1.29 | 0.10 | 1 083.43 | 0.03 | 0.00 |
| Biomass | NO | NCV | NO | NO | NO [3] | NO | NO | NO |
| Other Fuels | NO | NCV | NO | NO | NO | NO | NO | NO |
| b. Non-Ferrous Metals | 4 342.83 | NCV | | | | 254.16 | 0.01 | 0.00 |
| Liquid Fuels | 414.26 | NCV | 71.95 | 0.99 | 0.83 | 29.81 | 0.00 | 0.00 |
| Solid Fuels | 138.13 | NCV | 104.00 | 2.00 | 1.40 | 14.37 | 0.00 | 0.00 |
| Gaseous Fuels | 3 790.44 | NCV | 55.40 | 1.50 | 0.10 | 209.99 | 0.01 | 0.00 |
| Biomass | NO | NCV | NO | NO | NO [3] | NO | NO | NO |
| Other Fuels | NO | NCV | NO | NO | NO | NO | NO | NO |
| c. Chemicals | 28 779.89 | NCV | | | | 1 528.13 | 0.14 | 0.02 |
| Liquid Fuels | 710.15 | NCV | 77.50 | 0.76 | 0.75 | 55.04 | 0.00 | 0.00 |
| Solid Fuels | 836.88 | NCV | 94.29 | 5.00 | 1.40 | 78.91 | 0.00 | 0.00 |
| Gaseous Fuels | 16 012.15 | NCV | 55.40 | 1.50 | 0.10 | 887.07 | 0.02 | 0.00 |
| Biomass | 2 208.87 | NCV | 110.35 | 1.90 | 3.42 [3] | 243.75 | 0.00 | 0.01 |
| Other Fuels | 9 011.84 | NCV | 56.27 | 12.00 | 1.40 | 507.11 | 0.11 | 0.01 |
| d. Pulp, Paper and Print | 70 478.57 | NCV | | | | 2 191.15 | 0.14 | 0.07 |
| Liquid Fuels | 1 282.44 | NCV | 77.90 | 1.76 | 0.96 | 99.90 | 0.00 | 0.00 |
| Solid Fuels | 4 006.15 | NCV | 89.99 | 5.05 | 1.40 | 360.50 | 0.02 | 0.01 |
| Gaseous Fuels | 30 976.71 | NCV | 55.40 | 1.50 | 0.10 | 1 716.11 | 0.05 | 0.00 |
| Biomass | 34 009.67 | NCV | 110.01 | 2.00 | 1.88 [3] | 3 741.56 | 0.07 | 0.06 |
| Other Fuels | 203.60 | NCV | 71.89 | 12.00 | 1.40 | 14.64 | 0.00 | 0.00 |
| e. Food Processing, Beverages and Tobacco | 15 650.85 | NCV | | | | 899.27 | 0.02 | 0.01 |
| Liquid Fuels | 2 767.95 | NCV | 75.89 | 0.86 | 0.82 | 210.07 | 0.00 | 0.00 |
| Solid Fuels | 106.53 | NCV | 102.60 | 2.74 | 1.40 | 10.93 | 0.00 | 0.00 |
| Gaseous Fuels | 12 243.03 | NCV | 55.40 | 1.50 | 0.10 | 678.26 | 0.02 | 0.00 |
| Biomass | 533.34 | NCV | 110.14 | 1.80 | 2.82 [3] | 58.74 | 0.00 | 0.00 |
| Other Fuels | NO | NCV | NO | NO | NO | NO | NO | NO |
| f. Other *(please specify )* [4] | 91 566.60 | NCV | | | | 4 570.33 | 0.26 | 0.29 |
| Other non-specified | | | | | | | | |
| Liquid Fuels | 21 419.44 | NCV | 73.46 | 1.56 | 8.67 | 1 573.42 | 0.03 | 0.19 |
| Solid Fuels | 6 971.96 | NCV | 95.41 | 5.32 | 1.40 | 665.22 | 0.04 | 0.01 |
| Gaseous Fuels | 34 474.49 | NCV | 55.40 | 1.50 | 0.10 | 1 909.83 | 0.05 | 0.00 |
| Biomass | 20 916.33 | NCV | 108.40 | 2.01 | 4.00 [3] | 2 267.40 | 0.04 | 0.08 |
| Other Fuels | 7 784.38 | NCV | 54.19 | 12.00 | 1.40 | 421.86 | 0.09 | 0.01 |

**Note:** All footnotes for this table are given at the end of the table on sheet 4.

**TABLE 1.A(a) SECTORAL BACKGROUND DATA FOR ENERGY** Inventory 2007

**Fuel Combustion Activities - Sectoral Approach** Submission 2009 v1.1

**(Sheet 3 of 4)** AUSTRIA

| GREENHOUSE GAS SOURCE AND SINK CATEGORIES | AGGREGATE ACTIVITY DATA | | IMPLIED EMISSION FACTORS [2] | | | | EMISSIONS | | |
|---|---|---|---|---|---|---|---|---|---|
| | Consumption | | $CO_2$ | $CH_4$ | $N_2O$ | | $CO_2$ | $CH_4$ | $N_2O$ |
| | (TJ) | NCV/GCV[1] | (t/TJ) | (kg/TJ) | | | (Gg) | | |
| **1.A.3 Transport** | 343 617.51 | NCV | | | | | 23 922.60 | 0.99 | 0.91 |
| Liquid Fuels | 335 507.18 | NCV | 69.96 | 2.92 | 2.70 | | 23 473.06 | 0.98 | 0.91 |
| Solid Fuels | 5.63 | NCV | 95.00 | 6.83 | 6.83 | | 0.54 | 0.00 | 0.00 |
| Gaseous Fuels | 8 104.70 | NCV | 55.40 | 1.50 | 0.10 | | 449.00 | 0.01 | 0.00 |
| Biomass | NO | NCV | NO | NO | NO | | NO | NO | NO |
| Other Fuels | NA,NO | NCV | NA,NO | NA,NO | NA,NO | [3] | NA,NO | NA,NO | NA,NO |
| a. Civil Aviation | 1 012.87 | NCV | | | | | 73.71 | 0.00 | 0.00 |
| Aviation Gasoline | 124.19 | NCV | 72.45 | NO | NO | | 9.00 | NO | NO |
| Jet Kerosene | 888.68 | NCV | 72.82 | 5.60 | 3.93 | | 64.71 | 0.00 | 0.00 |
| b. Road Transportation | 331 144.64 | NCV | | | | | 23 167.21 | 0.96 | 0.86 |
| Gasoline | 83 170.68 | NCV | 72.26 | 9.83 | 4.84 | | 6 009.53 | 0.82 | 0.40 |
| Diesel Oil | 247 973.96 | NCV | 69.19 | 0.59 | 1.86 | | 17 157.68 | 0.15 | 0.46 |
| Liquefied Petroleum Gases (LPG) | NO | NCV | NO | NO | NO | | NO | NO | NO |
| Other Liquid Fuels (please specify) | NA | NCV | | | | | NA | NA | NA |
| Gaseous Fuels | NO | NCV | NO | NO | NO | | NO | NO | NO |
| Biomass | NO | NCV | NO | NO | NO | [3] | NO | NO | NO |
| Other Fuels *(please specify)* | NA | NCV | | | | | NA | NA | NA |
| c. Railways | 2 356.99 | NCV | | | | | 163.23 | 0.00 | 0.01 |
| Liquid Fuels | 2 351.36 | NCV | 69.19 | 1.74 | 6.32 | | 162.70 | 0.00 | 0.01 |
| Solid Fuels | 5.63 | NCV | 95.00 | 6.83 | 6.83 | | 0.54 | 0.00 | 0.00 |
| Gaseous Fuels | NO | NCV | NO | NO | NO | | NO | NO | NO |
| Other Fuels *(please specify)* | NA | NCV | | | | | NA | NA | NA |
| d. Navigation | 998.31 | NCV | | | | | 69.45 | 0.01 | 0.02 |
| Residual Oil (Residual Fuel Oil) | NO | NCV | NO | NO | NO | | NO | NO | NO |
| Gas/Diesel Oil | 875.28 | NCV | 69.12 | 3.01 | 25.16 | | 60.50 | 0.00 | 0.02 |
| Gasoline | 123.03 | NCV | 72.73 | 39.91 | 2.84 | | 8.95 | 0.00 | 0.00 |
| Other Liquid Fuels *(please specify)* | NA | NCV | | | | | NA | NA | NA |
| Solid Fuels | NO | NCV | NO | NO | NO | | NO | NO | NO |
| Gaseous Fuels | NO | NCV | NO | NO | NO | | NO | NO | NO |
| Other Fuels *(please specify)* | NA | NCV | | | | | NA | NA | NA |
| e. Other Transportation *(please specify)* [5] | 8 104.70 | NCV | | | | | 449.00 | 0.01 | 0.00 |
| Pipeline transport | 8 104.70 | NCV | | | | | 449.00 | 0.01 | 0.00 |
| Liquid Fuels | NO | NCV | NO | NO | NO | | NO | NO | NO |
| Solid Fuels | NO | NCV | NO | NO | NO | | NO | NO | NO |
| Gaseous Fuels | 8 104.70 | NCV | 55.40 | 1.50 | 0.10 | | 449.00 | 0.01 | 0.00 |
| Biomass | NO | NCV | NO | NO | NO | [3] | NO | NO | NO |
| Other Fuels | NO | NCV | NO | NO | NO | | NO | NO | NO |

**Note:** All footnotes for this table are given at the end of the table on sheet 4.

**TABLE 1.A(a) SECTORAL BACKGROUND DATA FOR ENERGY** Inventory 2007

**Fuel Combustion Activities - Sectoral Approach** Submission 2009 v1.1

**(Sheet 4 of 4)** AUSTRIA

| GREENHOUSE GAS SOURCE AND SINK CATEGORIES | AGGREGATE ACTIVITY DATA | | IMPLIED EMISSION FACTORS [(2)] | | | | EMISSIONS | | |
|---|---|---|---|---|---|---|---|---|---|
| | Consumption | | $CO_2$ | $CH_4$ | $N_2O$ | | $CO_2$ | $CH_4$ | $N_2O$ |
| | (TJ) | NCV/GCV[(1)] | (t/TJ) | (kg/TJ) | | | (Gg) | | |
| **1.A.4 Other Sectors** | 241 840.02 | NCV | | | | | 10 579.85 | 12.81 | 0.80 |
| Liquid Fuels | 78 513.27 | NCV | 73.45 | 1.52 | 4.36 | | 5 766.95 | 0.12 | 0.34 |
| Solid Fuels | 5 266.62 | NCV | 94.26 | 95.08 | 2.34 | | 496.42 | 0.50 | 0.01 |
| Gaseous Fuels | 75 145.41 | NCV | 55.40 | 0.80 | 1.00 | | 4 163.06 | 0.06 | 0.08 |
| Biomass | 81 441.86 | NCV | 102.51 | 148.74 | 4.48 | (3) | 8 348.94 | 12.11 | 0.36 |
| Other Fuels | 1 472.84 | NCV | 104.17 | 12.00 | 1.40 | | 153.43 | 0.02 | 0.00 |
| a. Commercial/Institutional | 37 146.61 | NCV | | | | | 1 951.54 | 0.67 | 0.05 |
| Liquid Fuels | 8 285.31 | NCV | 71.54 | 0.66 | 0.93 | | 592.73 | 0.01 | 0.01 |
| Solid Fuels | 617.06 | NCV | 93.10 | 90.00 | 2.23 | | 57.45 | 0.06 | 0.00 |
| Gaseous Fuels | 20 720.73 | NCV | 55.40 | 0.80 | 1.00 | | 1 147.93 | 0.02 | 0.02 |
| Biomass | 6 050.67 | NCV | 109.36 | 95.08 | 2.90 | (3) | 661.69 | 0.58 | 0.02 |
| Other Fuels | 1 472.84 | NCV | 104.17 | 12.00 | 1.40 | | 153.43 | 0.02 | 0.00 |
| b. Residential | 182 572.28 | NCV | | | | | 7 709.25 | 11.05 | 0.44 |
| Liquid Fuels | 57 611.50 | NCV | 74.53 | 0.96 | 1.23 | | 4 293.50 | 0.06 | 0.07 |
| Solid Fuels | 4 564.03 | NCV | 94.42 | 95.86 | 2.35 | | 430.92 | 0.44 | 0.01 |
| Gaseous Fuels | 53 877.67 | NCV | 55.40 | 0.80 | 1.00 | | 2 984.82 | 0.04 | 0.05 |
| Biomass | 66 519.08 | NCV | 101.43 | 158.06 | 4.50 | (3) | 6 747.25 | 10.51 | 0.30 |
| Other Fuels | NO | NCV | NO | NO | NO | | NO | NO | NO |
| c. Agriculture/Forestry/Fisheries | 22 121.13 | NCV | | | | | 919.07 | 1.09 | 0.31 |
| Liquid Fuels | 12 616.46 | NCV | 69.81 | 4.60 | 20.86 | | 880.71 | 0.06 | 0.26 |
| Solid Fuels | 85.54 | NCV | 94.13 | 90.00 | 2.83 | | 8.05 | 0.01 | 0.00 |
| Gaseous Fuels | 547.01 | NCV | 55.40 | 0.80 | 1.00 | | 30.30 | 0.00 | 0.00 |
| Biomass | 8 872.12 | NCV | 105.95 | 115.39 | 5.38 | (3) | 940.01 | 1.02 | 0.05 |
| Other Fuels | NO | NCV | NO | NO | NO | | NO | NO | NO |
| **1.A.5 Other *(Not specified elsewhere)* [(6)]** | 614.58 | NCV | | | | | 44.61 | 0.00 | 0.00 |
| **a. Stationary *(please specify)* [(7)]** | NA | NCV | | | | | NA | NA | NA |
| **b. Mobile *(please specify)* [(8)]** | 614.58 | NCV | | | | | 44.61 | 0.00 | 0.00 |
| Military use | | | | | | | | | |
| Liquid Fuels | 614.58 | NCV | 72.59 | 2.35 | 5.25 | | 44.61 | 0.00 | 0.00 |
| Solid Fuels | NO | NCV | NO | NO | NO | | NO | NO | NO |
| Gaseous Fuels | NO | NCV | NO | NO | NO | | NO | NO | NO |
| Biomass | NO | NCV | NO | NO | NO | (3) | NO | NO | NO |
| Other Fuels | NO | NCV | NO | NO | NO | | NO | NO | NO |

(1) If activity data are calculated using net calorific values (NCV) as specified by the IPCC Guidelines, write NCV in this column. If gross calorific values (GCV) are used, write GCV in this column.

(2) Accurate estimation of $CH_4$ and $N_2O$ emissions depends on combustion conditions, technology and emission control policy, as well as on fuel characteristics. Therefore, caution should be used when comparing the implied emission factors across countries.

(3) Although carbon dioxide emissions from biomass are reported in this table, they will not be included in the total $CO_2$ emissions from fuel combustion. The value for total $CO_2$ from biomass is recorded in Table1 sheet 2 under the Memo Items.

(4) Use the cell below to list all activities covered under "f. Other".

(5) Use the cell below to list all activities covered under "e. Other transportation".

(6) Include military fuel use under this category.

(7) Use the cell below to list all activities covered under "1.A.5.a Other - stationary".

(8) Use the cell below to list all activities covered under "1.A.5.b Other - mobile".

**Documentation Box:**
• Parties should provide detailed explanations on the fuel combustion sub-sector in the corresponding part of Chapter 3: Energy (CRF sub-sector 1.A) of the NIR. Use this documentation box to provide references to relevant sections of the NIR if any additional information and/or further details are needed to understand the
• If estimates are based on GCV, use this documentation box to provide reference to the relevant section of the NIR where the information necessary to allow the calculation of the activity data based on NCV can be found.
• If some derived gases (e.g. gas works gas, coke oven gas, blast furnace gas) are considered, use this documentation box to provide a reference to the relevant section of the NIR containing the information on the allocation of these derived gases under the above fuel categories (liquid, soild, gaseous, biomass and other

**TABLE 1.A(b) SECTORAL BACKGROUND DATA FOR ENERGY** Inventory 2007

**$CO_2$ from Fuel Combustion Activities - Reference Approach (IPCC Worksheet 1-1)** Submission 2009 v1.1

**(Sheet 1 of 1)** AUSTRIA

| FUEL TYPES | | | Unit | Production | Imports | Exports | International bunkers | Stock change | Apparent consumption | Conversion factor (TJ/Unit) | NCV/ GCV [(1)] | Apparent consumption (TJ) | Carbon emission factor (t C/TJ) | Carbon content (Gg C) | Carbon stored (Gg C) | Net carbon emissions (Gg C) | Fraction of carbon oxidized | Actual $CO_2$ emissions (Gg $CO_2$) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Liquid Fossil | Primary Fuels | Crude Oil | Gg | 800.34 | 7 640.96 | NO | | -104.60 | 8 545.90 | 42.75 | NCV | 365 337.35 | 20.00 | 7 306.75 | NO | 7 306.75 | 0.99 | 26 523.49 |
| | | Orimulsion | Gg | NO | NO | NO | | NO | NO | NA | NCV | NA,NO | NA | NA,NO | NA | NA,NO | NA | NA,NO |
| | | Natural Gas Liquids | Gg | 128.34 | 49.85 | NO | | NO | 178.18 | 45.22 | NCV | 8 057.48 | 17.20 | 138.59 | NO | 138.59 | 0.99 | 503.08 |
| | Secondary Fuels | Gasoline | Gg | | 889.02 | 650.76 | NO | -5.07 | 243.33 | 44.80 | NCV | 10 901.21 | 18.90 | 206.03 | NO | 206.03 | 0.99 | 747.90 |
| | | Jet Kerosene | Gg | | 159.20 | 1.18 | 670.12 | 37.67 | -549.77 | 44.59 | NCV | -24 514.10 | 19.50 | -478.02 | NO | -478.02 | 0.99 | -1 735.23 |
| | | Other Kerosene | Gg | | 2.09 | 0.16 | NO | 0.09 | 1.84 | 44.75 | NCV | 82.42 | 19.60 | 1.62 | NO | 1.62 | 0.99 | 5.86 |
| | | Shale Oil | Gg | | NO | NO | | NO | NO | NA | NCV | NA,NO | NA | NA,NO | NA | NA,NO | NA | NA,NO |
| | | Gas / Diesel Oil | Gg | | 5 015.41 | 954.97 | NO | -5.40 | 4 065.84 | 43.33 | NCV | 176 172.66 | 20.20 | 3 558.69 | NO | 3 558.69 | 0.99 | 12 918.04 |
| | | Residual Fuel Oil | Gg | | 182.51 | 37.16 | NO | 23.29 | 122.06 | 40.19 | NCV | 4 905.66 | 21.10 | 103.51 | NO | 103.51 | 0.99 | 375.74 |
| | | Liquefied Petroleum Gas (LPG) | Gg | | 128.57 | 21.03 | | -2.80 | 110.33 | 47.31 | NCV | 5 219.92 | 17.20 | 89.78 | NO | 89.78 | 0.99 | 325.91 |
| | | Ethane | Gg | | IE | IE | | IE | IE | NA | NCV | IE,NA | NA | IE,NA | NO | IE,NA,NO | NA | IE,NA,NO |
| | | Naphtha | Gg | | IE | IE | | IE | IE | 45.01 | NCV | IE | 20.00 | IE | IE | IE | 0.99 | IE |
| | | Bitumen | Gg | | 267.87 | 151.11 | | 1.54 | 115.22 | 40.19 | NCV | 4 630.75 | 22.00 | 101.88 | 465.16 | -363.29 | 0.99 | -1 318.73 |
| | | Lubricants | Gg | | 52.26 | 101.84 | NO | -2.37 | -47.21 | 40.19 | NCV | -1 897.20 | 20.00 | -37.94 | 30.12 | -68.06 | 0.99 | -247.06 |
| | | Petroleum Coke | Gg | | 74.89 | 1.75 | | 2.09 | 71.06 | 31.00 | NCV | 2 202.81 | 27.50 | 60.58 | 38.07 | 22.51 | 0.99 | 81.70 |
| | | Refinery Feedstocks | Gg | | 305.42 | 28.49 | | -58.21 | 335.14 | 42.50 | NCV | 14 243.38 | 20.00 | 284.87 | NO | 284.87 | 0.99 | 1 034.07 |
| | | Other Oil | Gg | | 63.34 | 156.88 | | 6.81 | -100.35 | 40.19 | NCV | -4 033.11 | 20.00 | -80.66 | 523.01 | -603.67 | 0.99 | -2 191.32 |
| Other Liquid Fossil | | | | | | | | | | | | NA | | NA | NA | NA | | NA |
| Liquid Fossil Totals | | | | | | | | | | | | 561 309.21 | | 11 255.65 | 1 056.36 | 10 199.30 | | 37 023.45 |
| Solid Fossil | Primary Fuels | Anthracite [(2)] | Gg | NO | NO | NO | | NO | NO | 28.00 | NCV | NO | 26.80 | NO | NO | NO | 0.98 | NO |
| | | Coking Coal | Gg | NO | 1 859.40 | NO | | -40.65 | 1 900.06 | 28.00 | NCV | 53 201.63 | 25.80 | 1 372.60 | 77.65 | 1 294.95 | 0.98 | 4 653.20 |
| | | Other Bituminous Coal | Gg | NO | 2 569.48 | 1.26 | NO | 264.95 | 2 303.26 | 27.88 | NCV | 64 207.55 | 25.80 | 1 656.55 | NO | 1 656.55 | 0.98 | 5 952.55 |
| | | Sub-bituminous Coal | Gg | NO | NO | NO | NO | NO | NO | NO | NCV | NO | 26.20 | NO | NO | NO | 0.98 | NO |
| | | Lignite | Gg | NO | 137.48 | NO | | 27.87 | 109.61 | 20.45 | NCV | 2 241.80 | 27.60 | 61.87 | NO | 61.87 | 0.98 | 222.33 |
| | | Oil Shale | Gg | NO | NO | NO | | NO | NO | NA | NCV | NA,NO | NA | NA,NO | NA | NA,NO | NA | NA,NO |
| | | Peat | Gg | 0.50 | NO | NO | | NO | 0.50 | 8.80 | NCV | 4.40 | 28.90 | 0.13 | NO | 0.13 | 0.98 | 0.46 |
| | Secondary Fuels | BKB[(3)] and Patent Fuel | Gg | | 31.19 | 0.60 | | -24.53 | 55.12 | 19.30 | NCV | 1 063.72 | 25.80 | 27.44 | NO | 27.44 | 0.98 | 98.62 |
| | | Coke Oven/Gas Coke | Gg | | 1 437.63 | 5.15 | | 78.69 | 1 353.79 | 28.20 | NCV | 38 176.81 | 29.50 | 1 126.22 | 6.82 | 1 119.40 | 0.98 | 4 022.37 |
| Other Solid Fossil | | | | | | | | | | | | NA | | NA | NA | NA | | NA |
| Solid Fossil Totals | | | | | | | | | | | | 158 895.92 | | 4 244.82 | 84.47 | 4 160.35 | | 14 949.53 |
| Gaseous Fossil | | Natural Gas (Dry) | TJ | 67 181.03 | ######## | ######## | | 11 020.24 | 295 160.89 | 1.00 | NCV | 295 160.89 | 15.30 | 4 515.96 | NO | 4 515.96 | 1.00 | 16 475.73 |
| Other Gaseous Fossil | | | | | | | | | | | | NA | | NA | NA | NA | | NA |
| Gaseous Fossil Totals | | | | | | | | | | | | 295 160.89 | | 4 515.96 | NA,NO | 4 515.96 | | 16 475.73 |
| **Total** | | | | | | | | | | | | 1 015 366.03 | | 20 016.43 | 1 140.82 | 18 875.61 | | 68 448.71 |
| Biomass total | | | | | | | | | | | | 170 616.31 | | 5 101.43 | NA,NO | 5 101.43 | | 16 481.11 |
| | | Solid Biomass | TJ | 164 558.63 | 17 626.60 | 13 268.76 | | NO | 168 916.47 | 1.00 | NCV | 168 916.47 | 29.90 | 5 050.60 | NO | 5 050.60 | 0.88 | 16 296.61 |
| | | Liquid Biomass | TJ | IE | IE | IE | | IE | IE | NA | NCV | IE,NA | NA | IE,NA | NA | IE,NA | NA | IE,NA |
| | | Gas Biomass | TJ | 1 699.84 | NO | NO | | NO | 1 699.84 | 1.00 | NCV | 1 699.84 | 29.90 | 50.83 | NO | 50.83 | 0.99 | 184.50 |

[(1)] To convert quantities in previous columns to energy units, use net calorific values (NCV) and write NCV in this column. If gross calorific values (GCV) are used, write GCV in this column.

[(2)] If data for Anthracite are not available separately, include with Other Bituminous Coal.

[(3)] BKB: Brown coal/peat briquettes.

**Documentation Box:**
Parties should provide detailed explanations on the fuel combustion sub-sector, including information relating to CO2 from the Reference approach, in the corresponding part of Chapter 3: Energy (CRF sub-sector 1.A) of the NIR. Use this documentation box to provide references to relevant sections of the NIR if any additional information and/or further details are needed to understand the content of this table.

# TABLE 1.A(c) COMPARISON OF CO2 EMISSIONS FROM FUEL COMBUSTION
**(Sheet 1 of 1)**

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| FUEL TYPES | REFERENCE APPROACH | | | SECTORAL APPROACH (1) | | DIFFERENCE (2) | |
|---|---|---|---|---|---|---|---|
| | Apparent energy consumption (3) (PJ) | Apparent energy consumption (excluding non-energy use and feedstocks) (4) (PJ) | $CO_2$ emissions (Gg) | Energy consumption (PJ) | $CO_2$ emissions (Gg) | Energy consumption (%) | $CO_2$ emissions (%) |
| Liquid Fuels (excluding international bunkers) | 561.31 | 483.54 | 37 023.45 | 498.43 | 35 605.08 | -2.99 | 3.98 |
| Solid Fuels (excluding international bunkers) (5) | 158.90 | 124.91 | 14 949.53 | 113.49 | 10 973.53 | 10.07 | 36.23 |
| Gaseous Fuels | 295.16 | 284.96 | 16 475.73 | 285.50 | 15 812.41 | -0.19 | 4.19 |
| Other (5) | NA | NE | NA | 30.27 | 1 752.47 | -100.00 | -100.00 |
| ***Total* (5)** | ***1 015.37*** | ***893.41*** | ***68 448.71*** | ***927.69*** | ***64 143.48*** | ***-3.70*** | ***6.71*** |

(1) "Sectoral approach" is used to indicate the approach (if different from the Reference approach) used by the Party to estimate $CO_2$ emissions from fuel combustion as reported in table 1.A(a), sheets 1-4.

(2) Difference in $CO_2$ emissions estimated by the Reference approach (RA) and the Sectoral approach (SA) (difference = 100% x ((RA-SA)/SA)). For calculating the difference in energy consumption between the two approaches, data as reported in the column "Apparent energy consumption (excluding non-energy use and feedstocks)" are used for the Reference approach.

(3) Apparent energy consumption data shown in this column are as in table 1.A(b).

(4) For the purposes of comparing apparent energy consumption from the Reference approach with energy consumption from the Sectoral approach, Parties should, in this column, subtract from the apparent energy consumption (Reference approach) the energy content corresponding to the fuel quantities used as feedstocks and/or for non-energy purposes, in accordance with the accounting of energy use in the Sectoral approach

(5) Emissions from biomass are not included.

**Note:** The Reporting Instructions of the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories require that estimates of $CO_2$ emissions from fuel combustion, derived using a detailed Sectoral approach, be compared to those from the Reference approach (Worksheet 1-1 of the IPCC Guidelines, Volume 2, Workbook). This comparison is to assist in verifying the Sectoral data.

**Documentation Box:**

Parties should provide detailed explanations on the fuel combustion sub-sector, including information related to the comparison of $CO_2$ emissions calculated using the Sectoral approach with those calculated using the Reference approach, in the corresponding part of Chapter 3: Energy (CRF sub-sector 1.A) of the NIR. Use this documentation box to provide references to relevant sections of the NIR if any additional information and/or further details are needed to understand the content of this table.

If the $CO_2$ emission estimates from the two approaches differ by more than 2 per cent, Parties should briefly explain the cause of this difference in this documentation box and provide a reference to relevant section of the NIR where this difference is explained in more detail.

1.AC Difference - Reference and Sectoral Approach/2007:Solid fuels CO2 emissions:

Reference Approach includes process emissions from blast furnaces which are included in category 2 C 1 and process emissions from carbide production which are included in category 2 B 4.

Liquid fuels CO2 emissions:

Heat values and carbon contents are sector and fuel specific. The reference approach considers a share of feedstocks used for plastics production and solvent production as non-carbon-stored. In the

Gaseous fuels CO2 emissions:

The Sectoral Aproach uses sector specific carbon contents and heating values (different from IPCC reference factors). Process emissions from ammonia-production are included in category 2 B 1.

Other fuels:

The sectoral approach considers waste as an additional fuel type (e.g. municipal solid waste and industrial fuel waste).

**TABLE 1.A(d) SECTORAL BACKGROUND DATA FOR ENERGY**
**Feedstocks and Non-Energy Use of Fuels**
**(Sheet 1 of 1)**

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Additional information [(a)]

| FUEL TYPE | ACTIVITY DATA AND RELATED INFORMATION | | IMPLIED EMISSION FACTOR | ESTIMATE | $CO_2$ not emitted | Subtracted from energy sector | Associated $CO_2$ emissions | Allocated under |
|---|---|---|---|---|---|---|---|---|
| | Fuel quantity (TJ) | Fraction of carbon stored | Carbon emission factor (t C/TJ) | Carbon stored in non-energy use of fuels (Gg C) | (Gg $CO_2$) | *(specify source category)* | (Gg) | *(Specify source category, e.g. Waste Incineration)* |
| Naphtha [(1)] | IE | 0.75 | IE | IE | IE | NA | NE | NE |
| Lubricants | 3 011.52 | 0.50 | 20.00 | 30.12 | 110.42 | NA | NE | NE |
| Bitumen | 21 143.73 | 1.00 | 22.00 | 465.16 | 1 705.59 | NA | NE | NE |
| Coal Oils and Tars (from Coking Coal) | 2 290.61 | 0.75 | 45.20 | 77.65 | 284.71 | NA | NE | NE |
| Natural Gas [(1)] | 10 115.35 | NO | NO | NO | NO | NA | NE | NE |
| Gas/Diesel Oil [(1)] | NO | 0.50 | NO | NO | NO | NA | NE | NE |
| LPG [(1)] | NO | 1.00 | NO | NO | NO | NA | NE | NE |
| Ethane [(1)] | NO | NO | NO | NO | NO | NA | NE | NE |
| Other *(please specify)* | | | | 529.83 | | | | |
| Coal | NO | 0.50 | NO | NO | NO | NA | NE | NE |
| Gasoline | NO | 0.50 | NO | NO | NO | NA | NE | NE |
| Butane | NO | 0.75 | NO | NO | NO | NA | NE | NE |
| Coke | 33 019.78 | 0.01 | 29.50 | 6.82 | 25.00 | NA | NE | NE |
| Other petroleum products | 34 867.18 | 0.75 | 20.00 | 523.01 | 1 917.70 | NA | NE | NE |

| | Carbon stored (Gg C) | $CO_2$ not emitted (Gg $CO_2$) |
|---|---|---|
| Total | 1 102.75 | 4 043.42 |
| Total amount of C and $CO_2$ from feedstocks and non-energy use of fuels that is included as emitted $CO_2$ in the Reference approach | 1 197.60 | 4 391.19 |

A fraction of energy carriers is stored in such products as plastics or asphalt. The non-stored fraction of the carbon in the energy carrier or product is oxidized, resulting in carbon dioxide emissions, either during use of the energy carriers in the industrial production (e.g. fertilizer production), or during use of the products (e.g. solvents, lubricants), or in both (e.g. monomers). To report associated emissions, use the above table.

[(1)] Enter data for those fuels that are used as feedstocks (fuel used as raw materials for manufacture of products such as plastics or fertilizers) or for other non-energy use (fuels not used as fuel or transformed into another fuel (e.g. bitumen for road construction, lubricants)).

[(a)] The fuel lines continue from the table to the left.

**Documentation box:**

• Parties should provide detailed explanations on the fuel combustion sub-sector, including information related to feedstocks, in the corresponding part of Chapter 3: Energy (CRF sub-sector 1.A) of the NIR. Use this documentation box to provide references to relevant sections of the NIR if any additional information and/or further details are needed to understand the content of this table.

• The above table is consistent with the IPCC Guidelines. Parties that take into account the emissions associated with the use and disposal of these feedstocks could continue to use their methodology, but should indicate this in this documentation box and provide a reference to the relevant section of the NIR where further

# TABLE 1.B.1 SECTORAL BACKGROUND DATA FOR ENERGY

## Fugitive Emissions from Solid Fuels

## (Sheet 1 of 1)

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| GREENHOUSE GAS SOURCE AND SINK CATEGORIES | ACTIVITY DATA | IMPLIED EMISSION FACTORS | | EMISSIONS | | |
|---|---|---|---|---|---|---|
| | Amount of fuel produced | $CH_4$ (1) | $CO_2$ | $CH_4$ Recovery/Flaring (2) | $CH_4$ Emissions (3) | $CO_2$ |
| | (Mt) | (kg/t) | | (Gg) | | |
| **1. B. 1. a. Coal Mining and Handling** | NO | | | NO | IE,NO | IE,NA,NO |
| i. Underground Mines(4) | NO | NO | NO | NO | NO | NO |
| Mining Activities | | NO | NO | NO | NO | NO |
| Post-Mining Activities | | NO | NO | NO | NO | NO |
| ii. Surface Mines(4) | NO | IE,NO | IE,NA | NO | IE,NO | IE,NA |
| Mining Activities | | NO | NA | NO | NO | NA |
| Post-Mining Activities | | IE | IE | NO | IE | IE |
| **1. B. 1. b. Solid Fuel Transformation** | 1.42 | IE | IE | NO | IE | IE |
| **1. B. 1. c. Other *(please specify)*** (5) | | | | NA | NA | NA |

(1) The IEFs for $CH_4$ are estimated on the basis of gross emissions as follows: ($CH_4$ emissions + amounts of $CH_4$ flared/recovered) / activity data.

(2) Amounts of CH4 drained (recovered), utilized or flared.

(3) Final CH4 emissions after subtracting the amounts of CH4 utilized or recovered.

(4) In accordance with the IPCC Guidelines, emissions from Mining Activities and Post-Mining Activities are calculated using the activity data of the amount of fuel produced for Underground Mines and Surface Mines.

(5) This category is to be used for reporting any other solid-fuel-related activities resulting in fugitive emissions, such as emissions from abandoned mines and waste piles.

**Note:** There are no clear references to the coverage of 1.B.1.b. and 1.B.1.c. in the IPCC Guidelines. Make sure that the emissions entered here are not reported elsewhere. If they are reported under another source category, indicate this by using notation key IE and making the necessary reference in Table 9 (completeness).

**Documentation box:**

- Parties should provide detailed explanations on the fugitive emissions from source category 1.B.1 Solid Fuels, in the corresponding part of Chapter 3: Energy (CRF source category 1.B.1) of the NIR. Use this documentation box to
- Regarding data on the amount of fuel produced entered in the above table, specify in this documentation box whether the fuel amount is based on the run-of-mine (ROM) production or on the saleable production.
- If entries are made for "Recovery/Flaring", indicate in this documentation box whether $CH_4$ is flared or recovered and provide a reference to the section in the NIR where further details on recovery/flaring can be found.
- If estimates are reported under 1.B.1.b. and 1.B.1.c., use this documentation box to provide information regarding activities covered under these categories and to provide a reference to the section in the NIR where the background information can be found.

**TABLE 1.B.2 SECTORAL BACKGROUND DATA FOR ENERGY**
**Fugitive Emissions from Oil, Natural Gas and Other Sources**
**(Sheet 1 of 1)**

Inventory 2007
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| GREENHOUSE GAS SOURCE AND SINK CATEGORIES | ACTIVITY DATA [1] | | | IMPLIED EMISSION FACTORS | | | EMISSIONS | | |
|---|---|---|---|---|---|---|---|---|---|
| | Description [1] | Unit [1] | Value | $CO_2$ | $CH_4$ | $N_2O$ | $CO_2$ | $CH_4$ | $N_2O$ |
| | | | | (kg/unit) [2] | | | (Gg) | | |
| **1. B. 2. a. Oil [3]** | | | | | | | 142.00 | 5.89 | IE,NA |
| I. Exploration | *number of wells drilled* | number | 730.00 | IE | IE | IE | IE | IE | IE |
| ii. Production[4] | *Oil throughput* | Mt | 0.85 | 166 276 346.60 | 6 581 967.21 | | 142.00 | 5.62 | |
| iii. Transport | *oil loaded in tankers* | number | NA | IE | IE | | IE | IE | |
| iv. Refining / Storage | *Oil refined (SNAP 0401)* | Mt | 8 545.90 | NA | 31.66 | NA | NA | 0.27 | NA |
| v. Distribution of Oil Products | *Gasoline Consumption (SNAP* | Mt | 1.97 | NA | NA | | NA | NA | |
| vi. Other | *(specify)* | | NO | NO | NO | | NO | NO | |
| **1. B. 2. b. Natural Gas** | | | | | | | 95.04 | 27.70 | |
| i. Exploration | *(specify)* | | 1 848.00 | NA | IE | | NA | IE | |
| ii. Production [4] / Processing | *Gas throughput (a)* | 10^6 m^3 | 1 848.00 | 51 406.93 | IE | | 95.00 | IE | |
| iii. Transmission | *Pipelines length (km)* | km | 1 548.00 | 24.50 | 2 900.00 | | 0.04 | 4.49 | |
| iv. Distribution | *Distribution network length* | km | 35 720.00 | NA | 649.74 | | NA | 23.21 | |
| v. Other Leakage | *(e.g. PJ gas consumed)* | PJ | 2 885.78 | NO | NO | | NO | NO | |
| *at industrial plants and power stations* | *Gas consumed* | PJ | NE | NO | NO | | NO | NO | |
| *in residential and commercial sectors* | *Gas consumed* | PJ | NE | NO | NO | | NO | NO | |
| **1. B. 2. c. Venting [5]** | | | | | | | IE | IE | |
| i. Oil | *oil produced* | Mt | NA | IE | IE | | IE | IE | |
| ii. Gas | *gas produced* | PJ | NA | IE | IE | | IE | IE | |
| iii. Combined | *Oil Ptoduced* | Mt | NA | IE | IE | | IE | IE | |
| **Flaring** | | | | | | | IE | IE | IE |
| i. Oil | *Oil consumed* | Mtoe | NA | IE | IE | IE | IE | IE | IE |
| ii. Gas | *gas consumed* | PJ | NA | IE | IE | IE | IE | IE | IE |
| iii. Combined | *oil consumed* | Mt | NA | IE | IE | IE | IE | IE | IE |
| **1.B.2.d. Other *(please specify)* [6]** | | | | | | | NA | NA | NA |

(1) Specify the activity data used in the Description column (see examples). Specify the unit of the activity data in the Unit column using one of the following units: PJ, Tg, 10^6 m^3, 10^6 bbl/yr, km, number of sources (e.g. wells).
(2) The unit of the implied emission factor will depend on the unit of the activity data used, and is therefore not specified in this column.
(3) Use the category also to cover emissions from combined oil and gas production fields. Natural gas processing and distribution from these fields should be included under 1.B.2.b.ii and 1.B.2.b.iv, respectively.
(4) If using default emission factors, these categories will include emissions from production other than venting and flaring.
(5) If using default emission factors, emissions from Venting and Flaring from all oil and gas production should be accounted for under Venting.
(6) For example, fugitive $CO_2$ emissions from production of geothermal power could be reported here.

**Documentation box:**
- Parties should provide detailed explanations on the fugitive emissions from source category 1.B.2 Oil and Natural Gas, in the corresponding part of Chapter 3: Energy (CRF source category 1.B.2) of the NIR. Use this documentation box to provide references to relevant sections of the NIR if any additional information and/or further details are needed to understand the content of this table.
- Regarding data on the amount of fuel produced entered in this table, specify in this documentation box whether the fuel amount is based on the raw material production or on the saleable production. Note cases where more than one type of activity data is used to estimate
- Venting and Flaring: Parties using the IPCC software could report venting and flaring emissions together, indicating this in this documentation box.
- If estimates are reported under "1.B.2.d Other", use this documentation box to provide information regarding activities covered under this category and to provide a reference to the section in the NIR where background information can be found.

# TABLE 1.C SECTORAL BACKGROUND DATA FOR ENERGY

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## International Bunkers and Multilateral Operations

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## (Sheet 1 of 1)

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| GREENHOUSE GAS SOURCE AND SINK CATEGORIES | ACTIVITY DATA | IMPLIED EMISSION FACTORS | | | EMISSIONS | | |
|---|---|---|---|---|---|---|---|
| | Consumption | $CO_2$ | $CH_4$ | $N_2O$ | $CO_2$ | $CH_4$ | $N_2O$ |
| | (TJ) | (t/TJ) | | | (Gg) | | |
| **Aviation Bunkers** | 29 880.63 | | | | 2 175.79 | 0.04 | 0.07 |
| Jet Kerosene | 29 880.63 | 72.82 | 0.00 | 0.00 | 2 175.79 | 0.04 | 0.07 |
| Gasoline | NO | NO | NO | NO | NO | NO | NO |
| **Marine Bunkers** | NA,NO | | | | NA,NO | NA,NO | NA,NO |
| Gasoline | NO | NO | NO | NO | NO | NO | NO |
| Gas/Diesel Oil | NO | NO | NO | NO | NO | NO | NO |
| Residual Fuel Oil | NO | NO | NO | NO | NO | NO | NO |
| Lubricants | NO | NO | NO | NO | NO | NO | NO |
| Coal | NO | NO | NO | NO | NO | NO | NO |
| Other *(please specify)* | NA | | | | NA | NA | NA |
| **Multilateral Operations** [(1)] | NO | NO | NO | NO | NO | NO | NO |

**Additional information**

| Fuel consumption | Distribution [(a)] (per cent) | |
|---|---|---|
| | Domestic | International |
| Aviation | 3.28 | 96.72 |
| Marine | 100.00 | NA,NO |

[(a)] For calculating the allocation of fuel consumption, the sums of fuel consumption for domestic navigation and aviation (table 1.A(a)) and for international bunkers (table 1.C) are used.

[(1)] Parties may choose to report or not report the activity data and implied emission factors for multilateral operations consistent with the principle of confidentiality stated in
In any case, Parties should report the emissions from multilateral operations, where available, under the Memo Items section of the Summary tables and in the Sectoral report table for energy.

**Note:** In accordance with the IPCC Guidelines, international aviation and

**Documentation box:**

• Parties should provide detailed explanations on the fuel combustion sub-sector, including international bunker fuels, in the corresponding part of Chapter 3: Energy (CRF sub-sector 1.A) of the NIR. Use this documentation box to provide references to relevant sections of the NIR if any additional information and/or further details are needed to understand the content of this table.

• Provide in this documentation box a brief explanation on how the consumption of international marine and aviation bunker fuels was estimated and separated from domestic consumption, and include a reference to the section of the NIR where the explanation is provided in more detail.

## TABLE 2(I) SECTORAL REPORT FOR INDUSTRIAL PROCESSES
## (Sheet 1 of 2)

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| GREENHOUSE GAS SOURCE AND SINK CATEGORIES | $CO_2$ | $CH_4$ | $N_2O$ | HFCs[(1)] | | PFCs[(1)] | | $SF_6$ | | $NO_x$ | CO | NMVOC | $SO_2$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | P | A | P | A | P | A | | | | |
| | (Gg) | | | $CO_2$ equivalent (Gg) | | | | | | (Gg) | | | |
| **Total Industrial Processes** | 9 535.22 | 0.91 | 0.87 | 1 372.88 | 860.63 | 451.77 | 182.71 | 0.02 | 0.02 | 1.71 | 24.70 | 4.90 | 1.22 |
| **A. Mineral Products** | 3 505.54 | IE,NA | IE,NA | | | | | | | IE,NA | 9.78 | IE,NA | IE,NA |
| 1. Cement Production | 2 130.78 | | | | | | | | | | | | NA |
| 2. Lime Production | 595.66 | | | | | | | | | | | | |
| 3. Limestone and Dolomite Use | 302.51 | | | | | | | | | | | | |
| 4. Soda Ash Production and Use | 17.20 | | | | | | | | | | | | |
| 5. Asphalt Roofing | IE | | | | | | | | | | 9.78 | IE | |
| 6. Road Paving with Asphalt | IE | | | | | | | | | NA | NA | IE | NA |
| 7. Other *(as specified in table 2(I).A-G)* | 459.41 | IE,NA | IE,NA | | | | | | | IE,NA | IE,NA | IE,NA | IE,NA |
| Glass Production | IE | IE | IE | | | | | | | IE | IE | IE | IE |
| Sinter Production | 329.47 | NA | NA | | | | | | | NA | NA | NA | NA |
| Bricks and Tiles (decarbonizing) | 129.94 | NA | NA | | | | | | | NA | NA | NA | NA |
| **B. Chemical Industry** | 530.62 | 0.90 | 0.87 | NO | NO | NO | NO | NO | NO | 0.34 | 11.15 | 1.32 | 0.77 |
| 1. Ammonia Production | 473.39 | 0.14 | NA | | | | | | | 0.18 | 0.08 | IE | NA |
| 2. Nitric Acid Production | | | 0.87 | | | | | | | 0.14 | | | |
| 3. Adipic Acid Production | NO | | NO | | | | | | | NO | NO | NO | |
| 4. Carbide Production | 36.29 | NA,NO | | | | | | | | NA | NA | NA | NA |
| 5. Other *(as specified in table 2(I).A-G)* | 20.95 | 0.76 | NA,NO | NO | NA,NO | NO | NA,NO | NO | NO | 0.03 | 11.07 | 1.32 | 0.77 |
| Carbon Black | | NO | | | | | | | | | | | |
| Ethylene | NA | 0.50 | NA | | | | | | | | | | |
| Dichloroethylene | | NO | | | | | | | | | | | |
| Styrene | | NO | | | | | | | | | | | |
| Methanol | | NO | | | | | | | | | | | |
| Other Chemical Industry | 20.59 | 0.26 | NA | NO | NO | NO | NO | NO | NO | 0.03 | 11.07 | 1.32 | 0.77 |
| CO2 from nitric acid production | 0.36 | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| **C. Metal Production** | 5 499.05 | 0.00 | NA | NO | NO | NO | NO | NA,NO | NO | 0.11 | 2.85 | 0.49 | 0.46 |
| 1. Iron and Steel Production | 5 482.04 | 0.00 | | | | | | | | 0.09 | 2.53 | 0.31 | 0.06 |
| 2. Ferroalloys Production | 17.01 | NA | | | | | | | | NA | NA | NA | NA |
| 3. Aluminium Production | NO | NO | | | | NO | NO | | | NO | NO | NO | NO |
| 4. $SF_6$ Used in Aluminium and Magnesium Foundries | | | | | | | | NA | NO | | | | |
| 5. Other *(as specified in table 2(I).A-G)* | NA | NA | NA | NO | NA,NO | NO | NA,NO | NO | NO | 0.02 | 0.32 | 0.18 | 0.40 |
| Non-ferrous metals | NA | NA | NA | NO | NO | NO | NO | NO | NO | 0.02 | 0.32 | 0.18 | 0.40 |

**Note:** P = Potential emissions based on Tier 1 approach of the IPCC Guidelines. A = Actual emissions based on Tier 2 approach of the IPCC Guidelines. This applies only to source categories where methods exist for both tiers.

[(1)] The emissions of HFCs and PFCs are to be expressed as $CO_2$ equivalent emissions. Data on disaggregated emissions of HFCs and PFCs are to be provided in Table 2(II).

## TABLE 2(I) SECTORAL REPORT FOR INDUSTRIAL PROCESSES
## (Sheet 2 of 2)

Inventory 2007
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| GREENHOUSE GAS SOURCE AND SINK CATEGORIES | $CO_2$ | $CH_4$ | $N_2O$ | HFCs[(1)] | | PFCs[(1)] | | $SF_6$ | | $NO_x$ | CO | NMVOC | $SO_2$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | P | A | P | A | P | A | | | | |
| | (Gg) | | | $CO_2$ equivalent (Gg) | | | | (Gg) | | | | | |
| **D. Other Production** | NA | | | | | | | | | 1.26 | 0.91 | 3.08 | NA |
| 1. Pulp and Paper | | | | | | | | | | 1.26 | 0.91 | 0.92 | NA |
| 2. Food and Drink[(2)] | NA | | | | | | | | | | | 2.16 | |
| **E. Production of Halocarbons and $SF_6$** | | | | | NA | | NA | | NA | | | | |
| 1. By-product Emissions | | | | | NA | | NA | | NA | | | | |
| Production of HCFC-22 | | | | | NA | | | | | | | | |
| Other | | | | | NA | | NA | | NA | | | | |
| 2. Fugitive Emissions | | | | | NA | | NA | | NA | | | | |
| 3. Other *(as specified in table 2(II))* | | | | | NA | | NA | | NA | | | | |
| **F. Consumption of Halocarbons and $SF_6$** | | | | 1 372.88 | 860.63 | 451.77 | 182.71 | 0.02 | 0.02 | | | | |
| 1. Refrigeration and Air Conditioning Equipment | | | | NA | 691.74 | NA | NO | NA | NA | | | | |
| 2. Foam Blowing | | | | NA | 119.57 | NA | NO | NA | NA | | | | |
| 3. Fire Extinguishers | | | | NA | 29.92 | NA | 0.16 | NA | NA | | | | |
| 4. Aerosols/ Metered Dose Inhalers | | | | NA | 10.31 | NA | NO | NA | NA | | | | |
| 5. Solvents | | | | NA | 2.02 | NA | NO | NA | NA | | | | |
| 6. Other applications using ODS[(3)] substitutes | | | | NA | NO | NA | NO | NA | NA | | | | |
| 7. Semiconductor Manufacture | | | | NA | 7.07 | NA | 182.55 | NA | 0.00 | | | | |
| 8. Electrical Equipment | | | | NA | NO | NA | NO | NA | 0.00 | | | | |
| 9. Other *(as specified in table 2(II)* | | | | NA | NA,NO | NA | NA,NO | NA | 0.01 | | | | |
| Double glaze windows | | | | NA | NA,NO | NA | NO | NA | 0.01 | | | | |
| Research and other use | | | | NA | NA,NO | NA | NO | NA | 0.00 | | | | |
| **G. Other *(as specified in tables 2(I).A-G and 2(II))*** | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |

**Note:** P = Potential emissions based on Tier 1 approach of the IPCC Guidelines. A = Actual emissions based on Tier 2 approach of the IPCC Guidelines. This applies only to source categories where methods exist for both tiers.

(1) The emissions of HFCs and PFCs are to be expressed as $CO_2$ equivalent emissions. Data on disaggregated emissions of HFCs and PFCs are to be provided in Table 2(II).

(2) $CO_2$ from Food and Drink Production (e.g. gasification of water) can be of biogenic or non-biogenic origin. Only information on $CO_2$ emissions of non-biogenic origin should be reported.

(3) ODS: ozone-depleting substances.

**Documentation box:**
Parties should provide detailed explanations on the industrial processes sector in Chapter 4: Industrial processes (CRF sector 2) of the NIR. Use this documentation box to provide references to relevant sections of the NIR if any additional information and/or further details are needed to understand the content of this table.

**TABLE 2(I).A-G SECTORAL BACKGROUND DATA FOR INDUSTRIAL PROCESSES** Inventory 2007

**Emissions of $CO_2$, $CH_4$ and $N_2O$** Submission 2009 v1.1

**(Sheet 1 of 2)** AUSTRIA

| GREENHOUSE GAS SOURCE AND SINK CATEGORIES | ACTIVITY DATA | | IMPLIED EMISSION FACTORS [(2)] | | | EMISSIONS | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Production/Consumption quantity | | $CO_2$ | $CH_4$ | $N_2O$ | $CO_2$ | | $CH_4$ | | $N_2O$ | |
| | | | | | | Emissions[(3)] | Recovery[(4)] | Emissions[(3)] | Recovery[(4)] | Emissions[(3)] | Recovery[(4)] |
| | Description [(1)] | (kt) | (t/t) | | | (Gg) | | | | | |
| **A. Mineral Products** | | | | | | 3 505.54 | IE,NO | IE,NA | NO | IE,NA | NO |
| 1. Cement Production | Clinker Production [kt] | 3 992.38 | 0.53 | | | 2 130.78 | NO | | | | |
| 2. Lime Production | Lime Produced [kt] | 782.00 | 0.76 | | | 595.66 | NO | | | | |
| 3. Limestone and Dolomite Use | Limestone and Dolomite used [kt] | 696.91 | 0.43 | | | 302.51 | NO | | | | |
| 4. Soda Ash | | | | | | 17.20 | IE,NO | | | | |
| Soda Ash Production | Soda Ash Production | NA | IE | | | IE | IE | | | | |
| Soda Ash Use | Soda Ash Used [kt] | 41.54 | 0.41 | | | 17.20 | NO | | | | |
| 5. Asphalt Roofing | Roofing Material Production [Mio m2] | 27.95 | IE | | | IE | NO | | | | |
| 6. Road Paving with Asphalt | Asphalt Production [kt] | 1 469.31 | IE | | | IE | NO | | | | |
| 7. Other *(please specify)* | | | | | | 459.41 | NO | IE,NA | NO | IE,NA | NO |
| Glass Production | (specify) | IE | IE | IE | IE | IE | NO | IE | NO | IE | NO |
| Sinter Production | MgCO3 sintered [kt] | 691.99 | 0.48 | NA | NA | 329.47 | NO | NA | NO | NA | NO |
| Bricks and Tiles (decarbonizing) | Bricks Production [kt] | 2 331.71 | 0.06 | NA | NA | 129.94 | NO | NA | NO | NA | NO |
| **B. Chemical Industry** | | | | | | 530.62 | NO | 0.90 | NO | 0.87 | NO |
| 1. Ammonia Production[(5)] | Ammonia Production [kt] | 441.30 | 1.07 | 0.00 | NA | 473.39 | NO | 0.14 | NO | NA | NO |
| 2. Nitric Acid Production | Nitric Acid Production [kt] | 499.40 | | | 0.00 | | | | | 0.87 | NO |
| 3. Adipic Acid Production | Adipic Acid Production | NO | NO | | NO | NO | NO | | | NO | NO |
| 4. Carbide Production | Carbide Production | 28.00 | 1.30 | NA,NO | | 36.29 | NO | NA,NO | NO | | |
| Silicon Carbide | Silicon Carbide Production | NO | NO | NO | | NO | NO | NO | NO | | |
| Calcium Carbide | Calcium Carbide Production | 28.00 | 1.30 | NA | | 36.29 | NO | NA | NO | | |
| 5. Other *(please specify)* | | | | | | 20.95 | NO | 0.76 | NO | NA,NO | NO |
| Carbon Black | Carbon Black Production | NO | | NO | | | | NO | NO | | |
| Ethylene | Ethylene Production [kt] | 500.00 | NA | 0.00 | NA | NA | NO | 0.50 | NO | NA | NO |
| Dichloroethylene | Dichloroethylene Production | NO | | NO | | | | NO | NO | | |
| Styrene | Styrene Production [kt] | NO | | NO | | | | NO | NO | | |
| Methanol | Methanol Production | NO | | NO | | | | NO | NO | | |
| Other Chemical Industry | Other Chemical Products [kt] | NA | NA | NA | NA | 20.59 | NO | 0.26 | NO | NA | NO |
| CO2 from nitric acid production | (Specify) | NO | NO | NO | NO | 0.36 | NO | NO | NO | NO | NO |

(1) Where the IPCC Guidelines provide options for activity data, e.g. cement production or clinker production for estimating the emissions from Cement Production, specify the activity data used (as shown in the example in parentheses) in order to make the choice of emission factor more transparent and to facilitate comparisons of implied emission factors.

(2) The implied emission factors (IEF) are estimated on the basis of gross emissions as follows: IEF = (emissions plus amounts recovered, oxidized, destroyed or transformed) / activity data.

(3) Final emissions are to be reported (after subtracting the amounts of emission recovery, oxidation, destruction or transformation).

(4) Amounts of emission recovery, oxidation, destruction or transformation.

(5) To avoid double counting, make offsetting deductions for fuel consumption (e.g. natural gas) in Ammonia Production, first for feedstock use of the fuel, and then for a sequestering use of the feedstock.

**TABLE 2(I).A-G SECTORAL BACKGROUND DATA FOR INDUSTRIAL PROCESSES**
**Emissions of $CO_2$, $CH_4$ and $N_2O$**
**(Sheet 2 of 2)**

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| GREENHOUSE GAS SOURCE AND SINK CATEGORIES | ACTIVITY DATA | | IMPLIED EMISSION FACTORS [2] | | | EMISSIONS | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Production/Consumption quantity | | $CO_2$ | $CH_4$ | $N_2O$ | $CO_2$ | | $CH_4$ | | $N_2O$ | |
| | | | | | | Emissions[3] | Recovery[4] | Emissions[3] | Recovery[4] | Emissions[3] | Recovery[4] |
| | Description [1] | (kt) | (t/t) | | | (Gg) | | | | | |
| **C. Metal Production** | | | | | | 5 499.05 | NO | 0.00 | NO | NA | NO |
| 1. Iron and Steel Production | | | 0.32 | 0.00 | | 5 482.04 | NO | 0.00 | NO | | |
| Steel | Steel Production [kt] | 7 578.00 | 0.11 | IE | | 825.74 | NO | IE | NO | | |
| Pig Iron | Iron Production [kt] | 5 887.71 | 0.78 | IE | | 4 598.00 | NO | IE | NO | | |
| Sinter | Sinter Production [kt] | 3 527.74 | IE | IE | | IE | NO | IE | NO | | |
| Coke | Coke Production [kt] | 1.42 | IE | IE | | IE | NO | IE | NO | | |
| Other *(please specify)* | | | | | | 58.31 | NO | 0.00 | NO | | |
| Electric Furnace Steel production | Electric Furnace Steel Production | 706.50 | 0.08 | 0.00 | | 58.31 | NO | 0.00 | NO | | |
| Rolling mills | Product | 6 871.50 | NA | 0.00 | | NA | NO | 0.00 | NO | | |
| Foundries | Product | 223.11 | NA | NA | | NA | NO | NA | NO | | |
| 2. Ferroalloys Production | Ferroalloys Production [kt] | 12.51 | 1.36 | NA | | 17.01 | NO | NA | NO | | |
| 3. Aluminium Production | Aluminium production [kt] | NO | NO | NO | | NO | NO | NO | NO | | |
| 4. $SF_6$ Used in Aluminium and Magnesium Foundries | | | | | | | | | | | |
| 5. Other *(please specify)* | | | | | | NA | NO | NA | NO | NA | NO |
| Non-ferrous metals | Non-ferrous metal Production [kt] | 133.91 | NA | NA | NA | NA | NO | NA | NO | NA | NO |
| **D. Other Production** | | | | | | NA | NO | | | | |
| 1. Pulp and Paper | | | | | | | | | | | |
| 2. Food and Drink | Bread, Wine, Beer, Spirits Production [kt] | 1 454.22 | NA | | | NA | NO | | | | |
| **G. Other** *(please specify)* | | | | | | NA | NA | NA | NA | NA | NA |

[1] Where the IPCC Guidelines provide options for activity data, e.g. cement production or clinker production for estimating the emissions from Cement Production, specify the activity data used (as shown in the example in parentheses) in order to make the choice of emission factor more transparent and to facilitate comparisons of implied emission factors.

[2] The implied emission factors (IEF) are estimated on the basis of gross emissions as follows: IEF = (emissions + amounts recovered, oxidized, destroyed or transformed) / activity data.

[3] Final emissions are to be reported (after subtracting the amounts of emission recovery, oxidation, destruction or transformation).

[4] Amounts of emission recovery, oxidation, destruction or transformation.

**Documentation box:**

• Parties should provide detailed explanations on the industrial processes sector in Chapter 4: Industrial processes (CRF sector 2) of the NIR. Use this documentation box to provide references to relevant sections of the NIR if any additional information and/or further details are needed to understand the content of this table.

• In relation to metal production, more specific information (e.g. data on virgin and recycled steel production) could be provided in this documentation box, or in the NIR, together with a reference to the relevant section.

• Confidentiality: Where only aggregate figures for activity data are provided, e.g. due to reasons of confidentiality, a note indicating this should be provided in this documentation box.

**TABLE 2(II) SECTORAL REPORT FOR INDUSTRIAL PROCESSES - EMISSIONS OF HFCs, PFCs AND $SF_6$**
**(Sheet 1 of 2)**

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| GREENHOUSE GAS SOURCE AND SINK CATEGORIES | HFC-23 | HFC-32 | HFC-41 | HFC-43-10mee | HFC-125 | HFC-134 | HFC-134a | HFC-152a | HFC-143 | HFC-143a | HFC-227ea | HFC-236fa | HFC-245ca | Unspecified mix of listed HFCs [1] | Total HFCs | $CF_4$ | $C_2F_6$ | $C_3F_8$ | $C_4F_{10}$ | $c\text{-}C_4F_8$ | $C_5F_{12}$ | $C_6F_{14}$ | Unspecified mix of listed PFCs [1] | Total PFCs | $SF_6$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | (t)[2] | | | | | | | | | | | | | $CO_2$ equivalent (Gg) | $CO_2$ equivalent (Gg) | (t)[2] | | | | | | | $CO_2$ equivalent (Gg) | $CO_2$ equivalent (Gg) | (t)[2] |
| **Total Actual Emissions of Halocarbons (by chemical) and $SF_6$** | 1.90 | 6.82 | NA,NO | 1.55 | 63.73 | NA,NO | 283.45 | 392.24 | NA,NO | 53.96 | 2.65 | NA,NO | NA,NO | 17.38 | | IE,NA,NO | IE,NA,NO | IE,NA,NO | 0.02 | IE,NA,NO | NA,NO | NA,NO | 182.55 | | 17.14 |
| **C. Metal Production** | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | | NO | NO | NO | NO | NO | NO | NO | NO | | NO |
| Aluminium Production | | | | | | | | | | | | | | | | NO | NO | NO | NO | NO | NO | NO | NO | | |
| $SF_6$ Used in Aluminium Foundries | | | | | | | | | | | | | | | | | | | | | | | | | NO |
| $SF_6$ Used in Magnesium Foundries | | | | | | | | | | | | | | | | | | | | | | | | | NO |
| **E. Production of Halocarbons and $SF_6$** | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | | NA | NA | NA | NA | NA | NA | NA | NA | | NA |
| 1. By-product Emissions | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | | NA | NA | NA | NA | NA | NA | NA | NA | | NA |
| Production of HCFC-22 | NA | | | | | | | | | | | | | | | | | | | | | | | | |
| Other | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | | NA | NA | NA | NA | NA | NA | NA | NA | | NA |
| 2. Fugitive Emissions | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | | NA | NA | NA | NA | NA | NA | NA | NA | | NA |
| 3. Other *(as specified in table 2(II).C,E)* | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | | NA | NA | NA | NA | NA | NA | NA | NA | | NA |
| **F(a). Consumption of Halocarbons and $SF_6$ (actual** | 1.90 | 6.82 | NO | 1.55 | 63.73 | NO | 283.45 | 392.24 | NO | 53.96 | 2.65 | NO | NO | 17.38 | | IE,NO | IE,NO | IE,NO | 0.02 | IE,NO | NO | NO | 182.55 | | 17.14 |
| 1. Refrigeration and Air Conditioning Equipment | NO | 6.82 | NO | NO | 63.73 | NO | 233.62 | 0.89 | NO | 53.96 | NO | NO | NO | NO | | NO | NO | NO | NO | NO | NO | NO | NO | | NA |
| 2. Foam Blowing | NO | NO | NO | NO | NO | NO | 49.83 | 391.35 | NO | NO | NO | NO | NO | NO | | NO | NO | NO | NO | NO | NO | NO | NO | | NA |
| 3. Fire Extinguishers | 1.90 | NO | NO | NO | NO | NO | NO | NO | NO | NO | 2.65 | NO | NO | NO | | NO | NO | NO | 0.02 | NO | NO | NO | NO | | NA |
| 4. Aerosols/Metered Dose Inhalers | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | 10.31 | | NO | NO | NO | NO | NO | NO | NO | NO | | NA |
| 5. Solvents | NO | NO | NO | 1.55 | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | | NO | NO | NO | NO | NO | NO | NO | NO | | NA |
| 6. Other applications using ODS[3] substitutes | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | | NO | NO | NO | NO | NO | NO | NO | NO | | NA |
| 7. Semiconductor Manufacture | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | 7.07 | | IE | IE | IE | NO | IE | NO | NO | 182.55 | | 4.15 |
| 8. Electrical Equipment | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | | NO | NO | NO | NO | NO | NO | NO | NO | | 1.70 |
| 9. Other *(as specified in table 2(II)F)* | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NA | | NO | NO | NO | NO | NO | NO | NO | NO | | 11.29 |
| Double glaze windows | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NA | | NO | NO | NO | NO | NO | NO | NO | NO | | 11.27 |
| Research and other use | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NA | | NO | NO | NO | NO | NO | NO | NO | NO | | 0.02 |
| **G. Other *(please specify)*** | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | | NA | NA | NA | NA | NA | NA | NA | NA | | NA |

**Note:** All footnotes for this table are given at the end of the table on sheet 2.

**Note:** Gases with global warming potential (GWP) values not yet agreed upon by the Conference of the Parties should be reported in table 9(b).

**TABLE 2(II) SECTORAL REPORT FOR INDUSTRIAL PROCESSES - EMISSIONS OF HFCs, PFCs AND $SF_6$**

**(Sheet 2 of 2)**

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| GREENHOUSE GAS SOURCE AND SINK CATEGORIES | HFC-23 | HFC-32 | HFC-41 | HFC-43-10mee | HFC-125 | HFC-134 | HFC-134a | HFC-152a | HFC-143 | HFC-143a | HFC-227ea | HFC-236fa | HFC-245ca | Unspecified mix of listed HFCs [1] | Total HFCs | $CF_4$ | $C_2F_6$ | $C_3F_8$ | $C_4F_{10}$ | $c\text{-}C_4F_8$ | $C_5F_{12}$ | $C_6F_{14}$ | Unspecified mix of listed PFCs [1] | Total PFCs | $SF_6$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | (t)[2] | | | | | | | | | | | | | $CO_2$ equivalent (Gg) | $CO_2$ equivalent (Gg) | (t)[2] | | | | | | | $CO_2$ equivalent (Gg) | $CO_2$ equivalent (Gg) | (t)[2] |
| **F(p). Total Potential Emissions of Halocarbons (by chemical) and $SF_6$ [4]** | 1.90 | 15.94 | NE,NO | 1.57 | 122.32 | NE,NO | 380.86 | 293.79 | NE,NO | 106.35 | 8.00 | NE,NO | NE,NO | 32.16 | | IE,NE,NO | IE,NE,NO | IE,NE,NO | IE,NE,NO | IE,NO | NO | NO | 451.77 | | 18.42 |
| Production[5] | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | | NO | NO | NO | NO | NO | NO | NO | NO | | NO |
| Import: | 1.90 | 15.94 | NE,NO | 1.57 | 122.32 | NE,NO | 380.86 | 293.79 | NE,NO | 106.35 | 8.00 | NE,NO | NE,NO | 32.16 | | IE,NO | IE,NO | IE,NO | NO | IE,NO | NO | NO | 451.77 | | 18.42 |
| In bulk | 1.90 | 15.94 | NO | 1.57 | 122.32 | NO | 380.86 | 293.79 | NO | 106.35 | 8.00 | NO | NO | 32.16 | | IE | IE | IE | NO | IE | NO | NO | 451.77 | | 18.42 |
| In products [6] | IE | IE | NE | NE | IE | NE | IE | IE | NE | IE | IE | NE | NE | NO | | NO | NO | NO | NO | NO | NO | NO | NO | | IE |
| Export: | IE | IE | NE,NO | NE,NO | IE | NE,NO | IE | IE | NE,NO | IE | IE | NE,NO | NE,NO | NO | | IE,NO | IE,NO | IE,NO | IE,NO | NO | NO | NO | NO | | IE |
| In bulk | IE | IE | NO | NO | IE | NO | IE | IE | NO | IE | IE | NO | NO | NO | | IE | IE | IE | IE | NO | NO | NO | NO | | IE |
| In products [6] | IE | IE | NE | NE | IE | NE | IE | IE | NE | IE | IE | NE | NE | NO | | NO | NO | NO | NO | NO | NO | NO | NO | | IE |
| Destroyed amount | NE | NE | NO | NO | NE | NO | NE | NE | NO | NE | NE | NO | NO | NO | | NE | NE | NE | NE | NO | NO | NO | NO | | NE |
| **GWP values used** | **11700** | **650** | **150** | **1300** | **2800** | **1000** | **1300** | **140** | **300** | **3800** | **2900** | **6300** | **560** | | | **6500** | **9200** | **7000** | **7000** | **8700** | **7500** | **7400** | | | **23900** |
| **Total Actual Emissions [7] ($CO_2$ equivalent (Gg))** | 22.24 | 4.43 | NA,NO | 2.02 | 178.45 | NA,NO | 368.48 | 54.91 | NA,NO | 205.04 | 7.68 | NA,NO | NA,NO | 17.38 | 860.63 | IE,NA,NO | IE,NA,NO | IE,NA,NO | 0.16 | IE,NA,NO | NA,NO | NA,NO | 182.55 | 182.71 | 409.58 |
| C. Metal Production | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| E. Production of Halocarbons and $SF_6$ | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| F(a). Consumption of Halocarbons and $SF_6$ | 22.24 | 4.43 | NO | 2.02 | 178.45 | NO | 368.48 | 54.91 | NO | 205.04 | 7.68 | NO | NO | 17.38 | 860.63 | IE,NO | IE,NO | IE,NO | 0.16 | IE,NO | NO | NO | 182.55 | 182.71 | 409.58 |
| G. Other | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| **Ratio of Potential/Actual Emissions from Consumption of Halocarbons and $SF_6$** | | | | | | | | | | | | | | | | | | | | | | | | | |
| Actual emissions - F(a) (Gg $CO_2$ eq.) | 22.24 | 4.43 | NO | 2.02 | 178.45 | NO | 368.48 | 54.91 | NO | 205.04 | 7.68 | NO | NO | 17.38 | 860.63 | IE,NO | IE,NO | IE,NO | 0.16 | IE,NO | NO | NO | 182.55 | 182.71 | 409.58 |
| Potential emissions - F(p) [8] (Gg $CO_2$ eq.) | 22.23 | 10.36 | NE,NO | 2.05 | 342.49 | NE,NO | 495.12 | 41.13 | NE,NO | 404.15 | 23.20 | NE,NO | NE,NO | 32.16 | 1 372.88 | IE,NE,NO | IE,NE,NO | IE,NE,NO | IE,NE,NO | IE,NO | NO | NO | 451.77 | 451.77 | 440.14 |
| Potential/Actual emissions ratio | 1.00 | 2.34 | NE,NO | 1.02 | 1.92 | NE,NO | 1.34 | 0.75 | NE,NO | 1.97 | 3.02 | NE,NO | NE,NO | 1.85 | 1.60 | IE,NE,NO | IE,NE,NO | IE,NE,NO | IE,NE,NO | IE,NO | NO | NO | 2.47 | 2.47 | 1.07 |

(1) In accordance with the UNFCCC reporting guidelines, HFC and PFC emissions should be reported for each relevant chemical. However, if it is not possible to report values for each chemical (i.e. mixtures, confidential data, lack of disaggregation), these columns could be used for reporting aggregate figures for HFCs and PFCs, respectively. Note that the unit used for these columns

(2) Note that the units used in this table differ from those used in the rest of the Sectoral report tables, i.e. *t* instead of *Gg*.

(3) ODS: ozone-depleting substances

(4) Potential emissions of each chemical of halocarbons and $SF_6$ estimated using Tier 1a or Tier 1b of the IPCC Guidelines (Volume 3. Reference Manual, pp. 2.47-2.50). Where potential emission estimates are available in a disaggregated manner for the source categories F.1 to F.9, these should be reported in the NIR and a reference should be provided in the documentation box. Use table Summary 3 to indicate whether Tier 1a or Tier 1b was used.

(5) Production refers to production of new chemicals. Recycled substances could be included here, but avoid double counting of emissions. An indication as to whether recycled substances are included should be provided in the documentation box to this table.

(6) Relevant only for Tier 1b.

(7) Total actual emissions equal the sum of the actual emissions of each halocarbon and $SF_6$ from the source categories 2.C, 2.E, 2.F and 2.G as reported in sheet 1 of this table multiplied by the corresponding GWP values.

(8) Potential emissions of each halocarbon and $SF_6$ taken from row F(p) multiplied by the corresponding GWP values.

**Note:** As stated in the UNFCCC reporting guidelines, Parties should report actual emissions of HFCs, PFCs and $SF_6$, where data are available, providing disaggregated data by chemical and source category in units of mass and in $CO_2$ equivalent. Parties reporting actual emissions should also report potential emissions for the sources where the concept of potential emissions applies, for reasons of transparency and comparability. Gases with GWP values not yet agreed upon by the COP should be reported in Table 9 (b).

| **Documentation box:** |
|---|
| • Parties should provide detailed explanations on the industrial processes sector in Chapter 4: Industrial processes (CRF sector 2) of the NIR. Use this documentation box to provide references to relevant sections of the NIR if any additional information and/or further details are needed to understand the content of this table. |
| • If estimates are reported under "2.G Other", use this documentation box to provide information regarding activities covered under this category and to provide reference to the section in the NIR where background information can be found. |

**TABLE 2(II).C SECTORAL BACKGROUND DATA FOR INDUSTRIAL PROCESSES**
**Metal Production**
**(Sheet 1 of 1)**

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| GREENHOUSE GAS SOURCE AND SINK CATEGORIES | ACTIVITY DATA | | IMPLIED EMISSION FACTORS[(2)] | | | EMISSIONS | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | $CF_4$ | $C_2F_6$ | $SF_6$ | $CF_4$ | | $C_2F_6$ | | $SF_6$ | |
| | | | | | | Emissions[(3)] | Recovery[(4)] | Emissions[(3)] | Recovery[(4)] | Emissions[(3)] | Recovery[(4)] |
| | Description [(1)] | (t) | (kg/t) | | | (t) | | | | | |
| **C. PFCs and $SF_6$ from Metal Production** | | | | | | NO | NO | NO | NO | NO | NO |
| PFCs from Aluminium Production | Aluminium production | NO | NO | NO | | NO | NO | NO | NO | | |
| $SF_6$ used in Aluminium and Magnesium Foundries | | | | | | | | | | NO | NO |
| Aluminium Foundries | cast Aluminium [t] | C | | | NO | | | | | NO | NO |
| Magnesium Foundries | cast Magnesium [t] | 3 600.00 | | | NO | | | | | NO | NO |

(1) Specify the activity data used as shown in the examples in parentheses.

(2) The implied emission factors (IEFs) are estimated on the basis of gross emissions as follows: IEF = (emissions + amounts recovered, oxidized, destroyed or transformed) / activity data.

(3) Final emissions (after subtracting the amounts of emission recovery, oxidation, destruction or transformation).

(4) Amounts of emission recovery, oxidation, destruction or transformation.

**Documentation box:**
- Parties should provide detailed explanations on the industrial processes sector in Chapter 4: Industrial processes (CRF sector 2) of the NIR. Use this documentation box to provide references to relevant sections of the NIR if any additional information and/or further details are needed to understand the content of this table.
- Where only aggregate figures for activity data are provided, e.g. due to reasons of confidentiality (see footnote 1 to table 2(II)), a note indicating this should be provided in this documentation box.
- Where applying Tier 1b and country-specific methods, specify any other relevant activity data used in this documentation box, including a reference to the section of the NIR where more detailed information can be found.
- Use this documentation box for providing clarification on emission recovery, oxidation, destruction and/or transformation, and provide a reference to the section of the NIR where more detailed information can be found.

**TABLE 2(II).E SECTORAL BACKGROUND DATA FOR INDUSTRIAL PROCESSES**
**Production of Halocarbons and $SF_6$**
**(Sheet 1 of 1)**

Inventory 2007
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| GREENHOUSE GAS SOURCE AND SINK CATEGORIES | ACTIVITY DATA | | IMPLIED EMISSION FACTORS[2] | EMISSIONS | |
|---|---|---|---|---|---|
| | | | | Emissions[3] | Recovery[4] |
| | Description [1] | (t) | (kg/t) | (t) | |
| **E. Production of Halocarbons and $SF_6$** | | | | | |
| **1. By-product Emissions** | | | | | |
| Production of HCFC-22 | | | | | |
| HFC-23 | HFC-23 production | NO | NA | NA | NO |
| Other *(specify activity and chemical)* | | | | | |
| **2. Fugitive Emissions** *(specify activity and chemical)* | | | | | |
| HFCs | | | | NA | |
| HFC-23 | | | | NA | |
| HFC-32 | | | | NA | |
| HFC-41 | | | | NA | |
| HFC-43-10-mee | | | | NA | |
| HFC-125 | | | | NA | |
| HFC-134 | | | | NA | |
| HFC-134a | | | | NA | |
| HFC-152a | | | | NA | |
| HFC-143 | | | | NA | |
| HFC-143a | | | | NA | |
| HFC-227ea | | | | NA | |
| HFC-236fa | | | | NA | |
| HFC-245ca | | | | NA | |
| Unspecified mix of HFCs | | | | NA | |
| PFCs | | | | NA | |
| CF4 | | | | NA | |
| C2F6 | | | | NA | |
| C3F8 | | | | NA | |
| C4F10 | | | | NA | |
| c-C4F8 | | | | NA | |
| C5F12 | | | | NA | |
| C6F14 | | | | NA | |
| Unspecified mix of PFCs | | | | NA | |
| SF6 | | | | NA | |
| **3. Other** *(specify activity and chemical)* | | | | | |
| HFCs | | | | NA | |
| HFC-23 | | | | NA | |
| HFC-32 | | | | NA | |
| HFC-41 | | | | NA | |
| HFC-43-10-mee | | | | NA | |
| HFC-125 | | | | NA | |
| HFC-134 | | | | NA | |
| HFC-134a | | | | NA | |
| HFC-152a | | | | NA | |
| HFC-143 | | | | NA | |
| HFC-143a | | | | NA | |
| HFC-227ea | | | | NA | |
| HFC-236fa | | | | NA | |
| HFC-245ca | | | | NA | |
| Unspecified mix of HFCs | | | | NA | |
| PFCs | | | | NA | |
| CF4 | | | | NA | |
| C2F6 | | | | NA | |
| C3F8 | | | | NA | |
| C4F10 | | | | NA | |
| c-C4F8 | | | | NA | |
| C5F12 | | | | NA | |
| C6F14 | | | | NA | |
| Unspecified mix of PFCs | | | | NA | |
| SF6 | | | | NA | |

(1) Specify the activity data used as shown in the examples within parentheses.
(2) The implied emission factors (IEFs) are estimated on the basis of gross emissions as follows: IEF = (emissions + amounts recovered, oxidized, destroyed or transformed) / activity data.
(3) Final emissions are to be reported (after subtracting the amounts of emission recovery, oxidation, destruction or transformation).
(4) Amounts of emission recovery, oxidation, destruction or transformation.

**Documentation box:**
• Parties should provide detailed explanations on the industrial processes sector in Chapter 4: Industrial processes (CRF sector 2) of the NIR. Use this documentation box to provide references to relevant sections of the NIR if any additional
• Where only aggregate figures for activity data are provided, e.g. due to reasons of confidentiality (see footnote 1 to table 2(II)), a note indicating this should be provided in this documentation box.
• Where applying Tier 2 and country-specific methods, specify any other relevant activity data used in this documentation box, including a reference to the section of the NIR where more detailed information can be found.
• Use this documentation box for providing clarification on emission recovery, oxidation, destruction and/or transformation, and provide a reference to the section of the NIR where more detailed information can be found.

**TABLE 2(II).F SECTORAL BACKGROUND DATA FOR INDUSTRIAL PROCESSES**
**Consumption of Halocarbons and $SF_6$**
**(Sheet 1 of 2)**

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| GREENHOUSE GAS SOURCE AND SINK CATEGORIES | ACTIVITY DATA *Amount of fluid* | | | IMPLIED EMISSION FACTORS | | | EMISSIONS | | |
|---|---|---|---|---|---|---|---|---|---|
| | Filled into new manufactured products | In operating systems (average annual stocks) | Remaining in products at decommissioning | Product manufacturing factor | Product life factor | Disposal loss factor | From manufacturing | From stocks | From disposal |
| | (t) | | | (% per annum) | | | (t) | | |
| **1. Refrigeration**[(1)] | | | | | | | | | |
| **Air Conditioning Equipment** | | | | | | | | | |
| Domestic Refrigeration *(please specify chemical)*[(1)] | | | | | | | | | |
| HFC-134a | NO | 14.62 | 5.92 | NA | 1.50 | 20.00 | NA | 0.22 | 1.18 |
| Commercial Refrigeration | | | | | | | | | |
| HFC-134a | 4.00 | 40.64 | 3.44 | NA | 1.50 | 20.00 | NA | 0.61 | 0.69 |
| Transport Refrigeration | | | | | | | | | |
| HFC-134a | 5.00 | 29.14 | 2.15 | NA | 10.00 | 20.00 | NA | 2.91 | 0.43 |
| Industrial Refrigeration | | | | | | | | | |
| HFC-125 | 107.88 | 723.13 | NO | NA | 8.00 | NA | IE | 57.85 | NO |
| HFC-152a | 1.17 | 11.10 | NO | NA | 8.00 | NA | IE | 0.89 | NO |
| HFC-134a | 126.40 | 956.87 | NO | NA | 8.00 | NA | IE | 76.55 | NO |
| HFC-143a | 105.04 | 666.46 | NO | NA | 8.00 | NA | IE | 53.32 | NO |
| HFC-32 | 3.68 | 23.85 | NO | NA | 8.00 | NA | IE | 1.91 | NO |
| Stationary Air-Conditioning | | | | | | | | | |
| HFC-143a | 1.31 | 16.70 | NO | NA | 3.83 | NA | IE | 0.64 | NO |
| HFC-32 | 12.26 | 89.76 | NO | NA | 5.47 | NA | IE | 4.91 | NO |
| HFC-125 | 14.44 | 111.69 | NO | NA | 5.26 | NA | IE | 5.88 | NO |
| HFC-134a | 37.90 | 372.89 | NO | NA | 5.16 | NA | IE | 19.25 | NO |
| Mobile Air-Conditioning | | | | | | | | | |
| HFC-134a | 191.09 | 926.60 | 16.88 | NA | 13.77 | 25.00 | NA | 127.55 | 4.22 |
| **2. Foam Blowing**[(1)] | | | | | | | | | |
| Hard Foam | | | | | | | | | |
| HFC-152a | 241.14 | 1 234.13 | NO | NA | 24.21 | NA | IE | 298.84 | NO |
| HFC-134a | 16.47 | 1 573.64 | NO | NA | 0.66 | NA | IE | 10.32 | NO |
| Soft Foam | | | | | | | | | |
| HFC-134a | NO | 106.76 | NO | NA | 37.00 | NO | NA | 39.51 | NO |
| HFC-152a | 51.48 | 180.46 | NO | NA | 51.27 | NO | NA | 92.52 | NO |

(1) Under each of the listed source categories, specify the chemical consumed (*e.g. HFC-32)* as indicated under category Domestic Refrigeration; use one row per chemical.

**Note:** This table provides for reporting of the activity data and emission factors used to calculate actual emissions from consumption of halocarbons and $SF_6$ using the "bottom-up approach" (based on the total stock of equipment and estimated emission rates from this equipment). Some Parties may prefer to estimate actual emissions following the alternative "top-down approach" (based on annual sales of equipment and/or gas). Those Parties should indicate the activity data used and provide any other information needed to understand the content of the table in the documentation box at the end of sheet 2 to this table, including a reference to the section of the NIR where further details can be found. Those Parties should provide the following data in the NIR:

1. the amount of fluid used to fill new products,
2. the amount of fluid used to service existing products,
3. the amount of fluid originally used to fill retiring products (the total nameplate capacity of retiring products),
4. the product lifetime, and
5. the growth rate of product sales, if this has been used to calculate the amount of fluid originally used to fill retiring products.

In the NIR, Parties may provide alternative formats for reporting equivalent information with a similar level of detail.

**TABLE 2(II).F SECTORAL BACKGROUND DATA FOR INDUSTRIAL PROCESSES**
**Consumption of Halocarbons and $SF_6$**
**(Sheet 2 of 2)**

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| GREENHOUSE GAS SOURCE AND SINK CATEGORIES | ACTIVITY DATA *Amount of fluid* | | | IMPLIED EMISSION FACTORS | | | EMISSIONS | | |
|---|---|---|---|---|---|---|---|---|---|
| | Filled into new manufactured products | In operating systems (average annual stocks) | Remaining in products at decommissioning | Product manufacturing factor | Product life factor | Disposal loss factor | From manufacturing | From stocks | From disposal |
| | (t) | | | (% per annum) | | | (t) | | |
| **3. Fire Extinguishers** *(please specify chemical)* [1] | | | | | | | | | |
| HFC-227ea | 8.00 | 52.95 | NE | NE | 5.00 | NE | NE | 2.65 | NE |
| C4F10 | NO | 0.46 | NE | NE | 5.00 | NE | NE | 0.02 | NE |
| HFC-23 | 1.90 | 38.02 | NE | NE | 5.00 | NE | NE | 1.90 | NE |
| **4. Aerosols** [1] | | | | | | | | | |
| Metered Dose Inhalers | | | | | | | | | |
| Unspecified mix of HFCs | 10 358.21 | NA | NA | NA | NA | NA | NA | 10 311.79 | NA |
| Other | | | | | | | | | |
| **5. Solvents** [1] | | | | | | | | | |
| HFC-43-10 mee | 1.57 | NA | NA | NA | NA | NA | NA | 1.55 | NA |
| **6. Other applications using ODS[2] substitutes** [1] | | | | | | | | | |
| **7. Semiconductor Manufacture** [1] | | | | | | | | | |
| SF6 | 5.55 | NA | NA | 0.75 | NA | NA | 4.15 | NA | NA |
| Unspecified mix of HFCs | 21 797.10 | NA | NA | 0.32 | NA | NA | 7 066.80 | NA | NA |
| Unspecified mix of PFCs | 451 772.00 | NA | NA | 0.40 | NA | NA | 182 546.50 | NA | NA |
| **8. Electrical Equipment**[1] | | | | | | | | | |
| SF6 | 12.85 | 170.44 | NE | NE | 1.00 | NE | NE | 1.70 | NE |
| **9. Other** ***(please specify)*** [1] | | | | | | | | | |
| Double glaze windows | | | | | | | | | |
| SF6 | NO | 265.13 | 8.16 | NO | 1.17 | 100.00 | NO | 3.11 | 8.16 |
| Research and other use | | | | | | | | | |
| SF6 | 0.02 | 0.50 | NA | NE | NA | NA | NE | 0.02 | NA |

[1] Under each of the listed source categories, specify the chemical consumed (e.g. HFC-32) as indicated under category Fire Extinguishers; use one row per chemical.
[2] ODS: ozone-depleting substances.

**Documentation box:**
- Parties should provide detailed explanations on the industrial processes sector in Chapter 4: Industrial processes (CRF sector 2) of the NIR. Use this documentation box to provide references to relevant sections of the NIR if any additional information and/or further details are needed to understand the content of this table.
- Where only aggregate figures for activity data are provided, e.g. due to reasons of confidentiality (see footnote 1 to table 2(II)), a note indicating this should be provided in this documentation box.
- With regard to data on the amounts of fluid that remained in retired products at decommissioning, use this documentation box to provide a reference to the section of the NIR where information on the amount of the chemical recovered (recovery efficiency) and other relevant information used in the emission estimation can be found.
- Parties that estimate their actual emissions following the alternative top-down approach might not be able to report emissions using this table. As indicated in the note to sheet 1 of this table, Parties should in these cases provide, in the NIR, alternative formats for

# TABLE 3 SECTORAL REPORT FOR SOLVENT AND OTHER PRODUCT USE
## (Sheet 1 of 1)

Inventory 2007
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| GREENHOUSE GAS SOURCE AND SINK CATEGORIES | $CO_2$ | $N_2O$ | NMVOC |
|---|---|---|---|
| | (Gg) | | |
| **Total Solvent and Other Product Use** | 248.53 | 0.52 | 104.09 |
| **A. Paint Application** | 77.70 | | 29.22 |
| **B. Degreasing and Dry Cleaning** | 37.80 | NA | 14.30 |
| **C. Chemical Products, Manufacture and Processing** | 16.66 | | 8.83 |
| **D. Other** | 116.37 | 0.52 | 51.74 |
| 1. Use of $N_2O$ for Anaesthesia | | 0.12 | |
| 2. $N_2O$ from Fire Extinguishers | | NO | |
| 3. $N_2O$ from Aerosol Cans | | 0.40 | |
| 4. Other Use of $N_2O$ | | NO | |
| 5. Other *(as specified in table 3.A-D)* | 116.37 | NA | 51.74 |
| Other non-specified | 116.37 | NA | 51.74 |

**Note:** The quantity of carbon released in the form of NMVOCs should be accounted for in both the NMVOC and the $CO_2$ columns. The quantites of NMVOCs should be converted into $CO_2$ equivalent emissions before being added to the $CO_2$ amounts in the $CO_2$ column.

**Documentation box:**

• Parties should provide detailed explanations about the Solvent and Other Product Use sector in Chapter 5: Solvent and Other Product Use (CRF sector 3) of the NIR. Use this documentation box to provide references to relevant sections of the NIR if any additional information and/or further details are needed to understand the content of this table.

• The IPCC Guidelines do not provide methodologies for the calculation of emissions of $N_2O$ from Solvent and Other Product Use. If reporting such data, Parties should provide in the NIR additional information (activity data and emission factors) used to derive these estimates, and provide in this documentation box a reference to the section of the NIR where this information can be found.

**TABLE 3.A-D SECTORAL BACKGROUND DATA FOR SOLVENT AND OTHER PRODUCT USE**
**(Sheet 1 of 1)**

Inventory 2007
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| GREENHOUSE GAS SOURCE AND SINK CATEGORIES | ACTIVITY DATA | | IMPLIED EMISSION FACTORS [(1)] | |
|---|---|---|---|---|
| | Description | (kt) | $CO_2$ (t/t) | $N_2O$ (t/t) |
| **A. Paint Application** | Solvents used [kt] | 67.24 | 1.16 | |
| **B. Degreasing and Dry Cleaning** | Solvents used [kt] | 25.83 | 1.46 | NA |
| **C. Chemical Products, Manufacture and Processing** | Solvents used [kt] | 17.36 | 0.96 | |
| **D. Other** | | | | |
| 1. Use of $N_2O$ for Anaesthesia | Use of N2O for Anaesthesia [kt] | 0.12 | | 1.00 |
| 2. $N_2O$ from Fire Extinguishers | N2O from Fire Extinguishers | NO | | NO |
| 3. $N_2O$ from Aerosol Cans | N2O from Aerosol Cans | NA | | NA |
| 4. Other Use of $N_2O$ | (specify) | NO | | NO |
| 5. Other *(please specify)* [(2)] | | | | |
| Other non-specified | Solvents used [kt] | 69.98 | 1.66 | NA |

(1) The implied emission factors will not be calculated until the corresponding emission estimates are entered directly into table 3.

(2) Some probable sources to be reported under 3.D Other are listed in this table. Complement the list with other relevant sources, as appropriate.

| **Documentation box:** |
|---|
| Parties should provide detailed explanations on the Solvent and Other Product Use sector in Chapter 5: Solvent and Other Product Use (CRF sector 3) of the NIR. Use this documentation box to provide references to relevant sections of the NIR if any additional information and/or further details are needed to understand the content of this table. |

**TABLE 4 SECTORAL REPORT FOR AGRICULTURE**
**(Sheet 1 of 2)**

Inventory 2007
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| GREENHOUSE GAS SOURCE AND SINK CATEGORIES | $CH_4$ | $N_2O$ | $NO_x$ | CO | NMVOC |
|---|---|---|---|---|---|
| | (Gg) | | | | |
| **Total Agriculture** | **195.73** | 12.38 | 5.27 | 1.07 | 1.81 |
| **A. Enteric Fermentation** | 153.09 | | | | |
| 1. Cattle (1) | 142.90 | | | | |
| ***Option A:*** | | | | | |
| Dairy Cattle | 60.34 | | | | |
| Non-Dairy Cattle | 82.56 | | | | |
| ***Option B:*** | | | | | |
| Mature Dairy Cattle | | | | | |
| Mature Non-Dairy Cattle | | | | | |
| Young Cattle | | | | | |
| 2. Buffalo | NO | | | | |
| 3. Sheep | 2.81 | | | | |
| 4. Goats | 0.30 | | | | |
| 5. Camels and Llamas | NO | | | | |
| 6. Horses | 1.57 | | | | |
| 7. Mules and Asses | IE | | | | |
| 8. Swine | 4.93 | | | | |
| 9. Poultry | 0.25 | | | | |
| 10. Other *(as specified in table 4.A)* | 0.33 | | | | |
| Deer | 0.33 | | | | |
| **B. Manure Management** | 42.17 | 2.83 | | | NE,NO |
| 1. Cattle (1) | 21.54 | | | | |
| *Option A:* | | | | | |
| Dairy Cattle | 10.68 | | | | |
| Non-Dairy Cattle | 10.87 | | | | |
| *Option B:* | | | | | |
| Mature Dairy Cattle | | | | | |
| Mature Non-Dairy Cattle | | | | | |
| Young Cattle | | | | | |
| 2. Buffalo | NO | | | | |
| 3. Sheep | 0.07 | | | | |
| 4. Goats | 0.01 | | | | |
| 5. Camels and Llamas | NO | | | | |
| 6. Horses | 0.12 | | | | |
| 7. Mules and Asses | IE | | | | |
| 8. Swine | 19.40 | | | | |
| 9. Poultry | 1.02 | | | | |
| 10. Other livestock *(as specified in table 4.B(a))* | 0.01 | | | | |
| Deer | 0.01 | | | | |

**Note:** All footnotes for this table are given at the end of the table on sheet 2.

**TABLE 4 SECTORAL REPORT FOR AGRICULTURE**
**(Sheet 2 of 2)**

Inventory 2007
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| GREENHOUSE GAS SOURCE AND SINK CATEGORIES | $CH_4$ | $N_2O$ | $NO_x$ | CO | NMVOC |
|---|---|---|---|---|---|
| | (Gg) | | | | |
| **B. Manure Management (continued)** | | | | | |
| 11. Anaerobic Lagoons | | NO | | | NO |
| 12. Liquid Systems | | 0.07 | | | NE |
| 13. Solid Storage and Dry Lot | | 2.71 | | | NE |
| 14. Other AWMS | | 0.05 | | | NE |
| **C. Rice Cultivation** | NO | | | | **NO** |
| 1. Irrigated | NO | | | | NO |
| 2. Rainfed | NO | | | | NO |
| 3. Deep Water | NO | | | | NO |
| 4. Other *(as specified in table 4.C)* | NO | | | | NO |
| Other non-specified | NO | | | | NO |
| **D. Agricultural Soils** [2] | 0.42 | 9.55 | | | 1.70 |
| 1. Direct Soil Emissions | 0.42 | 5.27 | | | 1.70 |
| 2. Pasture, Range and Paddock Manure [3] | | 0.72 | | | NA |
| 3. Indirect Emissions | NA | 3.56 | | | NA |
| 4. Other *(as specified in table 4.D)* | NA | NA | | | NA |
| **E. Prescribed Burning of Savannas** | NO | NO | NO | NO | NO |
| **F. Field Burning of Agricultural Residues** | 0.06 | 0.00 | 0.03 | 1.07 | 0.11 |
| 1 . Cereals | 0.04 | 0.00 | 0.03 | 0.86 | 0.06 |
| 2. Pulses | NA,NO | NA,NO | NO | NO | NO |
| 3 . Tubers and Roots | NA,NO | NA,NO | NO | NO | NO |
| 4 . Sugar Cane | NO | NO | NO | NO | NO |
| 5 . Other *(as specified in table 4.F)* | 0.02 | 0.00 | 0.00 | 0.22 | 0.05 |
| Vine | 0.02 | 0.00 | 0.00 | 0.22 | 0.05 |
| **G. Other *(please specify)*** | **NA** | **NA** | **5.23** | **NA** | **NA** |
| NOX from Agricultural Soils | NA | NA | 5.23 | NA | NA |

(1) The sum for cattle would be calculated on the basis of entries made under either option A (dairy and non-dairy cattle) or option B (mature dairy cattle, mature non-dairy cattle and young cattle).

(2) See footnote 4 to Summary 1.A of this common reporting format. Parties which choose to report $CO_2$ emissions and removals from agricultural soils under 4.D Agricultural Soils of the sector Agriculture should report the amount (in Gg) of these emissions or removals in table Summary 1.A of the CRF. References to additional information (activity data, emissions factors) reported in the NIR should be provided in the documentation box to table 4.D. In line with the corresponding table in the IPCC Guidelines (i.e. IPCC Sectoral Report for Agriculture), this table does not include provisions for reporting $CO_2$ estimates.

(3) Direct $N_2O$ emissions from pasture, range and paddock manure are to be reported in the "4.D Agricultural Soils" category. All other $N_2O$ emissions from animal manure are to be reported in the "4.B Manure Management" category. See also chapter 4.4 of the IPCC good practice guidance report.

**Note:** The IPCC Guidelines do not provide methodologies for the calculation of $CH_4$ emissions and $CH_4$ and $N_2O$ removals from agricultural soils, or $CO_2$ emissions from prescribed burning of savannas and field burning of agricultural residues. Parties that have estimated such emissions should provide, in the NIR, additional information (activity data and emission factors) used to derive these estimates and include a reference to the section of the NIR in the documentation box of the corresponding Sectoral background data tables.

| **Documentation box:** |
|---|
| • Parties should provide detailed explanations on the agriculture sector in Chapter 6: Agriculture (CRF sector 4) of the NIR. Use this documentation box to provide references to relevant sections of the NIR if any additional information and/or further details are needed to understand the content of this table.<br>• If estimates are reported under "4.G Other", use this documentation box to provide information regarding activities covered under this category and to provide reference to the section in the NIR where background information can be found. |
| 4.B Mules and Asses/2007:"4.A.7. Mules and Asses" are included in "4.A.6. Horses". |
| 4.B Swine:For calculation of 4.B.8 emissions only fattening pigs and breeding sows are considered as activity data but (for reasons of consistency with category "4.A.8. Swine") |
| population size of "4.B.8. Swine" includes young swine. |
| However, the emission factor of breeding sows considers emissions of young swine. |
| 4.B Swine/2007:For calculation of 4.B.8 emissions only fattening pigs and breeding sows are considered as activity data but (for reasons of consistency with category "4.A.8. Swine") |
| population size of "4.B.8. Swine" includes young swine. |
| However, the emission factor of breeding sows considers emissions of young swine. |

**TABLE 4.A SECTORAL BACKGROUND DATA FOR AGRICULTURE**
**Enteric Fermentation**
**(Sheet 1 of 1)**

Inventory 2007
Submission 2009 v1.1
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| GREENHOUSE GAS SOURCE AND SINK CATEGORIES | ACTIVITY DATA AND OTHER RELATED INFORMATION | | | IMPLIED EMISSION FACTORS [3] |
|---|---|---|---|---|
| | Population size [1] (1000s) | Average gross energy intake (MJ/head/day) | Average $CH_4$ conversion rate ($Y_m$) (%) | $CH_4$ (kg $CH_4$/head/yr) |
| 1. Cattle | 2 000.20 | | | 71.44 |
| *Option A:* | | | | |
| Dairy Cattle [4] | 524.50 | 292.32 | 6.00 | 115.04 |
| Non-Dairy Cattle | 1 475.70 | 142.17 | 6.00 | 55.95 |
| *Option B:* | | | | |
| Mature Dairy Cattle | | | | |
| Mature Non-Dairy Cattle | | | | |
| Young Cattle | | | | |
| 2. Buffalo | NO | NO | NO | NO |
| 3. Sheep | 351.33 | 20.00 | 6.00 | 8.00 |
| 4. Goats | 60.49 | 14.00 | 5.00 | 5.00 |
| 5. Camels and Llamas | NO | NO | NO | NO |
| 6. Horses | 87.07 | 110.00 | 2.50 | 18.00 |
| 7. Mules and Asses | IE | IE | IE | IE |
| 8. Swine | 3 286.29 | 38.00 | 0.60 | 1.50 |
| 9. Poultry | 13 027.15 | 2.18 | 0.09 | 0.02 |
| 10. Other *(please specify)* | | | | |
| Deer | 41.19 | 20.00 | 6.00 | 8.00 |

[1] Parties are encouraged to provide detailed livestock population data by animal type and region, if available, in the NIR, and provide in the documentation box below a reference to the relevant section. Parties should use the same animal population statistics to estimate CH4 emissions from enteric fermentation, CH4 and N2O from manure management, N2O direct emissions from soil and N2O emissions associated with manure production, as well as emissions from the use of manure as fuel, and sewage-related emissions reported in the Waste sector.
[2] $Y_m$ refers to the fraction of gross energy in feed converted to methane and should be given in per cent in this table.
[3] The implied emission factors will not be calculated until the corresponding emission estimates are entered directly into Table 4.
[4] Including data on dairy heifers, if available.

**Documentation box:**
• Parties should provide detailed explanations on the Agriculture sector in Chapter 6: Agriculture (CRF sector 4) of the NIR. Use this documentation box to provide references to relevant sections of the NIR if any additional information and/or further details are needed to understand the content of this table.
• Indicate in this documentation box whether the activity data used are one-year estimates or a three-year averages.
• Provide a reference to the relevant section in the NIR, in particular with regard to:
(a) disaggregation of livestock population (e.g. according to the classification recommended in the IPCC good practice guidance), including information on whether these data are one-
(b) parameters relevant to the application of IPCC good practice guidance.

**Additional information (only for those livestock types for which Tier 2 was used) [a]**

| Disaggregated list of animals [b] / Indicators: | | Dairy Cattle | Non-Dairy Cattle | Mature Dairy Cattle | Mature Non-Dairy Cattle | Young Cattle | Buffalo | Sheep | Goats | Camels and Llamas | Horses | Mules and Asses | Swine | Poultry | Other *(specify)* | Deer |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Weight | (kg) | 700.00 | 426.27 | | | | NO | NA | NA | NO | NA | NA | NA | NA | | NA |
| Feeding situation [c] | | Stall/Pasture | Stall/Pasture | | | | NO | NA | NA | NO | NA | NA | NA | NA | | NA |
| Milk yield | (kg/day) | 16.43 | NO | | | | NO | NA | NA | NO | NA | NA | NA | NA | | NA |
| Work | (h/day) | NO | NO | | | | NO | NA | NA | NO | NA | NA | NA | NA | | NA |
| Pregnant | (%) | 90.00 | 16.55 | 0.00 | 0.00 | 0.00 | NO | NA | NA | NO | NA | NA | NA | NA | | NA |
| Digestibility of feed | (%) | 70.00 | 72.35 | 0.00 | 0.00 | 0.00 | NO | NA | NA | NO | NA | NA | NA | NA | | NA |

[a] See also Tables A-1 and A-2 of the IPCC Guidelines (Volume 3. Reference Manual, pp. 4.31-4.34). These data are relevant if Parties do not have data on average feed intake.
[b] Disaggregate to the split actually used. Add columns to the table if necessary.
[c] Specify feeding situation as pasture, stall fed, confined, open range, etc.

**TABLE 4.B(a) SECTORAL BACKGROUND DATA FOR AGRICULTURE**

**$CH_4$ Emissions from Manure Management**

**(Sheet 1 of 2)**

Inventory 2007

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| GREENHOUSE GAS SOURCE AND SINK CATEGORIES | ACTIVITY DATA AND OTHER RELATED INFORMATION | | | | | | | IMPLIED EMISSION FACTORS (4) |
|---|---|---|---|---|---|---|---|---|
| | Population size | Allocation by climate region | | | Typical animal mass (average) | VS(2) daily excretion (average) | $CH_4$ producing potential (Bo)(2) (average) | $CH_4$ |
| | | Cool | Temperate | Warm | | | | |
| | (1000s) | (%) | | | (kg) | (kg dm/head/day) | ($m^3$ $CH_4$/kg VS) | (kg $CH_4$/head/yr) |
| 1. Cattle | 2 000.20 | | | | | | | 10.77 |
| *Option A:* | | | | | | | | |
| Dairy Cattle (3) | 524.50 | 100.00 | NO | NO | 700.00 | 4.23 | 0.24 | 20.36 |
| Non-Dairy Cattle | 1 475.70 | 100.00 | NO | NO | 426.27 | 1.95 | 0.17 | 7.36 |
| *Option B:* | | | | | | | | |
| Mature Dairy Cattle | | 0.00 | 0.00 | 0.00 | | | | |
| Mature Non-Dairy Cattle | | 0.00 | 0.00 | 0.00 | | | | |
| Young Cattle | | 0.00 | 0.00 | 0.00 | | | | |
| 2. Buffalo | NO | NO | NO | NO | NO | NO | NO | NO |
| 3. Sheep | 351.33 | 100.00 | NO | NO | 43.00 | 0.40 | 0.19 | 0.19 |
| 4. Goats | 60.49 | 100.00 | NO | NO | 30.00 | 0.28 | 0.17 | 0.12 |
| 5. Camels and Llamas | NO | NO | NO | NO | NO | NO | NO | NO |
| 6. Horses | 87.07 | 100.00 | NO | NO | 238.00 | 1.72 | 0.33 | 1.39 |
| 7. Mules and Asses | IE | IE | NO | NO | 238.00 | 627.80 | 0.33 | IE |
| 8. Swine | 3 286.29 | 100.00 | NO | NO | 82.00 | 0.40 | 0.45 | 5.90 |
| 9. Poultry | 13 027.15 | 100.00 | NO | NO | 1.10 | 0.10 | 0.32 | 0.08 |
| 10. Other livestock *(please specify)* | | | | | | | | |
| Deer | 41.19 | 100.00 | NO | NO | 43.00 | 0.40 | 0.19 | 0.19 |

(1) Climate regions are defined in terms of annual average temperature as follows: Cool = less than 15°C; Temperate = 15 - 25°C inclusive; and Warm = greater than 25°C (see table 4.2 of the IPCC Guidelines (Volume 3, Reference Manual, p. 4.8)).

(2) VS = Volatile Solids; Bo = maximum methane producing capacity for manure IPCC Guidelines (Volume 3, Reference Manual, p.4.23 and p.4.15); dm = dry matter. Provide average values for VS and Bo where original calculations were made at a more disaggregated level of these livestock categories.

(3) Including data on dairy heifers, if available.

(4) The implied emission factors will not be calculated until the corresponding emission estimates are entered directly into table 4.

**Documentation box:**

• Parties should provide detailed explanations on the Agriculture sector in Chapter 6: Agriculture (CRF sector 4) of the NIR. Use this documentation box to provide references to relevant sections of the NIR if any additional information and further details are needed to understand the content of this table.

• Indicate in this documentation box whether the activity data used are one-year estimates or three-year averages.

• Provide a reference to the relevant section in the NIR, in particular with regard to:

(a) disaggregation of livestock population (e.g. according to the classification recommended in the IPCC good practice guidance), including information on whether these data are one-year estimates or three-year averages.

(b) parameters relevant to the application of IPCC good practice guidance;

(c) information on how the MCFs are derived, if relevant data could not be provided in the additional information box.

4.B Mules and Asses/2007:"4.A.7. Mules and Asses" are included in "4.A.6. Horses".

4.B Swine:For calculation of 4.B.8 emissions only fattening pigs and breeding sows are considered as activity data but (for reasons of consistency with category "4.A.8. Swine")

population size of "4.B.8. Swine" includes young swine.

However, the emission factor of breeding sows considers emissions of young swine.

4.B Swine/2007:For calculation of 4.B.8 emissions only fattening pigs and breeding sows are considered as activity data but (for reasons of consistency with category "4.A.8. Swine")

population size of "4.B.8. Swine" includes young swine.

However, the emission factor of breeding sows considers emissions of young swine.

**TABLE 4.B(a) SECTORAL BACKGROUND DATA FOR AGRICULTURE**
**$CH_4$ Emissions from Manure Management**
**(Sheet 2 of 2)**

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**Additional information (for Tier 2)** [(a)]

| Animal category | Indicator | Climate region | Animal waste management system: Anaerobic lagoon | Liquid system | Daily spread | Solid storage | Dry lot | Pasture range paddock | Other |
|---|---|---|---|---|---|---|---|---|---|
| **Dairy Cattle** | Allocation (%) | Cool | NO | 18.95 | NO | 70.40 | NO | 10.65 | NO |
| | | Temperate | NO | NO | NO | NO | NO | NO | NO |
| | | Warm | NO | NO | NO | NO | NO | NO | NO |
| | MCF[(b)] | Cool | 90.00 | 39.00 | NO | 1.00 | NO | 1.00 | 1.00 |
| | | Temperate | NO | NO | NO | NO | NO | NO | NO |
| | | Warm | NO | NO | NO | NO | NO | NO | NO |
| **Non-Dairy Cattle** | Allocation (%) | Cool | NO | 23.76 | NO | 66.52 | NO | 9.72 | NO |
| | | Temperate | NO | NO | NO | NO | NO | NO | NO |
| | | Warm | NO | NO | NO | NO | NO | NO | NO |
| | MCF[(b)] | Cool | 90.00 | 39.00 | NO | 1.00 | NO | 1.00 | 1.00 |
| | | Temperate | NO | NO | NO | NO | NO | NO | NO |
| | | Warm | NO | NO | NO | NO | NO | NO | NO |
| **Mature Dairy Cattle** | Allocation (%) | Cool | | | | | | | |
| | | Temperate | | | | | | | |
| | | Warm | | | | | | | |
| | MCF[(b)] | Cool | | | | | | | |
| | | Temperate | | | | | | | |
| | | Warm | | | | | | | |
| **Mature Non-Dairy Cattle** | Allocation (%) | Cool | | | | | | | |
| | | Temperate | | | | | | | |
| | | Warm | | | | | | | |
| | MCF[(b)] | Cool | | | | | | | |
| | | Temperate | | | | | | | |
| | | Warm | | | | | | | |
| **Young Cattle** | Allocation (%) | Cool | | | | | | | |
| | | Temperate | | | | | | | |
| | | Warm | | | | | | | |
| | MCF[(b)] | Cool | | | | | | | |
| | | Temperate | | | | | | | |
| | | Warm | | | | | | | |
| **Buffalo** | Allocation (%) | Cool | NO | NO | NO | NO | NO | NO | NO |
| | | Temperate | NO | NO | NO | NO | NO | NO | NO |
| | | Warm | NO | NO | NO | NO | NO | NO | NO |
| | MCF[(b)] | Cool | NO | NO | NO | NO | NO | NO | NO |
| | | Temperate | NO | NO | NO | NO | NO | NO | NO |
| | | Warm | NO | NO | NO | NO | NO | NO | NO |
| **Sheep** | Allocation (%) | Cool | NA | NA | NA | NA | NA | NA | NA |
| | | Temperate | NA | NA | NA | NA | NA | NA | NA |
| | | Warm | NA | NA | NA | NA | NA | NA | NA |
| | MCF[(b)] | Cool | NA | NA | NA | NA | NA | NA | NA |
| | | Temperate | NA | NA | NA | NA | NA | NA | NA |
| | | Warm | NA | NA | NA | NA | NA | NA | NA |
| **Goats** | Allocation (%) | Cool | NA | NA | NA | NA | NA | NA | NA |
| | | Temperate | NA | NA | NA | NA | NA | NA | NA |
| | | Warm | NA | NA | NA | NA | NA | NA | NA |
| | MCF[(b)] | Cool | NA | NA | NA | NA | NA | NA | NA |
| | | Temperate | NA | NA | NA | NA | NA | NA | NA |
| | | Warm | NA | NA | NA | NA | NA | NA | NA |
| **Camels and Llamas** | Allocation (%) | Cool | NO | NO | NO | NO | NO | NO | NO |
| | | Temperate | NO | NO | NO | NO | NO | NO | NO |
| | | Warm | NO | NO | NO | NO | NO | NO | NO |
| | MCF[(b)] | Cool | NO | NO | NO | NO | NO | NO | NO |
| | | Temperate | NO | NO | NO | NO | NO | NO | NO |
| | | Warm | NO | NO | NO | NO | NO | NO | NO |
| **Horses** | Allocation (%) | Cool | NA | NA | NA | NA | NA | NA | NA |
| | | Temperate | NA | NA | NA | NA | NA | NA | NA |
| | | Warm | NA | NA | NA | NA | NA | NA | NA |
| | MCF[(b)] | Cool | NA | NA | NA | NA | NA | NA | NA |
| | | Temperate | NA | NA | NA | NA | NA | NA | NA |
| | | Warm | NA | NA | NA | NA | NA | NA | NA |
| **Mules and Asses** | Allocation (%) | Cool | IE | IE | IE | IE | NO | IE | IE |
| | | Temperate | NO | NO | NO | NO | NO | NO | NO |
| | | Warm | NO | NO | NO | NO | NO | NO | NO |
| | MCF[(b)] | Cool | IE | IE | IE | IE | NO | IE | IE |
| | | Temperate | NO | NO | NO | NO | NO | NO | NO |
| | | Warm | NO | NO | NO | NO | NO | NO | NO |
| **Swine** | Allocation (%) | Cool | NO | 71.52 | NO | 28.48 | NO | NO | NO |
| | | Temperate | NO | NO | NO | NO | NO | NO | NO |
| | | Warm | NO | NO | NO | NO | NO | NO | NO |
| | MCF[(b)] | Cool | 90.00 | 39.00 | NO | 1.00 | NO | 1.00 | 1.00 |
| | | Temperate | NO | NO | NO | NO | NO | NO | NO |
| | | Warm | NO | NO | NO | NO | NO | NO | NO |
| **Poultry** | Allocation (%) | Cool | NA | NA | NA | NA | NA | NA | NA |
| | | Temperate | NA | NA | NA | NA | NA | NA | NA |
| | | Warm | NA | NA | NA | NA | NA | NA | NA |
| | MCF[(b)] | Cool | NA | NA | NA | NA | NA | NA | NA |
| | | Temperate | NA | NA | NA | NA | NA | NA | NA |
| | | Warm | NA | NA | NA | NA | NA | NA | NA |
| **Other livestock** *(please specify)* | Allocation (%) | Cool | | | | | | | |
| | | Temperate | | | | | | | |
| | | Warm | | | | | | | |
| | MCF[(b)] | Cool | | | | | | | |
| | | Temperate | | | | | | | |
| | | Warm | | | | | | | |

[(a)] The information required in this table may not be directly applicable to country-specific methods developed for MCF calculations. In such cases, information on MCF derivation should be described in the NIR and references to the relevant sections of the NIR should be provided in the documentation box.

[(b)] MCF = Methane Conversion Factor (IPCC Guidelines, (Volume 3. Reference Manual, p. 4.9)). If another climate region categorization is used, replace the entries in the cells with the climate regions for which the MCFs are specified.

**TABLE 4.B(b) SECTORAL BACKGROUND DATA FOR AGRICULTURE** Inventory 2007

**$N_2O$ Emissions from Manure Management** Submission 2009 v1.1

**(Sheet 1 of 1)** AUSTRIA

| GREENHOUSE GAS SOURCE AND SINK CATEGORIES | ACTIVITY DATA AND OTHER RELATED INFORMATION | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Population size (1000s) | Nitrogen excretion (kg N/head/yr) | Nitrogen excretion per animal waste management system (AWMS) (kg N/yr) | | | | | |
| | | | Anaerobic lagoon | Liquid system | Daily spread | Solid storage and dry lot | Pasture range and | Other |
| Cattle | 2 000.20 | | NO | 25 122 156.23 | NO | 79 671 489.80 | 13 500 372.05 | NO |
| *Option A:* | | | | | | | | |
| Dairy Cattle | 524.50 | 96.48 | NO | 9 614 382.03 | NO | 35 623 815.52 | 5 363 813.13 | NO |
| Non-Dairy Cattle | 1 475.70 | 45.87 | NO | 15 507 774.20 | NO | 44 047 674.28 | 8 136 558.91 | NO |
| *Option B:* | | | | | | | | |
| Mature Dairy Cattle | | | | | | | | |
| Mature Non-Dairy Cattle | | | | | | | | |
| Young Cattle | | | | | | | | |
| Sheep | 351.33 | 13.10 | NO | NO | NO | 92 048.20 | 4 004 096.61 | 506 265.09 |
| Swine | 3 286.29 | 14.06 | NO | 15 911 403.20 | NO | 6 463 309.40 | NO | NO |
| Poultry | 13 027.15 | 0.55 | NO | 931 363.14 | NO | 71 643.32 | 143 286.64 | 6 018 038.76 |
| Buffalo | NO | NO | NO | NO | NO | NO | NO | NO |
| Goats | 60.49 | 12.30 | NO | NO | NO | NO | 714 230.50 | 29 759.60 |
| Camels and Liamas | NO | NO | NO | NO | NO | NO | NO | NO |
| Horses | 87.07 | 47.90 | NO | NO | NO | NO | 4 003 918.85 | 166 829.95 |
| Mules and Asses | IE | IE | IE | IE | IE | IE | IE | IE |
| Other livestock *(please specify)* | | | | | | | | |
| Deer | 41.19 | 13.10 | NO | NO | NO | NO | 518 005.44 | 21 583.56 |
| **Total per AWMS** | | | IE,NO | 41 964 922.57 | IE,NO | 86 298 490.72 | 22 883 910.08 | 6 742 476.97 |

| IMPLIED EMISSION FACTORS [(1)] | |
|---|---|
| Emission factor per animal waste management system (kg $N_2O$-N/kg N) | |
| Anaerobic lagoon | NO |
| Liquid system | 0.00 |
| Solid storage and dry lot | 0.02 |
| Other AWMS | 0.00 |

[(1)] The implied emission factor will not be calculated until the emissions are entered directly into table 4.

**Documentation box:**

• Parties should provide detailed explanations on the Agriculture sector in Chapter 6: Agriculture (CRF sector 4) of the NIR. Use this documentation box to provide references to relevant sections of the NIR if any additional information and/or further details are needed to understand the content of this table.

• Indicate in this documentation box whether the activity data used are one-year estimates or three-year averages.

• Provide a reference to the relevant section in the NIR, in particular with regard to:

(a) disaggregation of livestock population (e.g. according to the classification recommended in the IPCC good practice guidance), including information on whether these data are one-year estimates or three-year averages.

(b) information on other AWMS, if reported.

4.B Swine:For calculation of 4.B.8 emissions only fattening pigs and breeding sows are considered as activity data but (for reasons of consistency with category "4.A.8. Swine")
population size of "4.B.8. Swine" includes young swine.
However, the emission factor of breeding sows considers emissions of young swine.
4.B Swine/2007:For calculation of 4.B.8 emissions only fattening pigs and breeding sows are considered as activity data but (for reasons of consistency with category "4.A.8. Swine")
population size of "4.B.8. Swine" includes young swine.
However, the emission factor of breeding sows considers emissions of young swine.

# TABLE 4.C SECTORAL BACKGROUND DATA FOR AGRICULTURE

Inventory 2007

## Rice Cultivation

Submission 2009 v1.1

## (Sheet 1 of 1)

AUSTRIA

| GREENHOUSE GAS SOURCE AND SINK CATEGORIES | | ACTIVITY DATA AND OTHER RELATED INFORMATION | | | IMPLIED EMISSION FACTOR [(1)] | EMISSIONS |
|---|---|---|---|---|---|---|
| | | Harvested area [(2)] | Organic amendments added[(3)] | | $CH_4$ | $CH_4$ |
| | | ($10^9$ $m^2$/yr) | type | (t/ha) | (g/$m^2$) | (Gg) |
| **1. Irrigated** | | | | | | NO |
| Continuously Flooded | | NO | (specify type) | NO | NO | NO |
| Intermittently Flooded | Single Aeration | NO | (specify type) | NO | NO | NO |
| | Multiple Aeration | NO | (specify type) | NO | NO | NO |
| **2. Rainfed** | | | | | | NO |
| Flood Prone | | NO | (specify type) | NO | NO | NO |
| Drought Prone | | NO | (specify type) | NO | NO | NO |
| **3. Deep Water** | | | | | | NO |
| Water Depth 50-100 cm | | NO | (specify type) | NO | NO | NO |
| Water Depth > 100 cm | | NO | (specify type) | NO | NO | NO |
| **4. Other *(please specify)*** | | NO | | | | NO |
| Other non-specified | | NO | (specify type) | NO | NO | NO |

| | | | | | |
|---|---|---|---|---|---|
| Upland Rice[(4)] | NO | | | | |
| Total [(4)] | NO | | | | |

[(1)] The implied emission factor implicitly takes account of all relevant corrections for continuously flooded fields without organic amendment, the correction for the organic amendments and the effect of different soil characteristics, if considered in the calculation of methane emissions.

[(2)] Harvested area is the cultivated area multiplied by the number of cropping seasons per year.

[(3)] Specify dry weight or wet weight for organic amendments in the documentation box.

[(4)] These rows are included to allow comparison with international statistics. Methane emissions from upland rice are assumed to be zero.

**Documentation box:**

• Parties should provide detailed explanations on the Agriculture sector in Chapter 6: Agriculture (CRF sector 4) of the NIR. Use this documentation box to provide references to relevant sections of the NIR if any additional information and/or further details are needed to understand the content of this table.

• When disaggregating by more than one region within a country, and/or by growing season, provide additional information on disaggregation and related data in the NIR and provide a reference to the relevant section in the NIR.

• Where available, provide activity data and scaling factors by soil type and rice cultivar in the NIR.

# TABLE 4.D SECTORAL BACKGROUND DATA FOR AGRICULTURE

## Agricultural Soils

## (Sheet 1 of 2)

Inventory 2007

Submission 2009 v1.1

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| GREENHOUSE GAS SOURCE AND SINK CATEGORIES | ACTIVITY DATA AND OTHER RELATED INFORMATION | | IMPLIED EMISSION FACTORS | EMISSIONS |
|---|---|---|---|---|
| | Description | Value | | $N_2O$ |
| | | kg N/yr | kg $N_2O$-N/kg N [2] | (Gg) |
| **1. Direct Soil Emissions** | **N input to soils** | | | 5.27 |
| 1. Synthetic Fertilizers | Nitrogen input from application of synthetic fertilizers | 99 636 878.60 | 0.01 | 1.96 |
| 2. Animal Manure Applied to Soils | Nitrogen input from manure applied to soils | 104 169 501.85 | 0.01 | 2.05 |
| 3. N-fixing Crops | Nitrogen fixed by N-fixing crops | 22 630 536.80 | 0.01 | 0.44 |
| 4. Crop Residue | Nitrogen in crop residues returned to soils | 40 208 022.53 | 0.01 | 0.79 |
| 5. Cultivation of Histosols [2] | Area of cultivated organic soils (ha/yr) | NO | NO | NO |
| 6. Other direct emissions *(please specify)* | | | | 0.03 |
| Sewage Sludge Spreading | (specify) | 1 581 301.41 | 0.01 | 0.03 |
| **2. Pasture, Range and Paddock Manure** | **N excretion on pasture range and paddock** | 22 883 910.08 | 0.02 | 0.72 |
| **3. Indirect Emissions** | | | | 3.56 |
| 1. Atmospheric Deposition | Volatized N from fertilizers, animal manures and other | 35 823 426.69 | 0.01 | 0.56 |
| 2. Nitrogen Leaching and Run-off | N from fertilizers, animal manures and other that is lost through leaching and run-off | 76 390 681.90 | 0.02 | 3.00 |
| **4. Other** *(please specify)* | | | | NA |

(1) To convert from $N_2O$-N to $N_2O$ emissions, multiply by 44/28. Note that for cultivation of Histosols the unit of the IEF is kg $N_2O$-N/ha.

**Documentation box:**

• Parties should provide detailed explanations on the Agriculture sector in Chapter 6: Agriculture (CRF sector 4) of the NIR. Use this documentation box to provide references to relevant sections of the NIR if any additional information and/or further details are needed to understand the content of this table.

• Provide a reference to the relevant section in the NIR, in particular with regard to:

(a) Background information on $CH_4$ emissions from agricultural soils, if accounted for under the Agriculture sector;

(b) Disaggregated values for $Frac_{GRAZ}$ according to animal type, and for $Frac_{BURN}$ according to crop types;

(c) Full list of assumptions and fractions used.

# TABLE 4.D SECTORAL BACKGROUND DATA FOR AGRICULTURE

Inventory 2007

## Agricultural Soils[1]

Submission 2009 v1.1

## (Sheet 2 of 2)

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**Additional information**

| **Fraction** [(a)] | **Description** | **Value** |
|---|---|---|
| $Frac_{BURN}$ | Fraction of crop residue burned | 0.00 |
| $Frac_{FUEL}$ | Fraction of livestock N excretion in excrements burned for fuel | 0.00 |
| $Frac_{GASF}$ | Fraction of synthetic fertilizer N applied to soils that volatilizes as $NH_3$ and NOx | 0.04 |
| $Frac_{GASM}$ | Fraction of livestock N excretion that volatilizes as $NH_3$ and NOx | 0.20 |
| $Frac_{GRAZ}$ | Fraction of livestock N excreted and deposited onto soil during grazing | 0.14 |
| $Frac_{LEACH}$ | Fraction of N input to soils that is lost through leaching and run-off | 0.30 |
| $Frac_{NCRBF}$ | Fraction of total above-ground biomass of N-fixing crop that is N | 0.03 |
| $Frac_{NCRO}$ | Fraction of residue dry biomass that is N | 0.01 |
| $Frac_{R}$ | Fraction of total above-ground crop biomass that is removed from the field as a crop product | 0.34 |
| Other fractions *(please specify)* | | NO |

[(a)] Use the definitions for fractions as specified in the IPCC Guidelines (Volume 3. Reference Manual, pp. 4.92-4.113) as elaborated by the IPCC good practice guidance (pp. 4.54-4.74).

# TABLE 4.E SECTORAL BACKGROUND DATA FOR AGRICULTURE

Inventory 2007

## Prescribed Burning of Savannas

Submission 2009 v1.1

(Sheet 1 of 1)

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| GREENHOUSE GAS SOURCE AND SINK CATEGORIES | ACTIVITY DATA AND OTHER RELATED INFORMATION | | | | | IMPLIED EMISSION FACTORS | | EMISSIONS | |
|---|---|---|---|---|---|---|---|---|---|
| | Area of savanna burned (k ha/yr) | Average above-ground biomass density (t dm/ha) | Fraction of savanna burned | Biomass burned (Gg dm) | Nitrogen fraction in biomass | $CH_4$ (kg/t dm) | $N_2O$ (kg/t dm) | $CH_4$ (Gg) | $N_2O$ (Gg) |
| (specify ecological zone) | | | | | | | | NO | NO |
| Other non-specified | NO | NO | NO | NO | NO | NO | NO | NO | NO |

**Additional information**

| | Living Biomass | Dead Biomass |
|---|---|---|
| Fraction of above-ground biomass | NO | NO |
| Fraction oxidized | NO | NO |
| Carbon fraction | NO | NO |

**Documentation box:**
Parties should provide detailed explanations on the Agriculture sector in Chapter 6: Agriculture (CRF sector 4) of the NIR. Use this documentation box to provide references to relevant sections of the NIR if any additional information and/or further details are needed to understand the content of this table.

**TABLE 4.F SECTORAL BACKGROUND DATA FOR AGRICULTURE** Inventory 2007

**Field Burning of Agricultural Residues** Submission 2009 v1.1

**(Sheet 1 of 1)** AUSTRIA

| GREENHOUSE GAS SOURCE AND SINK CATEGORIES | ACTIVITY DATA AND OTHER RELATED INFORMATION | | | | | | | | IMPLIED EMISSION FACTORS | | EMISSIONS | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Crop production (t) | Residue/ Crop ratio | Dry matter (dm) fraction of residue | Fraction burned in fields | Fraction oxidized | Total biomass burned (Gg dm) | C fraction of residue | N-C ratio in biomass residues | $CH_4$ (kg/t dm) | $N_2O$ (kg/t dm) | $CH_4$ (Gg) | $N_2O$ (Gg) |
| **1. Cereals** | | | | | | | | | | | 0.04 | 0.00 |
| Wheat | 4 731 937.23 | 1.30 | 0.86 | 0.00 | 0.90 | 14.00 | 0.49 | 0.01 | 2.91 | 0.06 | 0.04 | 0.00 |
| Barley | NA | NA | NA | NA | NO | IE | NO | NA | IE | IE | IE | IE |
| Maize | NA | NA | NA | NA | NO | IE | IE | NA | IE | IE | IE | IE |
| Oats | NA | NA | NA | NA | NO | IE | IE | NA | IE | IE | IE | IE |
| Rye | NA | NA | NA | NA | NO | IE | IE | NA | IE | IE | IE | IE |
| Rice | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| Other *(please specify)* | | | | | | | | | | | NA | NA |
| **2. Pulses** | | | | | | | | | | | NA,NO | NA,NO |
| Dry bean | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| Peas | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| Soybeans | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| Other *(please specify)* | | | | | | | | | | | NA | NA |
| **3 Tubers and Roots** | | | | | | | | | | | NA,NO | NA,NO |
| Potatoes | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| Other *(please specify)* | | | | | | | | | | | NA | NA |
| **4 Sugar Cane** | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| **5 Other** *(please specify)* | | | | | | | | | | | 0.02 | 0.00 |
| Vine | NA | NA | NA | NA | NA | 3.01 | NA | NA | 6.04 | 0.06 | 0.02 | 0.00 |

**Documentation box:**

Parties should provide detailed explanations on the Agriculture sector in Chapter 6: Agriculture (CRF sector 4) of the NIR. Use this documentation box to provide references to relevant sections of the NIR if any additional information and/or further details are needed to understand the content of this table.

**TABLE 5 SECTORAL REPORT FOR LAND USE, LAND-USE CHANGE AND FORESTRY**

**(Sheet 1 of 1)**

Inventory 2007

Submission 2009 v1.1

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| GREENHOUSE GAS SOURCE AND SINK CATEGORIES | Net $CO_2$ emissions/removals(1), (2) | $CH_4$ (2) | $N_2O$ (2) | $NO_x$ | CO | NMVOC |
|---|---|---|---|---|---|---|
| | (Gg) | | | | | |
| **Total Land-Use Categories** | **-17 397.91** | **0.00** | **0.89** | **IE,NA,NE** | **IE,NA,NE** | **NA,NE** |
| **A. Forest Land** | **-19 539.13** | **0.00** | **0.00** | **NE** | **NE** | **NE** |
| 1. Forest Land remaining Forest Land | -16 966.78 | 0.00 | 0.00 | NE | NE | NE |
| 2. Land converted to Forest Land | -2 572.35 | NO | NO | NE | NE | NE |
| **B. Cropland** | **2 034.08** | **NA,NO** | **0.89** | **IE** | **IE** | **NE** |
| 1. Cropland remaining Cropland | 143.23 | NA | NA | IE | IE | NE |
| 2. Land converted to Cropland | 1 890.85 | NO | 0.89 | IE | IE | NE |
| **C. Grassland** | **-1 265.62** | **NO** | **NO** | **IE** | **IE** | **NE** |
| 1. Grassland remaining Grassland | 45.07 | NO | NO | IE | IE | NE |
| 2. Land converted to Grassland | -1 310.69 | NO | NO | IE | IE | NE |
| **D. Wetlands** | **371.78** | **NO** | **NO** | **NA** | **NA** | **NA** |
| 1. Wetlands remaining Wetlands (3) | NE,NO | NO | NO | NA | NA | NA |
| 2. Land converted to Wetlands | 371.78 | NO | NO | NA | NA | NA |
| **E. Settlements** | **530.55** | **NA,NO** | **NA,NO** | **NA** | **NA** | **NA** |
| 1. Settlements remaining Settlements (3) | NE,NO | NA | NA | NA | NA | NA |
| 2. Land converted to Settlements | 530.55 | NA | NA | NA | NA | NA |
| **F. Other Land** | **470.44** | **NA,NO** | **NA,NO** | **NA** | **NA** | **NA** |
| 1. Other Land remaining Other Land (4) | | | | | | |
| 2. Land converted to Other Land | 470.44 | NA | NA | NA | NA | NA |
| **G. Other *(please specify)*** (5) | **NE** | **NA** | **NA** | **NA** | **NA** | **NA** |
| *Harvested Wood Products* (6) | NE | NA | NA | NA | NA | NA |
| **Information items**(7) | | | | | | |
| Forest Land converted to other Land-Use Categories | 1 285.44 | NA | NA | NA | NA | NA |
| Grassland converted to other Land-Use Categories | 1 035.24 | NE | 0.89 | NA | NA | NA |

(1) According to the Revised 1996 IPCC Guidelines, for the purposes of reporting, the signs for removals are always negative (-) and for emissions positive (+).

(2) For each land-use category and sub-category, this table sums net $CO_2$ emissions and removals shown in tables 5.A to 5.F, and the $CO_2$, $CH_4$ and $N_2O$ emissions showing in tables 5(I) to 5(V).

(3) Parties may decide not to prepare estimates for these categories contained in appendices 3a.3 and 3a.4 of the IPCC good practice guidance for LULUCF, although they may do so if they wish.

(4) This land-use category is to allow the total of identified land area to match the national area.

(5) The total for category 5.G Other includes items specified only under category 5.G in this table as well as sources and sinks specified in category 5.G in tables 5(I) to 5(V).

(6) Parties may decide not to prepare estimates for this category contained in appendix 3a.1 of the IPCC good practice guidance for LULUCF, although they may do so if they wish and report in this row.

(7) These items are listed for information only and will not be added to the totals, because they are already included in subcategories 5.A.2 to 5.F.2.

**Documentation box:**

• Parties should provide detailed explanations on the Land Use, Land-Use Change and Forestry sector in Chapter 7: Land Use, Land-Use Change and Forestry (CRF sector 5) of the NIR. Use this documentation box to provide references to relevant sections of the NIR if any additional information and/or further details are needed to understand the content of this table.

• If estimates are reported under 5.G Other, use this documentation box to provide information regarding activities covered under this category and to provide reference to the section in the NIR where background information can be found.

**TABLE 5.A SECTORAL BACKGROUND DATA FOR LAND USE, LAND-USE CHANGE AND FORESTRY**
**Forest Land**
**(Sheet 1 of 1)**

Inventory 2007
Submission 2009 v1.1
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| GREENHOUSE GAS SOURCE AND SINK CATEGORIES | | ACTIVITY DATA | | IMPLIED CARBON-STOCK-CHANGE FACTORS | | | | | | CHANGES IN CARBON STOCK | | | | | | Net $CO_2$ emissions/ removals (8) (9) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Land-Use Category | Sub-division(1) | Area(2) (kha) | Area of organic soil(2) (kha) | Carbon stock change in living biomass per area (3) (4) | | | Net carbon stock change in dead organic matter per area(4) | Net carbon stock change in soils per area (4) | | Carbon stock change in living biomass(3) (4) | | | Net carbon stock change in dead organic matter(4) | Net carbon stock change in soils (4) (6) | | |
| | | | | Gains | Losses | Net change | | Mineral soils(5) | Organic soils | Gains | Losses | Net change | | Mineral soils | Organic soils(7) | |
| | | | | (Mg C/ha) | | | | | | (Gg C) | | | | | | (Gg) |
| **A. Total Forest Land** | | 3 600.65 | NA,NO | 3.01 | -1.71 | 1.30 | 0.05 | 0.13 | NO | 10 841.26 | -6 154.85 | 4 686.41 | 163.95 | 478.50 | NO | -19 539.13 |
| 1. Forest Land remaining Forest Land | | 3 373.09 | NA | 3.13 | -1.81 | 1.32 | 0.05 | NO | NO | 10 573.65 | -6 110.30 | 4 463.35 | 163.95 | NO | NO | -16 966.78 |
| | Coniferous | 2 489.34 | NA | 3.15 | -1.98 | 1.18 | 0.05 | NO | NO | 7 849.69 | -4 924.17 | 2 925.52 | 124.51 | NO | NO | -11 183.44 |
| | Deciduous | 883.75 | NA | 3.08 | -1.34 | 1.74 | 0.04 | NO | NO | 2 723.96 | -1 186.13 | 1 537.84 | 39.44 | NO | NO | -5 783.34 |
| 2. Land converted to Forest Land(10) | | 227.56 | NO | 1.18 | -0.20 | 0.98 | NO | 2.10 | NO | 267.61 | -44.56 | 223.05 | NO | 478.50 | NO | -2 572.35 |
| 2.1 Cropland converted to Forest Land | | 36.41 | NO | 1.18 | IE | 1.18 | NO | 3.02 | NO | 42.82 | IE | 42.82 | NO | 109.80 | NO | -559.61 |
| | Total | 36.41 | NO | 1.18 | IE | 1.18 | NO | 3.02 | NO | 42.82 | IE | 42.82 | NO | 109.80 | NO | -559.61 |
| 2.2 Grassland converted to Forest Land | | 134.26 | NO | 1.18 | IE | 1.18 | NO | 0.97 | NO | 157.89 | IE | 157.89 | NO | 130.15 | NO | -1 056.16 |
| | Total | 134.26 | NO | 1.18 | IE | 1.18 | NO | 0.97 | NO | 157.89 | IE | 157.89 | NO | 130.15 | NO | -1 056.16 |
| 2.3 Wetlands converted to Forest Land | | 11.38 | NO | 1.18 | IE | 1.18 | NO | 4.55 | NO | 13.38 | IE | 13.38 | NO | 51.82 | NO | -239.07 |
| | Total | 11.38 | NO | 1.18 | IE | 1.18 | NO | 4.55 | NO | 13.38 | IE | 13.38 | NO | 51.82 | NO | -239.07 |
| 2.4 Settlements converted to Forest Land | | 31.86 | NO | 1.18 | -1.40 | -0.22 | NO | 3.91 | NO | 37.47 | -44.56 | -7.09 | NO | 124.43 | NO | -430.25 |
| | Total | 31.86 | NO | 1.18 | -1.40 | -0.22 | NO | 3.91 | NO | 37.47 | -44.56 | -7.09 | NO | 124.43 | NO | -430.25 |
| 2.5 Other Land converted to Forest Land | | 13.65 | NO | 1.18 | IE | 1.18 | NO | 4.56 | NO | 16.06 | IE | 16.06 | NO | 62.29 | NO | -287.26 |
| | Total | 13.65 | NO | 1.18 | IE | 1.18 | NO | 4.56 | NO | 16.06 | IE | 16.06 | NO | 62.29 | NO | -287.26 |

(1) Land categories may be further divided according to climate zone, management system, soil type, vegetation type, tree species, ecological zone or national land classification.

(2) The total area of the subcategories, in accordance with the sub-division used, should be entered here. For lands converted to Forest Land report the cumulative area remaining in the category in the reporting year.

(3) Carbon stock gains and losses should be listed separately except in cases where, due to the methods used, it is technically impossible to separate information on gains and losses.

(4) The signs for estimates of gains in carbon stocks are positive (+) and of losses in carbon stocks are negative (-).

(5) Implied carbon-stock-change factors for mineral soils are calculated by dividing the net C stock change estimate for mineral soil by the difference between the area and the area of organic soil.

(6) When Parties are estimating fluxes for organic soils but cannot separate these fluxes from mineral soils, these fluxes should be reported under mineral soils.

(7) The value reported for organic soils is estimated as a flux. For consistency with other entries in this column, these fluxes should be expressed in the unit required in this column, i.e. in Gg C.

(8) According to the Revised 1996 IPCC Guidelines, for the purposes of reporting, the signs for removals are always negative (-) and for emissions positive (+). Net changes in carbon stocks are converted to $CO_2$ by multiplying C by 44/12 and changing the sign for net CO2 removals to be negative (-) and for net $CO_2$ emissions to be positive (+). Note that carbon stock changes in a single pool are not necessarily equal to emissions or removals, because some carbon stock changes result from carbon transfers among pools rather than exchanges with the atmosphere.

(9) Where Parties directly estimate emissions and removals rather than carbon stock changes, they may report emissions/removals directly in this column and use notation keys in the stock change columns.

(10) A Party may report aggregate estimates for all conversions of land to forest land when data are not available to report them separately. A Party should specify in the documentation box which types of land conversion are included. Separate estimates for grassland conversion should be provided in table 5 as an information item.

| **Documentation box:** |
|---|
| Parties should provide detailed explanations on the Land Use, Land-Use Change and Forestry sector in Chapter 7: Land Use, Land-Use Change and Forestry (CRF sector 5) of the NIR. Use this documentation box to provide references to relevant sections of the NIR if any additional information and/or further details are needed to understand the content of this table. |

**TABLE 5.B SECTORAL BACKGROUND DATA FOR LAND USE, LAND-USE CHANGE AND FORESTRY** Inventory 2007
**Cropland** Submission 2009 v1.1
**(Sheet 1 of 1)** AUSTRIA

| GREENHOUSE GAS SOURCE AND SINK CATEGORIES | | ACTIVITY DATA | | IMPLIED CARBON-STOCK-CHANGE FACTORS | | | | | | CHANGES IN CARBON STOCK | | | | | | Net $CO_2$ emissions/ removals [10] [11] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Land-Use Category | Sub-division [1] | Area[2] (kha) | Area of organic soil[2] (kha) | Carbon stock change in living biomass per area [3] [4] | | | Net carbon stock change in dead organic matter per area[4] | Net carbon stock change in soils per area [4] | | Carbon stock change in living biomass[3], [4], [6] | | | Net carbon stock change in dead organic matter[4] [7] | Net carbon stock change in soils [4] [8] | | |
| | | | | Gains | Losses | Net change | | Mineral soils[5] | Organic soils | Gains | Losses | Net change | | Mineral soils | Organic soils[9] | |
| | | | | (Mg C/ha) | | | | | | (Gg C) | | | | | | (Gg) |
| **B. Total Cropland** | | 1 473.88 | NO | 0.03 | -0.06 | -0.03 | NO | -0.33 | NO | 47.36 | -84.55 | -37.19 | NO | -493.00 | NO | 1 944.04 |
| 1. Cropland remaining Cropland | | 926.06 | NO | IE | -0.09 | -0.09 | NO | 0.07 | NO | IE | -79.30 | -79.30 | NO | 64.80 | NO | 53.18 |
| | Perennial convertec | 9.47 | NO | IE | -3.75 | -3.75 | NO | -0.35 | NO | IE | -35.57 | -35.57 | NO | -3.32 | NO | 142.59 |
| | Annual remaining a | 904.07 | NO | IE | -0.04 | -0.04 | NO | 0.07 | NO | IE | -40.01 | -40.01 | NO | 63.74 | NO | -87.00 |
| | Annual converted t | 12.51 | NO | IE | -0.30 | -0.30 | NO | 0.35 | NO | IE | -3.72 | -3.72 | NO | 4.38 | NO | -2.40 |
| 2. Land converted to Cropland[12] | | 547.83 | NO | 0.09 | -0.01 | 0.08 | NO | -1.02 | NO | 47.36 | -5.25 | 42.12 | NO | -557.80 | NO | 1 890.85 |
| 2.1 Forest Land converted to Cropland | | 5.48 | NO | IE | -0.88 | -0.88 | NO | -2.94 | NO | IE | -4.81 | -4.81 | NO | -16.10 | NO | 76.68 |
| | Total | 5.48 | NO | IE | -0.88 | -0.88 | NO | -2.94 | NO | IE | -4.81 | -4.81 | NO | -16.10 | NO | 76.68 |
| 2.2 Grassland converted to Cropland | | 542.35 | NO | 0.09 | 0.00 | 0.09 | NO | -1.00 | NO | 47.36 | -0.44 | 46.93 | NO | -541.70 | NO | 1 814.17 |
| | Grassland converte | 1.85 | NO | IE | -0.24 | -0.24 | NO | -0.65 | NO | IE | -0.44 | -0.44 | NO | -1.20 | NO | 6.00 |
| | Grassland converte | 540.50 | NO | 0.09 | IE | 0.09 | NO | -1.00 | NO | 47.36 | IE | 47.36 | NO | -540.50 | NO | 1 808.17 |
| 2.3 Wetlands converted to Cropland | | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| | Total | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| 2.4 Settlements converted to Cropland | | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| | Total | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| 2.5 Other Land converted to Cropland | | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| | Total | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |

(1) Land categories may be further divided according to climate zone, management system, soil type, vegetation type, tree species, ecological zone or national land classification.

(2) The total area of the subcategories, in accordance with the sub-division used, should be entered here. For lands converted to Cropland report the cumulative area remaining in the category in the reporting year.

(3) Carbon stock gains and losses should be listed separately except in cases where, due to the methods used, it is technically impossible to separate information on gains and losses.

(4) The signs for estimates of gains in carbon stocks are positive (+) and of losses in carbon stocks are negative (-).

(5) Implied carbon-stock-change factors for mineral soils are calculated by dividing the net C stock change estimate for mineral soil by the difference between the area and the area of organic soil.

(6) For category 5.B.1 Cropland remaining Cropland this column only includes changes in perennial woody biomass.

(7) No reporting on dead organic matter pools is required for category 5.B.1. Cropland remaining Cropland.

(8) When Parties are estimating fluxes for organic soils but cannot separate these fluxes from mineral soils, these fluxes should be reported under mineral soils.

(9) The value reported for organic soils is estimated as a flux. For consistency with other entries in this column, these fluxes should be expressed in the unit required in this column, i.e. in Gg C.

(10) According to the Revised 1996 IPCC Guidelines, for the purposes of reporting, the signs for removals are always negative (-) and for emissions positive (+). Net changes in carbon stocks are converted to $CO_2$ by multiplying C by 44/12 and changing the sign for net $CO_2$ removals to be negative (-) and for net $CO_2$ emissions to be positive (+). Note that carbon stock changes in a single pool are not necessarily equal to emissions or removals, because some carbon stock changes result from carbon transfers among pools rather than exchanges with the atmosphere.

(11) Where Parties directly estimate emissions and removals rather than carbon stock changes, they may report emissions/removals directly in this column and use notation keys in the stock change columns.

(12) A Party may report aggregate estimates for all land conversions to cropland, when data are not available to report them separately. A Party should specify in the documentation box which types of land conversion are included. Separate estimates for forest land and grassland conversion should be provided in table 5 as an information item.

| Documentation box: |
|---|
| Parties should provide detailed explanations on the Land Use, Land-Use Change and Forestry sector in Chapter 7: Land Use, Land-Use Change and Forestry (CRF sector 5) of the NIR. Use this documentation box to provide references to relevant sections of the NIR if any additional information and/or further details are needed to understand the content of this table. |

**TABLE 5.C SECTORAL BACKGROUND DATA FOR LAND USE, LAND-USE CHANGE AND FORESTRY** Inventory 2007

**Grassland** Submission 2009 v1.1

**(Sheet 1 of 1)** AUSTRIA

| GREENHOUSE GAS SOURCE AND SINK CATEGORIES | | ACTIVITY DATA | | IMPLIED CARBON-STOCK-CHANGE FACTORS | | | | | | CHANGES IN CARBON STOCK | | | | | | Net $CO_2$ emissions/ removals [10] [11] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Land-Use Category | Sub-division [1] | Area[2] (kha) | Area of organic soil[2] (kha) | Carbon stock change in living biomass per area [3] [4] | | | Net carbon stock change in dead organic matter per area[4] | Net carbon stock change in soils per area [4] | | Carbon stock change in living biomass[3], [4], [6] | | | Net carbon stock change in dead organic matter[4] [7] | Net carbon stock change in soils [4] [8] | | |
| | | | | Gains | Losses | Net change | | Mineral soils[5] | Organic soils | Gains | Losses | Net change | | Mineral soils | Organic soils[9] | |
| | | | | (Mg C/ha) | | | | | | (Gg C) | | | | | | (Gg) |
| **C. Total Grassland** | | 1 838.11 | IE,NO | IE,NO | -0.05 | -0.05 | NO | 0.23 | IE,NO | IE,NO | -83.32 | -83.32 | NO | 428.49 | | -1 265.62 |
| 1. Grassland remaining Grassland | | 1 288.78 | IE | NO | NO | NO | NO | -0.01 | IE | NO | NO | NO | NO | -12.29 | IE | 45.07 |
| | Total | 1 288.78 | IE | NO | NO | NO | NO | -0.01 | IE | NO | NO | NO | NO | -12.29 | IE | 45.07 |
| 2. Land converted to Grassland[12] | | 549.33 | NO | IE,NO | -0.15 | -0.15 | NO | 0.80 | NO | IE,NO | -83.32 | -83.32 | NO | 440.78 | | -1 310.69 |
| 2.1 Forest Land converted to Grassland | | 58.06 | NO | IE | -0.88 | -0.88 | NO | -0.85 | NO | IE | -51.02 | -51.02 | NO | -49.53 | NO | 368.68 |
| | Total | 58.06 | NO | IE | -0.88 | -0.88 | NO | -0.85 | NO | IE | -51.02 | -51.02 | NO | -49.53 | NO | 368.68 |
| 2.2 Cropland converted to Grassland | | 491.27 | NO | IE | -0.07 | -0.07 | NO | 1.00 | NO | IE | -32.30 | -32.30 | NO | 490.31 | | -1 679.37 |
| | Annual cropland co | 488.53 | NO | IE | -0.05 | -0.05 | NO | 1.00 | NO | IE | -22.33 | -22.33 | NO | 488.53 | NO | -1 709.43 |
| | Perennial cropland | 2.73 | NO | IE | -3.65 | -3.65 | NO | 0.65 | NO | IE | -9.98 | -9.98 | NO | 1.78 | | 30.06 |
| 2.3 Wetlands converted to Grassland | | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| | Total | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| 2.4 Settlements converted to Grassland | | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| | Total | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| 2.5 Other Land converted to Grassland | | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| | Total | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |

[1] Land categories may be further divided according to climate zone, management system, soil type, vegetation type, tree species, ecological zone or national land classification.

[2] The total area of the subcategories, in accordance with the sub-division used, should be entered here. For lands converted to Grassland report the cumulative area remaining in the category in the reporting year.

[3] Carbon stock gains and losses should be listed separately except in cases where, due to the methods used, it is technically impossible to separate information on gains and losses.

[4] The signs for estimates of gains in carbon stocks are positive (+) and of losses in carbon stocks are negative (-).

[5] Implied carbon-stock-change factors for mineral soils are calculated by dividing the net C stock change estimate for mineral soil by the difference between the area and the area of organic soil.

[6] For category 5.C.1 Grassland remaining Grassland this column only includes changes in perennial woody biomass.

[7] No reporting on dead organic matter pools is required for category 5.C.1 Grassland remaining Grassland.

[8] When Parties are estimating fluxes for organic soils but cannot separate these fluxes from mineral soils, these fluxes should be reported under mineral soils.

[9] The value reported for organic soils is estimated as a flux. For consistency with other entries in this column, these fluxes should be expressed in the unit required in this column, i.e. in Gg C.

[10] According to the Revised 1996 IPCC Guidelines, for the purposes of reporting, the signs for removals are always negative (-) and for emissions positive (+). Net changes in carbon stocks are converted to $CO_2$ by multiplying C by 44/12 and changing the sign for net $CO_2$ removals to be negative (-) and for net $CO_2$ emissions to be positive (+). Note that carbon stock changes in a single pool are not necessarily equal to emissions or removals, because some carbon stock changes result from carbon transfers among pools rather than exchanges with the atmosphere.

[11] Where Parties directly estimate emissions and removals rather than carbon stock changes, they may report emissions/removals directly in this column and use notation keys in the stock change columns.

[12] A Party may report aggregate estimates for all land conversions to grassland, when data are not available to report them separately. A Party should specify in the documentation box which types of land conversion are included. Separate estimates for forest land conversion should be provided in table 5 as an information item.

**Documentation box:**

Parties should provide detailed explanations on the Land Use, Land-Use Change and Forestry sector in Chapter 7: Land Use, Land-Use Change and Forestry (CRF sector 5) of the NIR. Use this documentation box to provide references to relevant sections of the NIR if any additional information and/or further details are needed to understand the content of this table.

**TABLE 5.D SECTORAL BACKGROUND DATA FOR LAND USE, LAND-USE CHANGE AND FORESTRY**
**Wetlands**
**(Sheet 1 of 1)**

Inventory 2007
Submission 2009 v1.1
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| GREENHOUSE GAS SOURCE AND SINK CATEGORIES | | ACTIVITY DATA | IMPLIED CARBON-STOCK-CHANGE FACTORS | | | | | CHANGES IN CARBON STOCK | | | | | Net $CO_2$ emissions/ removals (5) (6) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Land-Use Category | Sub-division (1) | Area(2) (kha) | Carbon stock change in living biomass per area (3) (4) | | | Net carbon stock change in dead organic matter per area(4) | Net carbon stock change in soils per area (4) | Carbon stock change in living biomass(3) (4) | | | Net carbon stock change in dead organic matter(4) | Net carbon stock change in soils (4) | |
| | | | Gains | Losses | Net change | | | Gains | Losses | Net change | | | |
| | | | (Mg C/ha) | | | | | (Gg C) | | | | | (Gg) |
| **D. Total Wetlands** | | 143.48 | IE,NE,NO | -0.12 | -0.12 | NE,NO | -0.59 | IE,NE,NO | -16.55 | -16.55 | NE,NO | -84.85 | 371.78 |
| 1. Wetlands remaining Wetlands (7) | | 121.70 | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE |
| | Total | 121.70 | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE |
| 2. Land converted to Wetlands (8) | | 21.78 | IE,NO | -0.76 | -0.76 | NO | -3.90 | IE,NO | -16.55 | -16.55 | NO | -84.85 | 371.78 |
| 2.1 Forest Land converted to Wetlands | | 3.29 | IE | -0.88 | -0.88 | NO | -6.05 | IE | -2.89 | -2.89 | NO | -19.88 | 83.50 |
| | Total | 3.29 | IE | -0.88 | -0.88 | NO | -6.05 | IE | -2.89 | -2.89 | NO | -19.88 | 83.50 |
| 2.2 Cropland converted to Wetlands | | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| | Total | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| 2.3 Grassland converted to Wetlands | | 14.42 | NO | NO | NO | NO | -3.50 | NO | NO | NO | NO | -50.47 | 185.07 |
| | Total | 14.42 | NO | NO | NO | NO | -3.50 | NO | NO | NO | NO | -50.47 | 185.07 |
| 2.4 Settlements converted to Wetlands | | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| | Total | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| 2.5 Other Land converted to Wetlands | | 4.07 | IE | -3.36 | -3.36 | NO | -3.56 | IE | -13.66 | -13.66 | NO | -14.49 | 103.20 |
| | Total | 4.07 | IE | -3.36 | -3.36 | NO | -3.56 | IE | -13.66 | -13.66 | NO | -14.49 | 103.20 |

(1) Land categories may be further divided according to climate zone, management system, soil type, vegetation type, tree species, ecological zone or national land classification.

(2) The total area of the subcategories, in accordance with the sub-division used, should be entered here. For lands converted to Wetlands report the cumulative area remaining in the category in the reporting year.

(3) Carbon stock gains and losses should be listed separately except in cases where, due to the methods used, it is technically impossible to separate information on gains and losses.

(4) The signs for estimates of gains in carbon stocks are positive (+) and of losses in carbon stocks are negative (-).

(5) According to the Revised 1996 IPCC Guidelines, for the purposes of reporting, the signs for removals are always negative (-) and for emissions positive (+). Net changes in carbon stocks are converted to $CO_2$ by multiplying C by 44/12 and changing the sign for net $CO_2$ removals to be negative (-) and for net $CO_2$ emissions to be positive (+). Note that carbon stock changes in a single pool are not necessarily equal to emissions or removals, because some carbon stock changes result from carbon transfers among pools rather than exchanges with the atmosphere.

(6) Where Parties directly estimate emissions and removals rather than carbon stock changes, they may report emissions/removals directly in this column and use notation keys in the stock change columns.

(7) Parties may decide not to prepare estimates for this category contained in appendix 3a.3 of the IPCC good practice guidance for LULUCF, although they may do so if they wish.

(8) A Party may report aggregate estimates for all land conversions to wetlands, when data are not available to report them separately. A Party should specify in the documentation box which types of land conversion are included. Separate estimates for forest land and grassland conversion should be provided in table 5 as an information item.

**Documentation box:**

Parties should provide detailed explanations on the Land Use, Land-Use Change and Forestry in Chapter 7: Land Use, Land-Use Change and Forestry (CRF sector 5) of the NIR. Use this documentation box to provide references to relevant sections of the NIR if any additional information and/or further details are needed to understand the content of this table.

**TABLE 5.E SECTORAL BACKGROUND DATA FOR LAND USE, LAND-USE CHANGE AND FORESTRY** Inventory 2007

**Settlements** Submission 2009 v1.1

**(Sheet 1 of 1)** AUSTRIA

| GREENHOUSE GAS SOURCE AND SINK CATEGORIES | | ACTIVITY DATA | IMPLIED CARBON-STOCK-CHANGE FACTORS | | | | | CHANGES IN CARBON STOCK | | | | | Net $CO_2$ emissions/ removals [6] [7] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Land-Use Category | Sub-division [1] | Area[2] (kha) | Carbon stock change in living biomass per area [3] [4] | | | Net carbon stock change in dead organic matter per area[4] | Net carbon stock change in soils per area [4] | Carbon stock change in living biomass[3], [4], [5] | | | Net carbon stock change in dead organic matter[4] | Net carbon stock change in soils [4] | |
| | | | Gains | Losses | Net change | | | Gains | Losses | Net change | | | |
| | | | (Mg C/ha) | | | | | (Gg C) | | | | | (Gg) |
| **E. Total Settlements** | | 502.90 | 0.22 | -0.15 | 0.08 | NO | -0.36 | 113.04 | -74.79 | 38.26 | NO | -182.95 | 530.55 |
| 1. Settlements remaining Settlements [8] | | 331.10 | NE | NE | NE | NO | NE | NE | NE | NE | NO | NE | NE,NO |
| | Total | 331.10 | NE | NE | NE | NO | NE | NE | NE | NE | NO | NE | NE,NO |
| 2. Land converted to Settlements [9] | | 171.80 | 0.66 | -0.44 | 0.22 | NO | -1.06 | 113.04 | -74.79 | 38.26 | NO | -182.95 | 530.55 |
| 2.1 Forest Land converted to Settlements | | 16.43 | 0.58 | -0.88 | -0.30 | NO | -4.45 | 9.57 | -14.44 | -4.87 | NO | -73.17 | 286.14 |
| | Total | 16.43 | 0.58 | -0.88 | -0.30 | NO | -4.45 | 9.57 | -14.44 | -4.87 | NO | -73.17 | 286.14 |
| 2.2 Cropland converted to Settlements | | 48.48 | 0.85 | -1.24 | -0.39 | NO | NO | 41.22 | -60.35 | -19.13 | NO | NO | 70.15 |
| | Total | 48.48 | 0.85 | -1.24 | -0.39 | NO | NO | 41.22 | -60.35 | -19.13 | NO | NO | 70.15 |
| 2.3 Grassland converted to Settlements | | 60.19 | 0.58 | NO | 0.58 | NO | -1.00 | 35.06 | NO | 35.06 | NO | -60.19 | 92.15 |
| | Total | 60.19 | 0.58 | NO | 0.58 | NO | -1.00 | 35.06 | NO | 35.06 | NO | -60.19 | 92.15 |
| 2.4 Wetlands converted to Settlements | | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| | Total | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| 2.5 Other Land converted to Settlements | | 46.69 | 0.58 | NO | 0.58 | NO | -1.06 | 27.20 | NO | 27.20 | NO | -49.59 | 82.11 |
| | Total | 46.69 | 0.58 | NO | 0.58 | NO | -1.06 | 27.20 | NO | 27.20 | NO | -49.59 | 82.11 |

(1) Land categories may be further divided according to climate zone, management system, soil type, vegetation type, tree species, ecological zone or national land classification.

(2) The total area of the subcategories, in accordance with the sub-division used, should be entered here. For lands converted to Settlements report the cumulative area remaining in the category in the reporting year.

(3) Carbon stock gains and losses should be listed separately except in cases where, due to the methods used, it is technically impossible to separate information on gains and losses.

(4) The signs for estimates of gains in carbon stocks are positive (+) and of losses in carbon stocks are negative (-).

(5) For category 5.E.1 Settlements remaining Settlements this column only includes changes in perennial woody biomass.

(6) According to the Revised 1996 IPCC Guidelines, for the purposes of reporting, the signs for removals are always negative (-) and for emissions positive (+). Net changes in carbon stocks are converted to $CO_2$ by multiplying C by 44/12 and changing the sign for net $CO_2$ removals to be negative (-) and for net $CO_2$ emissions to be positive (+). Note that carbon stock changes in a single pool are not necessarily equal to emissions or removals, because some carbon stock changes result from carbon transfers among pools rather than exchanges with the atmosphere.

(7) Where Parties directly estimate emissions and removals rather than carbon stock changes, they may report emissions/removals directly in this column and use notation keys in the stock change columns.

(8) Parties may decide not to prepare estimates for this category contained in appendix 3a.4 of the IPCC good practice guidance for LULUCF, although they may do so if they wish.

(9) A Party may report aggregate estimates for all land conversions to settlements, when data are not available to report them separately. A Party should specify in the documentation box which types of land conversion are included. Separate estimates for forest land and grassland conversion should be provided in table 5 as an information item.

**Documentation box:**
Parties should provide detailed explanations on the Land Use, Land-Use Change and Forestry sector in Chapter 7: Land Use, Land-Use Change and Forestry (CRF sector 5) of the NIR. Use this documentation box to provide references to relevant sections of the NIR if any additional information and/or further details are needed to understand the content of this table.

**TABLE 5.F SECTORAL BACKGROUND DATA FOR LAND USE, LAND-USE CHANGE AND FORESTRY**

**Other land**

**(Sheet 1 of 1)**

Inventory 2007

Submission 2009 v1.1

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| GREENHOUSE GAS SOURCE AND SINK CATEGORIES | | ACTIVITY DATA | IMPLIED CARBON-STOCK-CHANGE FACTORS | | | | | CHANGES IN CARBON STOCK | | | | | Net $CO_2$ emissions/ removals [5] [6] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Land-Use Category | Sub-division [1] | Area[2] (kha) | Carbon stock change in living biomass per area [3] [4] | | | Net carbon stock change in dead organic matter per area[4] | Net carbon stock change in soils per area [4] | Carbon stock change in living biomass[3] [4] | | | Net carbon stock change in dead organic matter[4] | Net carbon stock change in soils [4] | |
| | | | Gains | Losses | Net change | | | Gains | Losses | Net change | | | |
| | | | (Mg C/ha) | | | | | (Gg C) | | | | | (Gg) |
| **F. Total Other Land** | | 26.29 | IE,NO | -0.88 | -0.88 | NO | -4.00 | IE,NO | -23.10 | -23.10 | NO | -105.20 | 470.44 |
| 1. Other Land remaining Other Land [7] | | NE | | | | | | | | | | | |
| 2. Land converted to Other Land [8] | | 26.29 | IE,NO | -0.88 | -0.88 | NO | -4.00 | IE,NO | -23.10 | -23.10 | NO | -105.20 | 470.44 |
| 2.1 Forest Land converted to Other Land | | 26.29 | IE | -0.88 | -0.88 | NO | -4.00 | IE | -23.10 | -23.10 | NO | -105.20 | 470.44 |
| | Total | 26.29 | IE | -0.88 | -0.88 | NO | -4.00 | IE | -23.10 | -23.10 | NO | -105.20 | 470.44 |
| 2.2 Cropland converted to Other Land | | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| | Total | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| 2.3 Grassland converted to Other Land | | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| | Total | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| 2.4 Wetlands converted to Other Land | | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| | Total | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| 2.5 Settlements converted to Other Land | | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| | Total | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |

(1) Land categories may be further divided according to climate zone, management system, soil type, vegetation type, tree species, ecological zone or national land classification.

(2) The total area of the subcategories, in accordance with the sub-division used, should be entered here. For lands converted to Other Land report the cumulative area remaining in the category in the reporting year.

(3) Carbon stock gains and losses should be listed separately except in cases where, due to the methods used, it is technically impossible to separate information on gains and losses.

(4) The signs for estimates of gains in carbon stocks are positive (+) and of losses in carbon stocks are negative (-).

(5) According to the Revised 1996 IPCC Guidelines, for the purposes of reporting, the signs for removals are always negative (-) and for emissions positive (+). Net changes in carbon stocks are converted to $CO_2$ by multiplying C by 44/12 and changing the sign for net $CO_2$ removals to be negative (-) and for net $CO_2$ emissions to be positive (+). Note that carbon stock changes in a single pool are not necessarily equal to emissions or removals, because some carbon stock changes result from carbon transfers among pools rather than exchanges with the atmosphere.

(6) Where Parties directly estimate emissions and removals rather than carbon stock changes, they may report emissions/removals directly in this column and use notation keys in the stock change columns.

(7) This land-use category is to allow the total of identified land area to match the national area.

(8) A Party may report aggregate estimates for all land conversions to other land, when data are not available to report them separately. A Party should specify in the documentation box which types of land conversion are included. Separate estimates for forest land and grassland conversion should be provided in table 5 as an information item.

**Documentation box:**

Parties should provide detailed explanations on the Land Use, Land-Use Change and Forestry sector in Chapter 7: Land Use, Land-Use Change and Forestry (CRF sector 5) of the NIR. Use this documentation box to provide references to relevant sections of the NIR if any additional information and/or further details are needed to understand the content of this table.

**TABLE 5 (I) SECTORAL BACKGROUND DATA FOR LAND USE, LAND-USE CHANGE AND FORESTRY**

Inventory 2007

**Direct $N_2O$ emissions from N fertilization[1] of Forest Land and Other**

Submission 2009 v1.1

**(Sheet 1 of 1)**

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| GREENHOUSE GAS SOURCE AND SINK CATEGORIES | ACTIVITY DATA | IMPLIED EMISSION FACTORS | EMISSIONS [4] |
|---|---|---|---|
| Land-Use Category [2] | Total amount of fertilizer applied | $N_2O$-N emissions per unit of fertilizer | $N_2O$ |
| | (Gg N/yr) | (kg $N_2O$-N/kg N)[3] | (Gg) |
| **Total for all Land Use Categories** | **NO** | **NO** | **NO** |
| **A. Forest Land [5] [6]** | **NO** | **NO** | **NO** |
| 1. Forest Land remaining Forest Land | NO | NO | NO |
| 2. Land converted to Forest Land | NO | NO | NO |
| **G. Other *(please specify)*** | | | |

(1) Direct $N_2O$ emissions from fertilization are estimated using equations 3.2.17 and 3.2.18 of the IPCC good practice guidance for LULUCF based on the amounts of fertilizers applied to forest land.

(2) $N_2O$ emissions from N fertilization of cropland and grassland are reported in the Agriculture sector; therefore only Forest Land is included in this table.

(3) In the calculation of the implied emission factor, $N_2O$ emissions are converted to $N_2O$-N by multiplying by 28/44.

(4) Emissions are reported with a positive sign.

(5) If a Party is not able to separate the fertilizer applied to forest land from that applied to agriculture, it may report all $N_2O$ emissions from fertilization in the Agriculture sector. This should be explicitly indicated in the documentation box.

(6) A Party may report aggregate estimates for all N fertilization on forest land in the category Forest Land remaining Forest Land when data are not available to report Forest Land remaining Forest Land and Land converted to Forest Land separ

| **Documentation box:** |
|---|
| Parties should provide detailed explanations on the Land Use, Land-Use Change and Forestry sector in Chapter 7: Land Use, Land-Use Change and Forestry (CRF sector 5) of the NIR. Use this documentation box to provide references to relevant sections of the NIR if any additional information and/or further details are needed to understand the content of this table. |

**TABLE 5 (II) SECTORAL BACKGROUND DATA FOR LAND USE, LAND-USE CHANGE AND FORESTRY**

Inventory 2007

**Non-$CO_2$ emissions from drainage of soils and wetlands**[1]

Submission 2009 v1.1

**(Sheet 1 of 1)**

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| GREENHOUSE GAS SOURCE AND SINK CATEGORIES | | ACTIVITY DATA | IMPLIED EMISSION FACTORS | | EMISSIONS [5] | |
|---|---|---|---|---|---|---|
| Land-Use Category [2] | Sub-division [3] | Area (kha) | $N_2O$-N per area [4] (kg $N_2O$-N/ha) | $CH_4$ per area (kg $CH_4$/ha) | $N_2O$ (Gg) | $CH_4$ (Gg) |
| **Total all Land-Use Categories** | | | | | **NO** | **NO** |
| **A. Forest Land** [6] | | | **NO** | **NO** | **NO** | **NO** |
| Organic Soil | | NO | NO | NO | NO | NO |
| | Total | NO | NO | NO | NO | NO |
| Mineral Soil | | NO | NO | NO | NO | NO |
| | Total | NO | NO | NO | NO | NO |
| **D. Wetlands** | | | **NO** | **NO** | **NO** | **NO** |
| Peatland [7] | | NO | NO | NO | NO | NO |
| Flooded Lands [7] | | NO | NO | NO | NO | NO |
| **G. Other (please specify)** | | | | | | |

(1) Parties may decide not to prepare estimates for these categories contained in appendices 3a.2 and 3a.3 of the IPCC good practice guidance for LULUCF, although they may do so if they wish.

(2) $N_2O$ emissions from drained cropland and grassland soils are covered in the Agriculture tables of the CRF under Cultivation of Histosols.

(3) A Party should report further disaggregations of drained soils corresponding to the methods used. Tier 1 disaggregates soils into "nutrient rich" and "nutrient poor" areas, whereas higher-tier methods can further disaggregate into differen

(4) In the calculation of the implied emission factor, $N_2O$ emissions are converted to $N_2O$-N by multiplying by 28/44.

(5) Emissions are reported with a positive sign.

(6) In table 5, these emissions will be added to 5.A.1 Forest Land remaining Forest Land.

(7) In table 5, these emissions will be added to 5.D.2 Land converted to Wetlands.

**Documentation box:**
Parties should provide detailed explanations on the Land Use, Land-Use Change and Forestry sector in Chapter 7: Land Use, Land-Use Change and Forestry (CRF sector 5) of the NIR. Use this documentation box to provide references to relevant sections of the NIR if any additional information and/or further details are needed to understand the content of this table.

## TABLE 5 (III) SECTORAL BACKGROUND DATA FOR LAND USE, LAND-USE CHANGE AND FORESTRY

Inventory 2007

## $N_2O$ emissions from disturbance associated with land-use conversion to cropland [1]

Submission 2009 v1.1

## (Sheet 1 of 1)

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| GREENHOUSE GAS SOURCE AND SINK CATEGORIES | ACTIVITY DATA | IMPLIED EMISSION FACTORS | EMISSIONS [4] |
|---|---|---|---|
| Land-Use Category [2] | Land area converted | $N_2O$-N emissions per area converted[3] | $N_2O$ |
| | (kha) | (kg $N_2O$-N/ha) | (Gg) |
| **Total all Land-Use Categories [5]** | **542.35** | **1.04** | **0.89** |
| **B. Cropland** | **542.35** | **1.04** | **0.89** |
| 2. Lands converted to Cropland [6] | 542.35 | 1.04 | 0.89 |
| Organic Soils | NO | NO | NO |
| Mineral Soils | 542.35 | 1.04 | 0.89 |
| 2.1 Forest Land converted to Cropland | NE,NO | NE,NO | NE,NO |
| Organic Soils | NO | NO | NO |
| Mineral Soils | NE | NE | NE |
| 2.2 Grassland converted to Cropland | 542.35 | 1.04 | 0.89 |
| Organic Soils | NO | NO | NO |
| Mineral Soils | 542.35 | 1.04 | 0.89 |
| 2.3 Wetlands converted to Cropland [7] | NO | NO | NO |
| Organic Soils | NO | NO | NO |
| Mineral Soils | NO | NO | NO |
| 2.5 Other Land converted to Cropland | NO | NO | NO |
| Organic Soils | NO | NO | NO |
| Mineral Soils | NO | NO | NO |
| **G. Other** *(please specify)* | | | |

(1) Methodologies for $N_2O$ emissions from disturbance associated with land-use conversion are based on equations 3.3.14 and 3.3.15 of the IPCC good practice guidance for LULUCF. $N_2O$ emissions from fertilization in the preceding land use and new land use should not be reported.

(2) According to the IPCC good practice guidance for LULUCF, $N_2O$ emissions from disturbance of soils are only relevant for land conversions to cropland. $N_2O$ emissions from Cropland remaining Cropland are included in the Agriculture sector of the good practice guidance. The good practice guidance provides methodologies only for mineral soils.

(3) In the calculation of the implied emission factor, $N_2O$ emissions are converted to $N_2O$-N by multiplying by 28/44.

(4) Emissions are reported with a positive sign.

(5) Parties can separate between organic and mineral soils, if they have data available.

(6) If activity data cannot be disaggregated to all initial land uses, Parties may report some initial land uses aggregated under Other Land converted to Cropland (indicate in the documentation box what this category includes).

(7) Parties should avoid double counting with $N_2O$ emissions from drainage and from cultivation of organic soils reported in Agriculture under Cultivation of Histosols.

**Documentation box:**

Parties should provide detailed explanations on the Land Use, Land-Use Change and Forestry sector in Chapter 7: Land Use, Land-Use Change and Forestry (CRF Sector 5) of the NIR. Use this documentation box to provide references to relevant sections of the NIR if any additional information and/or further details are needed to understand the content of this table.

**TABLE 5 (IV) SECTORAL BACKGROUND DATA FOR LAND USE, LAND-USE CHANGE AND FORESTRY**

Inventory 2007

**$CO_2$ emissions from agricultural lime application [1]**

Submission 2009 v1.1

**(Sheet 1 of 1)**

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| GREENHOUSE GAS SOURCE AND SINK CATEGORIES | ACTIVITY DATA | IMPLIED EMISSION FACTORS | EMISSIONS [3] |
|---|---|---|---|
| Land-Use Category | Total amount of lime applied (Mg/yr) | $CO_2$-C per unit of lime [2] (Mg $CO_2$-C /Mg) | $CO_2$ (Gg) |
| **Total all Land-Use Categories [4], [5], [6]** | **204 641.65** | **0.12** | **90.04** |
| **B. Cropland [6] [7]** | **204 641.65** | **0.12** | **90.04** |
| Limestone $CaCO_3$ | 204 641.65 | 0.12 | 90.04 |
| Dolomite $CaMg(CO_3)_2$ | IE | IE | IE |
| **C. Grassland [6] [8]** | **IE** | **IE** | **IE** |
| Limestone $CaCO_3$ | IE | IE | IE |
| Dolomite $CaMg(CO_3)_2$ | IE | IE | IE |
| **G. Other *(please specify)* [6] [9]** | | | |

(1) $CO_2$ emissions from agricultural lime application are addressed in equations 3.3.6 and 3.4.11 of the IPCC good practice guidance for LULUCF.

(2) The implied emission factor is expressed in unit of carbon to faciliate comparison with published emission factors.

(3) Emissions are reported with a positive sign.

(4) If Parties are not able to separate liming application for different land-use categories, they should include liming for all land-use categories in the category 5.G Other.

(5) Parties that are able to provide data for lime application to forest land should provide this information under 5.G Other and specify in the documentation box that forest land application is included in this ca

(6) A Party may report aggregate estimates for total lime applications when data are not available for limestone and dolomite.

(7) In table 5, these $CO_2$ emissions will be added to 5.B.1 Cropland remaining Cropland.

(8) In table 5, these $CO_2$ emissions will be added to 5.C.1 Grassland remaining Grassland.

(9) If a Party has data broken down to limestone and dolomite at national level, it can report these data under 5.G Other.

| **Documentation box:** |
|---|
| Parties should provide detailed explanations on the Land Use, Land-Use Change and Forestry sector in Chapter 7: Land Use, Land-Use Change and Forestry (CRF sector 5) of the NIR. Use this documentation box to provide references to relevant sections of the NIR if any additional information and/or further details are needed to understand the content of this table. |

**TABLE 5 (V) SECTORAL BACKGROUND DATA FOR LAND USE, LAND-USE CHANGE AND FORESTRY**

Inventory 2007

**Biomass Burning [1]**

Submission 2009 v1.1

**(Sheet 1 of 1)**

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| GREENHOUSE GAS SOURCE AND SINK CATEGORIES | ACTIVITY DATA | | | IMPLIED EMISSION FACTOR | | | EMISSIONS [5] | | |
|---|---|---|---|---|---|---|---|---|---|
| | Description[3] | Unit | Values | $CO_2$ | $CH_4$ | $N_2O$ | $CO_2$ [4] | $CH_4$ | $N_2O$ |
| **Land-Use Category[2]** | | (ha or kg dm) | | (Mg/activity data unit) | | | (Gg) | | |
| **Total for Land-Use Categories** | | | **NA** | **IE,NA,NO** | **NA** | **NA** | **IE,NA,NO** | **0.00** | **0.00** |
| **A. Forest Land** | | | **37.00** | **IE,NO** | **0.06** | **0.00** | **IE,NO** | **0.00** | **0.00** |
| 1. Forest land remaining Forest Land | | | 37.00 | IE,NO | 0.06 | 0.00 | IE,NO | 0.00 | 0.00 |
| *Controlled Burning* | (specify) | ha | NO | NO | NO | NO | NO | NO | NO |
| *Wildfires* | (specify) | ha | 37.00 | IE | 0.06 | 0.00 | IE | 0.00 | 0.00 |
| 2. Land converted to Forest Land | | | NO | NO | NO | NO | NO | NO | NO |
| *Controlled Burning* | (specify) | ha | NO | NO | NO | NO | NO | NO | NO |
| *Wildfires* | (specify) | ha | NO | NO | NO | NO | NO | NO | NO |
| **B. Cropland** | | | **NA** | **NA,NO** | **NA,NO** | **NA,NO** | **NA,NO** | **NA,NO** | **NA,NO** |
| 1. Cropland remaining Cropland [6] | | | NA | NA | NA | NA | NA | NA | NA |
| *Controlled Burning* | (specify) | | NA | NA | NA | NA | NA | NA | NA |
| *Wildfires* | (specify) | | NA | NA | NA | NA | NA | NA | NA |
| 2. Land converted to Cropland | | | NO | NO | NO | NO | NO | NO | NO |
| *Controlled Burning* | (specify) | | NO | NO | NO | NO | NO | NO | NO |
| *Wildfires* | (specify) | | NO | NO | NO | NO | NO | NO | NO |
| 2.1. Forest Land converted to Cropland | Area burned | ha | NO | NO | NO | NO | NO | NO | NO |
| *Controlled Burning* | Area burned | ha | NO | NO | NO | NO | NO | NO | NO |
| *Wildfires* | Area burned | ha | NO | NO | NO | NO | NO | NO | NO |
| **C. Grassland** | | | **NO** | **NO** | **NO** | **NO** | **NO** | **NO** | **NO** |
| 1. Grassland remaining grassland [7] | | | NO | NO | NO | NO | NO | NO | NO |
| *Controlled Burning* | (specify) | | NO | NO | NO | NO | NO | NO | NO |
| *Wildfires* | (specify) | | NO | NO | NO | NO | NO | NO | NO |
| 2. Land converted to Grassland | | | NO | NO | NO | NO | NO | NO | NO |
| *Controlled Burning* | (specify) | | NO | NO | NO | NO | NO | NO | NO |
| *Wildfires* | (specify) | | NO | NO | NO | NO | NO | NO | NO |
| 2.1. Forest Land converted to Grassland | Area burned | ha | NO | NO | NO | NO | NO | NO | NO |
| *Controlled Burning* | Area burned | ha | NO | NO | NO | NO | NO | NO | NO |
| *Wildfires* | Area burned | ha | NO | NO | NO | NO | NO | NO | NO |
| **D. Wetlands** | | | **NO** | **NO** | **NO** | **NO** | **NO** | **NO** | **NO** |
| 1. Wetlands remaining Wetlands [8] | | | NO | NO | NO | NO | NO | NO | NO |
| *Controlled Burning* | (specify) | | NO | NO | NO | NO | NO | NO | NO |
| *Wildfires* | (specify) | | NO | NO | NO | NO | NO | NO | NO |
| 2. Land converted to Wetlands | | | NO | NO | NO | NO | NO | NO | NO |
| *Controlled Burning* | (specify) | | NO | NO | NO | NO | NO | NO | NO |
| *Wildfires* | (specify) | | NO | NO | NO | NO | NO | NO | NO |
| 2.1. Forest Land converted to Wetlands | Area burned | ha | NO | NO | NO | NO | NO | NO | NO |
| *Controlled Burning* | Area burned | ha | NO | NO | NO | NO | NO | NO | NO |
| *Wildfires* | Area burned | ha | NO | NO | NO | NO | NO | NO | NO |
| **E. Settlements [8]** | (specify) | ha | NO | **NO** | **NO** | **NO** | NO | NO | NO |
| **F. Other Land [9]** | Area burned | ha | NO | **NO** | **NO** | **NO** | NO | NO | NO |
| **G. Other (please specify)** | | | | | | | | | |

[1] Methodological guidance on burning can be found in sections 3.2.1.4 and 3.4.1.3 of the IPCC good practice guidance for LULUCF.

[2] Parties should report both controlled/prescribed burning and wildfires emissions, where appropriate, in a separate manner.

[3] For each category activity data should be selected between area burned or biomass burned. Units for area will be ha and for biomass burned kg dm. The implied emission factor will refer to the selected activity data with an automatic change in the units.

[4] If $CO_2$ emissions from biomass burning are not already included in tables 5.A - 5.F, they should be reported here. This should be clearly documented in the documentation box and in the NIR. Double counting should be avoided. Parties that include all carbon stock changes in the carbon stock tables (5.A, 5.B, 5.C, 5.D, 5.E and 5.F), should report IE (included elsewhere) in this column.

[5] Emissions are reported with a positive sign.

[6] In-situ above-ground woody biomass burning is reported here. Agricultural residue burning is reported in the Agriculture sector.

[7] Includes only emissions from controlled biomass burning on grasslands outside the tropics (prescribed savanna burning is reported under the Agriculture sector).

[8] Parties may decide not to prepare estimates for these categories contained in appendices 3a.2, 3a.3 and 3a.4 of the IPCC good practice guidance for LULUCF, although they may do so if they wish.

[9] This land-use category is to allow the total of identified land area to match the national area.

**Documentation box:**
Parties should provide detailed explanations on the Land Use, Land-Use Change and Forestry sector in Chapter 7: Land Use, Land-Use Change and Forestry (CRF sector 5) of the NIR. Use this documentation box to provide references to relevant sections of the NIR if any additional information and/or further details are needed to understand the content of this table.

# TABLE 6 SECTORAL REPORT FOR WASTE
# (Sheet 1 of 1)

Inventory 2007

Submission 2009 v1.1

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| GREENHOUSE GAS SOURCE AND SINK CATEGORIES | $CO_2$ [1] | $CH_4$ | $N_2O$ | $NO_x$ | CO | NMVOC | $SO_2$ |
|---|---|---|---|---|---|---|---|
| | (Gg) | | | | | | |
| **Total Waste** | **12.26** | **86.22** | **1.14** | **0.05** | **5.86** | **0.08** | **0.06** |
| **A. Solid Waste Disposal on Land** | **NA,NO** | **83.06** | | **NA,NO** | **5.85** | **0.08** | |
| 1. Managed Waste Disposal on Land | NA | 83.06 | | NA | 5.85 | 0.08 | |
| 2. Unmanaged Waste Disposal Sites | NO | NO | | NO | NO | NO | |
| 3. Other *(as specified in table 6.A)* | NA | NA | | NA | NA | NA | |
| **B. Waste Water Handling** | | **1.49** | **0.90** | **NA** | **NA** | **NA** | |
| 1. Industrial Wastewater | | IE,NA | 0.19 | NA | NA | NA | |
| 2. Domestic and Commercial Waste Water | | 1.49 | 0.71 | NA | NA | NA | |
| 3. Other *(as specified in table 6.B)* | | NA | NA | NA | NA | NA | |
| **C. Waste Incineration** | **12.26** | **0.00** | **0.00** | **0.05** | **0.01** | **0.00** | **0.06** |
| **D. Other** *(please specify)* | **NA** | **1.67** | **0.24** | **NA** | **NA** | **NA** | **NA** |
| Compost production | NA | 1.67 | 0.24 | NA | NA | NA | NA |

[1] $CO_2$ emissions from source categories Solid waste disposal on land and Waste incineration should only be included if they derive from non-biological or inorganic waste sources.

**Documentation box:**

• Parties should provide detailed explanations on the waste sector in Chapter 8: Waste (CRF sector 6) of the NIR. Use this documentation box to provide references to relevant sections of the NIR if any additional information and/or further details are needed to understand the content of this table.

• If estimates are reported under "6.D Other", use this documentation box to provide information regarding activities covered under this category and to provide reference to the section in the NIR where background information can be found.

## TABLE 6.A SECTORAL BACKGROUND DATA FOR WASTE
**Solid Waste Disposal**
**(Sheet 1 of 1)**

Inventory 2007
Submission 2009 v1.1
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| GREENHOUSE GAS SOURCE AND SINK CATEGORIES | ACTIVITY DATA AND OTHER RELATED INFORMATION | | | IMPLIED EMISSION FACTOR | | EMISSIONS | | |
|---|---|---|---|---|---|---|---|---|
| | Annual MSW at the SWDS | MCF | DOC degraded | $CH_4$ (1) | $CO_2$ | $CH_4$ | | $CO_2$ (4) |
| | | | | | | Emissions (2) | Recovery (3) | |
| | (Gg) | | % | (t /t MSW) | | (Gg) | | |
| 1 Managed Waste Disposal on Land | 540.50 | 1.00 | 108.70 | 0.18 | NA | 83.06 | 15.48 | NA |
| 2 Unmanaged Waste Disposal Sites | NO | NO | NO | NO | NO | NO | NO | NO |
| a. Deep (>5 m) | NO | NO | NO | NO | NO | NO | NO | NO |
| b. Shallow (<5 m) | NO | NO | NO | NO | NO | NO | NO | NO |
| 3 Other *(please specify)* | | | | | | NA | NA | NA |

**Additional information**

| Description | Value |
|---|---|
| Total population (1000s)(a) | **8 315.00** |
| Urban population (1000s)(a) | 5 417.52 |
| Waste generation rate (kg/capita/day) | 0.18 |
| Fraction of MSW disposed to SWDS | 0.05 |
| Fraction of DOC in MSW | 0.17 |
| $CH_4$ oxidation factor (b) | 0.10 |
| $CH_4$ fraction in landfill gas | 0.55 |
| $CH_4$ generation rate constant (k) (c) | 0.10 |
| Time lag considered (yr) (c) | 58.00 |

**Note:** MSW - Municipal Solid Waste, SWDS - Solid Waste Disposal Site, MCF - Methane Correction Factor, DOC - Degradable Organic Carbon (IPCC Guidelines (Volume 3. Reference Manual, section 6.2.4)).
MSW includes household waste, yard/garden waste, commercial/market waste and organic industrial solid waste. MSW should not include inorganic industrial waste such as construction or demolition materials.

(1) The $CH_4$ implied emission factor (IEF) is calculated on the basis of gross $CH_4$ emissions, as follows: IEF = ($CH_4$ emissions + $CH_4$ recovered)/annual MSW at the SWDS.
(2) Actual emissions (after recovery).
(3) $CH_4$ recovered and flared or utilized.
(4) Under Solid Waste Disposal, $CO_2$ emissions should be reported only when the disposed waste is combusted at the disposal site as a management practice. $CO_2$ emissions from non-biogenic wastes are included in the total emissions, whereas the $CO_2$ emissions from biogenic wastes are not included in the total emissions.

(a) Specify whether total or urban population is used and the rationale for doing so.
(b) See IPCC Guidelines (Volume 3. Reference Manual, p. 6.9).
(c) Only for Parties using Tier 2 methods.

## TABLE 6.C SECTORAL BACKGROUND DATA FOR WASTE
**Waste Incineration**
**(Sheet 1 of 1)**

| GREENHOUSE GAS SOURCE AND SINK CATEGORIES | ACTIVITY DATA Amount of incinerated wastes | IMPLIED EMISSION FACTOR | | | EMISSIONS | | |
|---|---|---|---|---|---|---|---|
| | | $CO_2$ | $CH_4$ | $N_2O$ | $CO_2$ (1) | $CH_4$ | $N_2O$ |
| | (Gg) | (kg/t waste) | | | (Gg) | | |
| Waste Incineration | 6.10 | | | | 12.26 | 0.00 | 0.00 |
| a. Biogenic (1) | NA | NA | NA | NA | NA | NA | NA |
| b. Other (non-biogenic - *please specify*) (1), (2) | 6.10 | | | | 12.26 | 0.00 | 0.00 |
| Municipal waste burning | NO | NO | NO | NO | NO | NO | NO |
| Waste oil | 3.00 | 3 224.00 | 0.00 | 0.02 | 9.67 | 0.00 | 0.00 |
| Hospital waste | 3.10 | 836.00 | 0.10 | 0.01 | 2.59 | 0.00 | 0.00 |

(1) Under Solid Waste Disposal, $CO_2$ emissions should be reported only when the disposed waste is combusted at the disposal site as a management practice. $CO_2$ emissions from non-biogenic wastes are included in the total emissions, while the $CO_2$ emissions from biogenic wastes are not included in the total emissions.

(2) Enter under this source category all types of non-biogenic wastes, such as plastics.

**Note:** Only emissions from waste incineration without energy recovery are to be reported in the Waste sector. Emissions from incineration with energy recovery are to be reported in the Energy sector, as Other Fuels (see IPCC good practice guidance, page 5.23).

**Documentation box:**
- Parties should provide detailed explanations on the waste sector in Chapter 8: Waste (CRF sector 6) of the NIR. Use this documentation box to provide references to relevant sections of the NIR if any additional information
- Parties that use country-specific models should provide a reference in the documentation box to the relevant section in the NIR where these models are described, and fill in only the relevant cells of tables 6.A and 6.C.
- Provide a reference to the relevant section in the NIR, in particular with regard to:
  - (a) A population size (total or urban population) used in the calculations and the rationale for doing so;
  - (b) The composition of landfilled waste;
  - (c) In relation to the amount of incinerated wastes (specify whether the reported data relate to wet or dry matter).

# TABLE 6.B SECTORAL BACKGROUND DATA FOR WASTE

Inventory 2007

## Waste Water Handling

Submission 2009 v1.1

## (Sheet 1 of 2)

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| GREENHOUSE GAS SOURCE AND SINK CATEGORIES | ACTIVITY DATA AND RELATED INFORMATION[1] | IMPLIED EMISSION FACTOR | | EMISSIONS | | |
|---|---|---|---|---|---|---|
| | Total organic product | $CH_4$ [2] | $N_2O$ [3] | $CH_4$ Emissions [4] | $CH_4$ Recovery [5] | $N_2O$ [3] |
| | (Gg DC[1]/yr) | (kg/kg DC) | | (Gg) | | |
| 1. Industrial Waste Water | | | | IE,NA | NA | 0.19 |
| a. Waste Water | 510.00 | NA | 0.00 | NA | NA | 0.19 |
| b. Sludge | NA | IE | NA | IE | NA | IE |
| 2. Domestic and Commercial Wastewater | | | | 1.49 | NA | 0.71 |
| a. Waste Water | 333.85 | 0.00 | NA | 1.49 | NA | NA |
| b. Sludge | NA | IE | NA | IE | NA | IE |
| 3. Other *(please specify)* [6] | | | | NA | NA | NA |
| | | | | | | |

| GREENHOUSE GAS SOURCE AND SINK CATEGORIES | ACTIVITY DATA AND OTHER RELATED INFORMATION | | | IMPLIED EMISSION FACTOR | EMISSIONS |
|---|---|---|---|---|---|
| | Population (1000s) | Protein consumption (kg/person/yr) | N fraction (kg N/kg protein) | $N_2O$ (kg $N_2O$-N/kg sewage N produced) | $N_2O$ (Gg) |
| $N_2O$ from human sewage [3] | 8 315.00 | 43.07 | 0.16 | 0.01 | 0.71 |

(1) DC - degradable organic component. DC indicators are COD (Chemical Oxygen Demand) for industrial waste water and BOD (Biochemical Oxygen Demand) for Domestic/Commercial waste water/sludge (IPCC Guidelines (Volume 3. Reference Manual, pp. 6.14, 6.18)).

(2) The $CH_4$ implied emission factor (IEF) is calculated on the basis of gross $CH_4$ emissions, as follows: IEF = ($CH_4$ emissions + $CH_4$ recovered or flared) / total organic product.

(3) Parties using methods other than those from the IPCC for estimating $N_2O$ emissions from human sewage or waste-water treatment should provide aggregate data in this table.

(4) Actual emissions (after recovery).

(5) $CH_4$ recovered and flared or utilized.

(6) Use the cells below to specify each activity covered under "6.B.3 Other". Note that under each reported activity, data for waste water and sludge are to be reported separately.

**Documentation box:**

• Parties should provide detailed explanations on the Waste sector in Chapter 8: Waste (CRF sector 6) of the NIR. Use this documentation box to provide references to relevant sections of the NIR if any additional information and/or further details are needed to understand the content of this table.

• Regarding the estimates for $N_2O$ from human sewage, specify whether total or urban population is used in the calculations and the rationale for doing so. Provide explanation in the documentation box.

• Parties using methods other than those from the IPCC for estimating $N_2O$ emissions from human sewage or waste-water treatment should provide, in the NIR, corresponding information on methods, activity data and emission factors used, and should provide a reference to the relevant section of the NIR in this documentation box.

# TABLE 6.B SECTORAL BACKGROUND DATA FOR WASTE

Inventory 2007

## Waste Water Handling

Submission 2009 v1.1

## (Sheet 2 of 2)

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**Additional information**

| | Domestic | Industrial |
|---|---|---|
| Total waste water ($m^3$): | 1 077 258.32 | 1 050 000.00 |
| Treated waste water (%): | 100.00 | 100.00 |

| Waste-water streams: | Waste-water output ($m^3$) | DC (kg COD/$m^3$) |
|---|---|---|
| **Industrial waste water** | NA | NA |
| Iron and steel | NA | NA |
| Non-ferrous | NE | NE |
| Fertilizers | NE | NE |
| Food and beverage | NE | NE |
| Paper and pulp | NE | NE |
| Organic chemicals | NE | NE |
| Other (please specify) | NE | NE |
| Textile | | |
| Rubber | | |
| Poultry | | |
| Wood and wood production | | |
| Wool Scouring | | |
| Other agricultural | | |
| Chemical | | |
| Dairy Processing | | |
| Electricity, steam, water production | | |
| Leather industry | | |
| Leather and Skins | | |
| Iron and steel | | |
| Meat industry | | |
| Fuels | | |
| Machinery and equipment | | |
| Mining and quarrying | | |
| | **DC (kg BOD/1000 person/yr)** | |
| **Domestic and Commercial** | NE | |
| | | |
| **Other (please specify)** | | |

| Handling systems: | Industrial waste water treated (%) | Industrial sludge treated (%) | Domestic waste water treated (%) | Domestic sludge treated (%) |
|---|---|---|---|---|
| Aerobic | NE | NA | NA | NE |
| Anaerobic | NE | NA | NA | NE |
| Other (please specify) | NE | NA | NA | NE |

**SUMMARY 1.A SUMMARY REPORT FOR NATIONAL GREENHOUSE GAS INVENTORIES (IPCC TABLE 7A)**
**(Sheet 1 of 3)**

Inventory 2007
Submission 2009 v1.1
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| GREENHOUSE GAS SOURCE AND SINK CATEGORIES | Net $CO_2$ emissions/removals | $CH_4$ | $N_2O$ | HFCs[1] | | PFCs[1] | | $SF_6$ | | $NO_x$ | CO | NMVOC | $SO_2$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | P | A | P | A | P | A | | | | |
| | (Gg) | | | $CO_2$ equivalent (Gg) | | | | (Gg) | | | | | |
| **Total National Emissions and Removals** | **56 778.63** | **331.22** | **18.22** | **1 372.88** | **860.63** | **451.77** | **182.71** | **0.02** | **0.02** | **219.22** | **767.56** | **179.38** | **25.52** |
| **1. Energy** | **64 380.52** | **48.35** | **2.42** | | | | | | | **212.19** | **735.93** | **68.50** | **24.24** |
| A. Fuel Combustion — Reference Approach [2] | 68 448.71 | | | | | | | | | | | | |
| Sectoral Approach [2] | 64 143.48 | 14.76 | 2.42 | | | | | | | 212.19 | 735.93 | 65.76 | 24.05 |
| 1. Energy Industries | 13 928.60 | 0.29 | 0.26 | | | | | | | 14.60 | 4.38 | 0.68 | 5.97 |
| 2. Manufacturing Industries and Construction | 15 667.82 | 0.67 | 0.46 | | | | | | | 32.29 | 166.12 | 2.19 | 11.17 |
| 3. Transport | 23 922.60 | 0.99 | 0.91 | | | | | | | 140.62 | 220.62 | 20.63 | 0.23 |
| 4. Other Sectors | 10 579.85 | 12.81 | 0.80 | | | | | | | 24.60 | 344.54 | 42.24 | 6.66 |
| 5. Other | 44.61 | 0.00 | 0.00 | | | | | | | 0.09 | 0.27 | 0.02 | 0.01 |
| B. Fugitive Emissions from Fuels | 237.04 | 33.59 | IE,NA | | | | | | | IE,NA | IE,NA | 2.74 | 0.18 |
| 1. Solid Fuels | IE,NA,NO | IE,NA,NO | IE,NA | | | | | | | IE,NA | IE,NA | IE,NA | IE,NA |
| 2. Oil and Natural Gas | 237.04 | 33.59 | IE,NA | | | | | | | IE,NA | IE,NA | 2.74 | 0.18 |
| **2. Industrial Processes** | **9 535.22** | **0.91** | **0.87** | **1 372.88** | **860.63** | **451.77** | **182.71** | **0.02** | **0.02** | **1.71** | **24.70** | **4.90** | **1.22** |
| A. Mineral Products | 3 505.54 | IE,NA | IE,NA | | | | | | | IE,NA | 9.78 | IE,NA | IE,NA |
| B. Chemical Industry | 530.62 | 0.90 | 0.87 | NO | NO | NO | NO | NO | NO | 0.34 | 11.15 | 1.32 | 0.77 |
| C. Metal Production | 5 499.05 | 0.00 | NA | | | | NO | | NO | 0.11 | 2.85 | 0.49 | 0.46 |
| D. Other Production [3] | NA | | | | | | | | | 1.26 | 0.91 | 3.08 | NA |
| E. Production of Halocarbons and $SF_6$ | | | | | NA | | NA | | NA | | | | |
| F. Consumption of Halocarbons and $SF_6$ | | | | 1 372.88 | 860.63 | 451.77 | 182.71 | 0.02 | 0.02 | | | | |
| G. Other | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |

**Note:** **A** = Actual emissions based on Tier 2 approach of the IPCC Guidelines.
**P** = Potential emissions based on Tier 1 approach of the IPCC Guidelines.

**Note:** All footnotes for this table are given at the end of the table on sheet 3.

**SUMMARY 1.A SUMMARY REPORT FOR NATIONAL GREENHOUSE GAS INVENTORIES (IPCC TABLE 7A)**
**(Sheet 2 of 3)**

Inventory 2007
Submission 2009 v1.1
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| GREENHOUSE GAS SOURCE AND SINK CATEGORIES | Net $CO_2$ emissions/removals | $CH_4$ | $N_2O$ | HFCs [1] | | PFCs[1] | | $SF_6$ | | $NO_x$ | CO | NMVOC | $SO_2$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | P | A | P | A | P | A | | | | |
| | (Gg) | | | $CO_2$ equivalent (Gg) | | | | | | (Gg) | | | |
| **3. Solvent and Other Product Use** | **248.53** | | **0.52** | | | | | | | **NA** | **NA** | **104.09** | **NA** |
| **4. Agriculture** | | **195.73** | **12.38** | | | | | | | **5.27** | **1.07** | **1.81** | **0.00** |
| A. Enteric Fermentation | | 153.09 | | | | | | | | | | | |
| B. Manure Management | | 42.17 | 2.83 | | | | | | | | | NE,NO | |
| C. Rice Cultivation | | NO | | | | | | | | | | NO | |
| D. Agricultural Soils[4] | | 0.42 | 9.55 | | | | | | | | | 1.70 | |
| E. Prescribed Burning of Savannas | | NO | NO | | | | | | | NO | NO | NO | |
| F. Field Burning of Agricultural Residues | | 0.06 | 0.00 | | | | | | | 0.03 | 1.07 | 0.11 | |
| G. Other | | NA | NA | | | | | | | 5.23 | NA | NA | 0.00 |
| **5. Land Use, Land-Use Change and Forestry** | (5) **-17 397.91** | **0.00** | **0.89** | | | | | | | **IE,NA,NE** | **IE,NA,NE** | **NA,NE** | **NA** |
| A. Forest Land | (5) -19 539.13 | 0.00 | 0.00 | | | | | | | NE | NE | NE | |
| B. Cropland | (5) 2 034.08 | NA,NO | 0.89 | | | | | | | IE | IE | NE | |
| C. Grassland | (5) -1 265.62 | NO | NO | | | | | | | IE | IE | NE | |
| D. Wetlands | (5) 371.78 | NO | NO | | | | | | | NA | NA | NA | |
| E. Settlements | (5) 530.55 | NA,NO | NA,NO | | | | | | | NA | NA | NA | |
| F. Other Land | (5) 470.44 | NA,NO | NA,NO | | | | | | | NA | NA | NA | |
| G. Other | (5) NE | NA | NA | | | | | | | NA | NA | NA | NA |
| **6. Waste** | **12.26** | **86.22** | **1.14** | | | | | | | **0.05** | **5.86** | **0.08** | **0.06** |
| A. Solid Waste Disposal on Land | (6) NA,NO | 83.06 | | | | | | | | NA,NO | 5.85 | 0.08 | |
| B. Waste-water Handling | | 1.49 | 0.90 | | | | | | | NA | NA | NA | |
| C. Waste Incineration | (6) 12.26 | 0.00 | 0.00 | | | | | | | 0.05 | 0.01 | 0.00 | 0.06 |
| D. Other | NA | 1.67 | 0.24 | | | | | | | NA | NA | NA | NA |
| **7. Other** ***(please specify)*** [7] | **NA** | **NA** | **NA** | **NA** | **NA** | **NA** | **NA** | **NA** | **NA** | **NA** | **NA** | **NA** | **NA** |

**Note:** All footnotes for this table are given at the end of the table on sheet 3.

## SUMMARY 1.A SUMMARY REPORT FOR NATIONAL GREENHOUSE GAS INVENTORIES (IPCC TABLE 7A) (Sheet 3 of 3)

Inventory 2007
Submission 2009 v1.1
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| GREENHOUSE GAS SOURCE AND SINK CATEGORIES | Net $CO_2$ emissions/removals | $CH_4$ | $N_2O$ | HFCs | | PFCs | | $SF_6$ | | $NO_x$ | CO | NMVOC | $SO_2$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | P | A | P | A | P | A | | | | |
| | (Gg) | | | $CO_2$ equivalent (Gg) | | | | (Gg) | | | | | |
| **Memo Items:** [8] | | | | | | | | | | | | | |
| **International Bunkers** | **2 175.79** | **0.04** | **0.07** | | | | | | | **8.87** | **2.39** | **0.95** | **0.69** |
| Aviation | 2 175.79 | 0.04 | 0.07 | | | | | | | 8.87 | 2.39 | 0.95 | 0.69 |
| Marine | NA,NO | NA,NO | NA,NO | | | | | | | NO | NO | NO | NO |
| **Multilateral Operations** | **NO** | **NO** | **NO** | | | | | | | **NO** | **NO** | **NO** | **NO** |
| **$CO_2$ Emissions from Biomass** | **18 660.74** | | | | | | | | | | | | |

(1) The emissions of HFCs and PFCs are to be expressed as $CO_2$ equivalent emissions. Data on disaggregated emissions of HFCs and PFCs are to be provided in Table 2(II) of this common reporting format.

(2) For verification purposes, countries are asked to report the results of their calculations using the Reference approach and to explain any differences with the Sectoral approach in the documentation box to Table 1.A.(c). For estimating national total emissions, the results from the Sectoral approach should be used, where possible.

(3) Other Production includes Pulp and Paper and Food and Drink Production.

(4) Parties which previously reported $CO_2$ from soils in the Agriculture sector should note this in the NIR.

(5) For the purposes of reporting, the signs for removals are always negative (-) and for emissions positive (+).

(6) $CO_2$ from source categories Solid Waste Disposal on Land and Waste Incineration should only be included if it stems from non-biogenic or inorganic waste streams. Only emissions from Waste Incineration Without Energy Recovery are to be reported in the Waste sector, whereas emissions from Incineration With Energy Recovery are to be reported in the Energy sector.

(7) If reporting any country-specific source category under sector "7. Other", detailed explanations should be provided in Chapter 9: Other (CRF sector 7) of the NIR.

(8) Countries are asked to report emissions from international aviation and marine bunkers and multilateral operations, as well as $CO_2$ emissions from biomass, under Memo Items. These emissions should not be included in the national total emissions from the energy sector. Amounts of biomass used as fuel are included in the national energy consumption but the corresponding $CO_2$ emissions are not included in the national total as it is assumed that the biomass is produced in a sustainable manner. If the biomass is harvested at an unsustainable rate, net $CO_2$ emissions are accounted for as a loss of biomass stocks in the Land Use, Land-use Change and Forestry sector.

# SUMMARY 1.B SHORT SUMMARY REPORT FOR NATIONAL GREENHOUSE GAS INVENTORIES (IPCC TABLE 7B) (Sheet 1 of 1)

Inventory 2007
Submission 2009 v1.1
AUSTRIA

| GREENHOUSE GAS SOURCE AND SINK CATEGORIES | Net $CO_2$ emissions/removals | $CH_4$ | $N_2O$ | HFCs[1] | | PFCs[1] | | $SF_6$ | | $NO_x$ | CO | NMVOC | $SO_2$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | P | A | P | A | P | A | | | | |
| | (Gg) | | | $CO_2$ equivalent (Gg) | | | | | | (Gg) | | | |
| **Total National Emissions and Removals** | **56 778.63** | **331.22** | **18.22** | **1 372.88** | **860.63** | **451.77** | **182.71** | **0.02** | **0.02** | **219.22** | **767.56** | **179.38** | **25.52** |
| **1. Energy** | **64 380.52** | **48.35** | **2.42** | | | | | | | **212.19** | **735.93** | **68.50** | **24.24** |
| A. Fuel Combustion — Reference Approach[2] | 68 448.71 | | | | | | | | | | | | |
| Sectoral Approach[2] | 64 143.48 | 14.76 | 2.42 | | | | | | | 212.19 | 735.93 | 65.76 | 24.05 |
| B. Fugitive Emissions from Fuels | 237.04 | 33.59 | IE,NA | | | | | | | IE,NA | IE,NA | 2.74 | 0.18 |
| **2. Industrial Processes** | **9 535.22** | **0.91** | **0.87** | **1 372.88** | **860.63** | **451.77** | **182.71** | **0.02** | **0.02** | **1.71** | **24.70** | **4.90** | **1.22** |
| **3. Solvent and Other Product Use** | **248.53** | | **0.52** | | | | | | | **NA** | **NA** | **104.09** | **NA** |
| **4. Agriculture [3]** | | **195.73** | **12.38** | | | | | | | **5.27** | **1.07** | **1.81** | **0.00** |
| **5. Land Use, Land-Use Change and Forestry** | [4] **-17 397.91** | **0.00** | **0.89** | | | | | | | **IE,NA,NE** | **IE,NA,NE** | **NA,NE** | **NA** |
| **6. Waste** | **12.26** | **86.22** | **1.14** | | | | | | | **0.05** | **5.86** | **0.08** | **0.06** |
| **7. Other** | **NA** | **NA** | **NA** | **NA** | **NA** | **NA** | **NA** | **NA** | **NA** | **NA** | **NA** | **NA** | **NA** |
| **Memo Items: [5]** | | | | | | | | | | | | | |
| **International Bunkers** | **2 175.79** | **0.04** | **0.07** | | | | | | | **8.87** | **2.39** | **0.95** | **0.69** |
| Aviation | 2 175.79 | 0.04 | 0.07 | | | | | | | 8.87 | 2.39 | 0.95 | 0.69 |
| Marine | NA,NO | NA,NO | NA,NO | | | | | | | NO | NO | NO | NO |
| **Multilateral Operations** | **NO** | **NO** | **NO** | | | | | | | **NO** | **NO** | **NO** | **NO** |
| **$CO_2$ Emissions from Biomass** | **18 660.74** | | | | | | | | | | | | |

**Note: A** = Actual emissions based on Tier 2 approach of the IPCC Guidelines.
**P** = Potential emissions based on Tier 1 approach of the IPCC Guidelines.

(1) The emissions of HFCs and PFCs are to be expressed as $CO_2$ equivalent emissions. Data on disaggregated emissions of HFCs and PFCs are to be provided in Table 2(II) of this common reporting format.

(2) For verification purposes, countries are asked to report the results of their calculations using the Reference approach and to explain any differences with the Sectoral approach in the documentation box to Table 1.A.(c). For estimating national total emissions, the result from the Sectoral approach should be used, where possible.

(3) Parties which previously reported $CO_2$ from soils in the Agriculture sector should note this in the NIR.

(4) For the purposes of reporting, the signs for removals are always negative (-) and for emissions positive (+).

(5) Countries are asked to report emissions from international aviation and marine bunkers and multilateral operations, as well as $CO_2$ emissions from biomass, under Memo Items. These emissions should not be included in the national total emissions from the energy sector. Amounts of biomass used as fuel are included in the national energy consumption but the corresponding $CO_2$ emissions are not included in the national total as it is assumed that the biomass is produced in a sustainable manner. If the biomass is harvested at an unsustainable rate, net $CO_2$ emissions are accounted for as a loss of biomass stocks in the Land Use, Land-use Change and Forestry sector.

## SUMMARY 2 SUMMARY REPORT FOR $CO_2$ EQUIVALENT EMISSIONS
## (Sheet 1 of 1)

Inventory 2007
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| GREENHOUSE GAS SOURCE AND SINK CATEGORIES | $CO_2$ [(1)] | $CH_4$ | $N_2O$ | HFCs [(2)] | PFCs [(2)] | $SF_6$ [(2)] | Total |
|---|---|---|---|---|---|---|---|
| | $CO_2$ equivalent (Gg ) | | | | | | |
| **Total (Net Emissions)** [(1)] | **56 778.63** | **6 955.65** | **5 648.19** | **860.63** | **182.71** | **409.58** | **70 835.38** |
| **1. Energy** | **64 380.52** | **1 015.44** | **751.03** | | | | **66 146.99** |
| A. Fuel Combustion (Sectoral Approach) | 64 143.48 | 310.06 | 751.03 | | | | 65 204.57 |
| 1. Energy Industries | 13 928.60 | 6.16 | 79.57 | | | | 14 014.33 |
| 2. Manufacturing Industries and Construction | 15 667.82 | 14.02 | 142.69 | | | | 15 824.53 |
| 3. Transport | 23 922.60 | 20.83 | 280.92 | | | | 24 224.35 |
| 4. Other Sectors | 10 579.85 | 269.03 | 246.85 | | | | 11 095.73 |
| 5. Other | 44.61 | 0.03 | 1.00 | | | | 45.64 |
| B. Fugitive Emissions from Fuels | 237.04 | 705.38 | IE,NA | | | | 942.42 |
| 1. Solid Fuels | IE,NA,NO | IE,NA,NO | IE,NA | | | | IE,NA,NO |
| 2. Oil and Natural Gas | 237.04 | 705.38 | IE,NA | | | | 942.42 |
| **2. Industrial Processes** | **9 535.22** | **19.05** | **270.01** | **860.63** | **182.71** | **409.58** | **11 277.19** |
| A. Mineral Products | 3 505.54 | IE,NA | IE,NA | | | | 3 505.54 |
| B. Chemical Industry | 530.62 | 18.96 | 270.01 | NO | NO | NO | 819.59 |
| C. Metal Production | 5 499.05 | 0.09 | NA | NO | NO | NA,NO | 5 499.14 |
| D. Other Production | NA | | | | | | NA |
| E. Production of Halocarbons and $SF_6$ | | | | NA | NA | NA | NA |
| F. Consumption of Halocarbons and $SF_6$ [(2)] | | | | 860.63 | 182.71 | 409.58 | 1 452.91 |
| G. Other | NA | NA | NA | NA | NA | NA | NA |
| **3. Solvent and Other Product Use** | **248.53** | | **160.27** | | | | **408.80** |
| **4. Agriculture** | | **4 110.42** | **3 839.07** | | | | **7 949.49** |
| A. Enteric Fermentation | | 3 214.83 | | | | | 3 214.83 |
| B. Manure Management | | 885.50 | 877.66 | | | | 1 763.16 |
| C. Rice Cultivation | | NO | | | | | NO |
| D. Agricultural Soils[(3)] | | 8.86 | 2 961.10 | | | | 2 969.96 |
| E. Prescribed Burning of Savannas | | NO | NO | | | | NO |
| F. Field Burning of Agricultural Residues | | 1.24 | 0.31 | | | | 1.55 |
| G. Other | | NA | NA | | | | NA |
| **5. Land Use, Land-Use Change and Forestry**[(1)] | **-17 397.91** | **0.05** | **274.89** | | | | **-17 122.97** |
| A. Forest Land | -19 539.13 | 0.05 | 0.01 | | | | -19 539.07 |
| B. Cropland | 2 034.08 | NA,NO | 274.88 | | | | 2 308.96 |
| C. Grassland | -1 265.62 | NO | NO | | | | -1 265.62 |
| D. Wetlands | 371.78 | NO | NO | | | | 371.78 |
| E. Settlements | 530.55 | NA,NO | NA,NO | | | | 530.55 |
| F. Other Land | 470.44 | NA,NO | NA,NO | | | | 470.44 |
| G. Other | NE | NA | NA | | | | NA,NE |
| **6. Waste** | **12.26** | **1 810.69** | **352.91** | | | | **2 175.87** |
| A. Solid Waste Disposal on Land | NA,NO | 1 744.20 | | | | | 1 744.20 |
| B. Waste-water Handling | | 31.32 | 279.40 | | | | 310.72 |
| C. Waste Incineration | 12.26 | 0.01 | 0.03 | | | | 12.30 |
| D. Other | NA | 35.17 | 73.47 | | | | 108.65 |
| **7. Other *(as specified in Summary 1.A)*** | **NA** | **NA** | **NA** | **NA** | **NA** | **NA** | **NA** |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Memo Items:** [(4)] | | | | | | | |
| **International Bunkers** | 2 175.79 | 0.90 | 22.57 | | | | 2 199.26 |
| Aviation | 2 175.79 | 0.90 | 22.57 | | | | 2 199.26 |
| Marine | NA,NO | NA,NO | NA,NO | | | | NA,NO |
| **Multilateral Operations** | **NO** | **NO** | **NO** | | | | **NO** |
| **$CO_2$ Emissions from Biomass** | **18 660.74** | | | | | | **18 660.74** |

| | |
|---|---|
| Total $CO_2$ Equivalent Emissions without Land Use, Land-Use Change and Forestry | 87 958.35 |
| Total $CO_2$ Equivalent Emissions with Land Use, Land-Use Change and Forestry | 70 835.38 |

(1) For $CO_2$ from Land Use, Land-use Change and Forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for emissions positive (+).

(2) Actual emissions should be included in the national totals. If no actual emissions were reported, potential emissions should be included.

(3) Parties which previously reported $CO_2$ from soils in the Agriculture sector should note this in the NIR.

(4) See footnote 8 to table Summary 1.A.

## SUMMARY 3 SUMMARY REPORT FOR METHODS AND EMISSION FACTORS USED
## (Sheet 1 of 2)

Inventory 2007
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| GREENHOUSE GAS SOURCE AND SINK CATEGORIES | $CO_2$ | | $CH_4$ | | $N_2O$ | | HFCs | | PFCs | | $SF_6$ | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Method applied | Emission factor | Method applied | Emission factor | Method applied | Emission factor | Method applied | Emission factor | Method applied | Emission factor | Method applied | Emission factor |
| **1. Energy** | **CS,M,T1,T2,** | **CS,PS** | **CS,M,T1,T2** | **CS,D** | **CS,M,T2** | **CS** | | | | | | |
| A. Fuel Combustion | CS,M,T2,T3 | CS,PS | CS,M,T2 | CS | CS,M,T2 | CS | | | | | | |
| 1. Energy Industries | T2 | CS,PS | T2 | CS | T2 | CS | | | | | | |
| 2. Manufacturing Industries and Construction | T2,T3 | CS,PS | T2 | CS | T2 | CS | | | | | | |
| 3. Transport | CS,M | CS | CS,M | CS | CS,M | CS | | | | | | |
| 4. Other Sectors | T2,T3 | CS | T2 | CS | T2 | CS | | | | | | |
| 5. Other | CS,M | CS | CS,M | CS | CS,M | CS | | | | | | |
| B. Fugitive Emissions from Fuels | CS,T1 | CS,PS | T1 | CS,D | NA | NA | | | | | | |
| 1. Solid Fuels | NA | NA | NA | NA | NA | NA | | | | | | |
| 2. Oil and Natural Gas | CS,T1 | CS,PS | T1 | CS,D | NA | NA | | | | | | |
| **2. Industrial Processes** | **CS,T1,T2** | **CS,D,PS** | **CR,CS** | **CS,PS** | **CS** | **PS** | **CS** | **CS** | **CS** | **CS** | **CS** | **CS** |
| A. Mineral Products | CS,T1 | CS,D | NA | NA | NA | NA | | | | | | |
| B. Chemical Industry | CS,T2 | CS,PS | CS | PS | CS | PS | NA | NA | NA | NA | NA | NA |
| C. Metal Production | CS,T2 | D,PS | CR | CS | NA | NA | NA | NA | NA | NA | NA | NA |
| D. Other Production | NA | NA | | | | | | | | | | |
| E. Production of Halocarbons and $SF_6$ | | | | | | | NA | NA | NA | NA | NA | NA |
| F. Consumption of Halocarbons and $SF_6$ | | | | | | | CS | CS | CS | CS | CS | CS |
| G. Other | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |

Use the following notation keys to specify the method applied:

**D** (IPCC default)
**T1a, T1b, T1c** (IPCC Tier 1a, Tier 1b and Tier 1c, respectively)
**CR** (CORINAIR)
**RA** (Reference Approach)
**T2** (IPCC Tier 2)
**CS** (Country Specific)
**T1** (IPCC Tier 1)
**T3** (IPCC Tier 3)
**OTH** (Other)

If using more than one method within one source category, list all the relevant methods. Explanations regarding country-specific methods, other methods or any modifications to the default IPCC methods, as

Use the following notation keys to specify the emission factor used:

**D** (IPCC default)
**CS** (Country Specific)
**OTH** (Other)
**CR** (CORINAIR)
**PS** (Plant Specific)

Where a mix of emission factors has been used, list all the methods in the relevant cells and give further explanations in the documentation box. Also use the documentation box to explain the use of notation

**SUMMARY 3 SUMMARY REPORT FOR METHODS AND EMISSION FACTORS USED**
**(Sheet 2 of 2)**

Inventory 2007
Submission 2009 v1.1
AUSTRIA

| GREENHOUSE GAS SOURCE AND SINK CATEGORIES | $CO_2$ | | $CH_4$ | | $N_2O$ | | HFCs | | PFCs | | $SF_6$ | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Method applied | Emission factor | Method applied | Emission factor | Method applied | Emission factor | Method applied | Emission factor | Method applied | Emission factor | Method applied | Emission factor |
| **3. Solvent and Other Product Use** | **CR,CS** | **CS** | | | **CS** | **D** | | | | | | |
| **4. Agriculture** | | | **CS,D,T1,T2** | **CS,D** | **D,T1** | **CS,D** | | | | | | |
| A. Enteric Fermentation | | | T1,T2 | CS,D | | | | | | | | |
| B. Manure Management | | | T1,T2 | CS,D | T1 | CS | | | | | | |
| C. Rice Cultivation | | | NA | NA | | | | | | | | |
| D. Agricultural Soils | | | CS | CS | T1 | D | | | | | | |
| E. Prescribed Burning of Savannas | | | NA | NA | NA | NA | | | | | | |
| F. Field Burning of Agricultural Residues | | | D | D | D | D | | | | | | |
| G. Other | | | NA | NA | NA | NA | | | | | | |
| **5. Land Use, Land-Use Change and Forestry** | **T1,T3** | **CS,D** | **T1** | **CS,D** | **T1** | **CS,D** | | | | | | |
| A. Forest Land | T1,T3 | CS | T1 | CS,D | T1 | CS,D | | | | | | |
| B. Cropland | T1,T3 | CS,D | NA | NA | T1 | CS,D | | | | | | |
| C. Grassland | T1,T3 | CS,D | NA | NA | NA | NA | | | | | | |
| D. Wetlands | T1,T3 | CS | NA | NA | NA | NA | | | | | | |
| E. Settlements | T1,T3 | CS | NA | NA | NA | NA | | | | | | |
| F. Other Land | T1,T3 | CS | NA | NA | NA | NA | | | | | | |
| G. Other | NA | NA | NA | NA | NA | NA | | | | | | |
| **6. Waste** | **D** | **CS,D** | **CS,D,T2** | **CS,D** | **CS,D** | **CS,D** | | | | | | |
| A. Solid Waste Disposal on Land | NA | NA | T2 | CS,D | | | | | | | | |
| B. Waste-water Handling | | | D | CS,D | CS,D | CS,D | | | | | | |
| C. Waste Incineration | D | CS,D | D | CS | D | CS | | | | | | |
| D. Other | NA | NA | CS | CS | CS | CS | | | | | | |
| **7. Other (as specified in Summary 1.A)** | **NA** | **NA** | **NA** | **NA** | **NA** | **NA** | **NA** | **NA** | **NA** | **NA** | **NA** | **NA** |

Use the following notation keys to specify the method applied:

**D** (IPCC default) **T1a, T1b, T1c** (IPCC Tier 1a, Tier 1b and Tier 1c, respectively) **CR** (CORINAIR)
**RA** (Reference Approach) **T2** (IPCC Tier 2) **CS** (Country Specific)
**T1** (IPCC Tier 1) **T3** (IPCC Tier 3) **OTH** (Other)

If using more than one method within one source category, list all the relevant methods. Explanations regarding country-specific methods, other methods or any modifications to the default IPCC methods, as well as information regarding the

Use the following notation keys to specify the emission factor used:

**D** (IPCC default) **CS** (Country Specific) **OTH** (Other)
**CR** (CORINAIR) **PS** (Plant Specific)

Where a mix of emission factors has been used, list all the methods in the relevant cells and give further explanations in the documentation box. Also use the documentation box to explain the use of notation OTH.

**Documentation box:**

• Parties should provide the full information on methodological issues, such as methods and emission factors used, in the relevant sections of Chapters 3 to 9 (see section 2.2 of each of Chapters 3 - 9) of the NIR. Use this documentation box to provide references to relevant sections of the NIR if any additional information and further details are needed to understand the content of this table.

• Where a mix of methods/emission factors has been used within one source category, use this documentation box to specify those methods/emission factors for the various sub-sources where they have been applied.

• Where the notation OTH (Other) has been entered in this table, use this documentation box to specify those other methods/emission factors.

**TABLE 7 SUMMARY OVERVIEW FOR KEY CATEGORIES**
**(Sheet 1 of 1)**

Inventory 2007
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| KEY CATEGORIES OF EMISSIONS AND REMOVALS | Gas | Criteria used for key source identification | | | Key category excluding LULUCF [1] | Key category including LULUCF [1] | Comments [1] |
|---|---|---|---|---|---|---|---|
| | | L | T | Q | | | |
| **Specify key categories according to the national level of disaggregation used:** | | | | | | | |
| 1 A 1 a liquid | CO2 | x | x | | x | x | |
| 1 A 1 a other | CO2 | x | x | | x | x | |
| 1 A 1 a solid | CO2 | x | x | | x | x | |
| 1 A 1 b liquid | CO2 | x | | | x | x | |
| 1 A 2 mobile, liquid | CO2 | x | | | x | x | |
| 1 A 2 other | CO2 | x | x | | x | x | |
| 1 A 2 solid | CO2 | | x | | x | x | |
| 1 A 2 stationary, liquid | CO2 | x | x | | x | x | |
| 1 A 3 a jet kerosene | CO2 | | x | | x | x | |
| 1 A 3 b diesel oil | CO2 | x | x | | x | x | |
| 1 A 3 b gasoline | CO2 | x | x | | x | x | |
| 1 A 3 b gasoline | N2O | | | | | | |
| 1 A 4 biomass | CH4 | | x | | x | | |
| 1 A 4 mobile, diesel | CO2 | x | x | | x | x | |
| 1 A 4 other | CO2 | | x | | x | x | |
| 1 A 4 solid | CO2 | x | x | | x | x | |
| 1 A 4 stationary, liquid | CO2 | x | x | | x | x | |
| 1 A gaseous | CO2 | x | x | | x | x | |
| 1 B 2 b natural gas | CH4 | x | x | | x | x | |
| 2 A 1 Cement Production | CO2 | x | x | | x | x | |
| 2 A 2 Lime Production | CO2 | x | x | | x | x | |
| 2 A 3 Limestone and Dolomite Use | CO2 | x | | | x | | |
| 2 A 7 b Sinter Production | CO2 | x | x | | x | x | |
| 2 B 1 Ammonia Production | CO2 | x | | | x | x | |
| 2 B 2 Nitric Acid Production | N2O | | x | | x | x | |
| 2 C 1 Iron and Steel Production | CO2 | x | x | | x | x | |
| 2 C 3 Aluminium production | CO2 | | x | | x | x | |
| 2 C 3 Aluminium production | PFCs | | x | | x | x | |
| 2 C 4 SF6 Used in Al and Mg Foundries | CO2 | | x | | x | x | |
| 2 F 1 to 2 F 5: ODS Substitutes | HFCs | x | x | | x | x | |
| 2 F 7 Semiconductor Manufacture | HFC, PFC, SF6 | | x | | | x | |
| 2 F 9 Other Sources of SF6 | SF6 | | | | | | |
| 3 SOLVENT AND OTHER PRODUCT USE | CO2 | | x | | x | x | |
| 4 A 1 Cattle | CH4 | x | x | | x | x | |
| 4 B 1 Cattle | CH4 | x | x | | x | x | |
| 4 B 1 Cattle | N2O | x | x | | x | x | |
| 4 B 8 Swine | CH4 | x | x | | x | x | |
| 4 D 1 Direct Soil Emissions | N2O | x | x | | x | x | |
| 4 D 2 Pasture, Range and Paddock Manure | N2O | | | | | | |
| 4 D 3 Indirect Emissions | N2O | x | x | | x | x | |
| 5 A 1 Forest land remaining forest land | CO2 | x | x | | | x | |
| 5 A 2 Land converted to forest land | CO2 | x | x | | | x | |
| 5 B 1 Cropland remaining cropland | CO2 | | x | | | x | |
| 5 B 2 Land converted to cropland | CO2 | x | x | | | x | |
| 5 C 2 Land converted to grassland | CO2 | x | | | | x | |
| 5 D 2 Land converted to wetland | CO2 | x | | | | x | |
| 5 E 2 Land converted to settlements | CO2 | | | | | | |
| 5 F 2 Land converted to other land | CO2 | x | x | | | x | |
| 6 A SOLID WASTE DISPOSAL ON LAND | CH4 | x | x | | x | x | |
| 6 B Wastewater Handling | N2O | | x | | x | x | |
| | | | | | | | |

**Note:** L = Level assessment; T = Trend assessment; Q = Qualitative assessment.
[1] The term "key categories" refers to both the key source categories as addressed in the IPCC good practice guidance and the key categories as addressed in the IPCC good practice guidance for LULUCF.
[2] For estimating key categories Parties may chose the disaggregation level presented as an example in table 7.1 of the IPCC good practice guidance (page 7.6) and table 5.4.1 (page 5.31) of the IPCC good practice guidance for LULUCF, the level used in table Summary 1.A of the common reporting format or any other disaggregation level that the Party used to determine its key categories.

**Documentation box:**
Parties should provide the full information on methodologies used for identifying key categories and the quantitative results from the level and trend assessments (according to tables 7.1–7.3 of the IPCC good practice guidance and tables 5.4.1–5.4.3 of the IPCC good practice guidance for LULUCF) in Annex 1 to the NIR.

**TABLE 8(a) RECALCULATION - RECALCULATED DATA**
**(Sheet 1 of 2)**

**Recalculated year:** Inventory 2007
Submission 2009 v1.1
AUSTRIA

| GREENHOUSE GAS SOURCE AND SINK CATEGORIES | | $CO_2$ | | | | | | $CH_4$ | | | | | | $N_2O$ | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Previous submission | Latest submission | Difference | Difference[(1)] | Impact of recalculation on total emissions excluding LULUCF [(2)] | Impact of recalculation on total emissions including LULUCF[(3)] | Previous submission | Latest submission | Difference | Difference[(1)] | Impact of recalculation on total emissions excluding LULUCF [(2)] | Impact of recalculation on total emissions including LULUCF[(3)] | Previous submission | Latest submission | Difference | Difference[(1)] | Impact of recalculation on total emissions excluding LULUCF [(2)] | Impact of recalculation on total emissions including LULUCF[(3)] |
| | | $CO_2$ equivalent (Gg) | | | (%) | | | $CO_2$ equivalent (Gg) | | | (%) | | | $CO_2$ equivalent (Gg) | | | (%) | | |
| **Total National Emissions and Removals** | | | **56 778.63** | | | | | | 6 955.65 | | | | | | 5 648.19 | | | | |
| **1. Energy** | | | **64 380.52** | | | | | | 1 015.44 | | | | | | 751.03 | | | | |
| 1.A. | Fuel Combustion Activities | | 64 143.48 | | | | | | 310.06 | | | | | | 751.03 | | | | |
| 1.A.1. | Energy Industries | | 13 928.60 | | | | | | 6.16 | | | | | | 79.57 | | | | |
| 1.A.2. | Manufacturing Industries and Construction | | 15 667.82 | | | | | | 14.02 | | | | | | 142.69 | | | | |
| 1.A.3. | Transport | | 23 922.60 | | | | | | 20.83 | | | | | | 280.92 | | | | |
| 1.A.4. | Other Sectors | | 10 579.85 | | | | | | 269.03 | | | | | | 246.85 | | | | |
| 1.A.5. | Other | | 44.61 | | | | | | 0.03 | | | | | | 1.00 | | | | |
| 1.B. | Fugitive Emissions from Fuels | | 237.04 | | | | | | 705.38 | | | | | | IE,NA | | | | |
| 1.B.1. | Solid fuel | | IE,NA,NO | | | | | | IE,NA,NO | | | | | | IE,NA | | | | |
| 1.B.2. | Oil and Natural Gas | | 237.04 | | | | | | 705.38 | | | | | | IE,NA | | | | |
| **2. Industrial Processes** | | | **9 535.22** | | | | | | **19.05** | | | | | | **270.01** | | | | |
| 2.A. | Mineral Products | | 3 505.54 | | | | | | IE,NA | | | | | | IE,NA | | | | |
| 2.B. | Chemical Industry | | 530.62 | | | | | | 18.96 | | | | | | 270.01 | | | | |
| 2.C. | Metal Production | | 5 499.05 | | | | | | 0.09 | | | | | | NA | | | | |
| 2.D. | Other Production | | NA | | | | | | | | | | | | | | | | |
| 2.G. | Other | | NA | | | | | | NA | | | | | | NA | | | | |
| **3. Solvent and Other Product Use** | | | **248.53** | | | | | | | | | | | | **160.27** | | | | |
| **4. Agriculture** | | | | | | | | | **4 110.42** | | | | | | **3 839.07** | | | | |
| 4.A. | Enteric Fermentation | | | | | | | | 3 214.83 | | | | | | | | | | |
| 4.B. | Manure Management | | | | | | | | 885.50 | | | | | | 877.66 | | | | |
| 4.C. | Rice Cultivation | | | | | | | | NO | | | | | | | | | | |
| 4.D. | Agricultural Soils [(4)] | | | | | | | | 8.86 | | | | | | 2 961.10 | | | | |
| 4.E. | Prescribed Burning of Savannas | | | | | | | | NO | | | | | | NO | | | | |
| 4.F. | Field Burning of Agricultural Residues | | | | | | | | 1.24 | | | | | | 0.31 | | | | |
| 4.G. | Other | | | | | | | | NA | | | | | | NA | | | | |
| **5. Land Use, Land-Use Change and Forestry (net)** [(5)] | | | **-17 397.91** | | | | | | 0.05 | | | | | | 274.89 | | | | |
| 5.A. | Forest Land | | -19 539.13 | | | | | | 0.05 | | | | | | 0.01 | | | | |
| 5.B. | Cropland | | 2 034.08 | | | | | | NA,NO | | | | | | 274.88 | | | | |
| 5.C. | Grassland | | -1 265.62 | | | | | | NO | | | | | | NO | | | | |
| 5.D. | Wetlands | | 371.78 | | | | | | NO | | | | | | NO | | | | |
| 5.E. | Settlements | | 530.55 | | | | | | NA,NO | | | | | | NA,NO | | | | |
| 5.F. | Other Land | | 470.44 | | | | | | NA,NO | | | | | | NA,NO | | | | |
| 5.G. | Other | | NE | | | | | | NA | | | | | | NA | | | | |

**Note:** All footnotes for this table are given at the end of the table on sheet 2.

**TABLE 8(a) RECALCULATION - RECALCULATED DATA**
**(Sheet 2 of 2)**

**Recalculated year:** Inventory 2007
Submission 2009 v1.1
AUSTRIA

| GREENHOUSE GAS SOURCE AND SINK CATEGORIES | $CO_2$ | | | | | | $CH_4$ | | | | | | $N_2O$ | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Previous submission | Latest submission | Difference | Difference(1) | Impact of recalculation on total emissions excluding LULUCF (2) | Impact of recalculation on total emissions including LULUCF(3) | Previous submission | Latest submission | Difference | Difference(1) | Impact of recalculation on total emissions excluding LULUCF (2) | Impact of recalculation on total emissions including LULUCF(3) | Previous submission | Latest submission | Difference | Difference(1) | Impact of recalculation on total emissions excluding LULUCF (2) | Impact of recalculation on total emissions including LULUCF(3) |
| | $CO_2$ equivalent (Gg) | | | (%) | | | $CO_2$ equivalent (Gg) | | | (%) | | | $CO_2$ equivalent (Gg) | | | (%) | | |
| **6. Waste** | | **12.26** | | | | | | 1 810.69 | | | | | | 352.91 | | | | |
| 6.A. Solid Waste Disposal on Land | | NA,NO | | | | | | 1 744.20 | | | | | | | | | | |
| 6.B. Waste-water Handling | | | | | | | | 31.32 | | | | | | 279.40 | | | | |
| 6.C. Waste Incineration | | 12.26 | | | | | | 0.01 | | | | | | 0.03 | | | | |
| 6.D. Other | | NA | | | | | | 35.17 | | | | | | 73.47 | | | | |
| **7. Other *(as specified in Summary 1.A)*** | | NA | | | | | | NA | | | | | | NA | | | | |
| | | | | | | | | | | | | | | | | | | |
| **Memo Items:** | | | | | | | | | | | | | | | | | | |
| **International Bunkers** | | **2 175.79** | | | | | | **0.90** | | | | | | **22.57** | | | | |
| **Multilateral Operations** | | **NO** | | | | | | **NO** | | | | | | **NO** | | | | |
| **$CO_2$ Emissions from Biomass** | | **18 660.74** | | | | | | | | | | | | | | | | |

| GREENHOUSE GAS SOURCE AND SINK CATEGORIES | HFCs | | | | | | PFCs | | | | | | $SF_6$ | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Previous submission | Latest submission | Difference | Difference(1) | Impact of recalculation on total emissions excluding LULUCF (2) | Impact of recalculation on total emissions including LULUCF(3) | Previous submission | Latest submission | Difference | Difference(1) | Impact of recalculation on total emissions excluding LULUCF (2) | Impact of recalculation on total emissions including LULUCF(3) | Previous submission | Latest submission | Difference | Difference(1) | Impact of recalculation on total emissions excluding LULUCF (2) | Impact of recalculation on total emissions including LULUCF(3) |
| | $CO_2$ equivalent (Gg) | | | (%) | | | $CO_2$ equivalent (Gg) | | | (%) | | | $CO_2$ equivalent (Gg) | | | (%) | | |
| **Total Actual Emissions** | | **860.63** | | | | | | **182.71** | | | | | | **409.58** | | | | |
| 2.C.3. Aluminium Production | | | | | | | | NO | | | | | | | | | | |
| 2.E. Production of Halocarbons and $SF_6$ | | NA | | | | | | NA | | | | | | NA | | | | |
| 2.F. Consumption of Halocarbons and $SF_6$ | | 860.63 | | | | | | 182.71 | | | | | | 409.58 | | | | |
| 2.G. Other | | NA | | | | | | NA | | | | | | NA | | | | |
| **Potential Emissions from Consumption of HFCs/PFCs and $SF_6$** | | **1 372.88** | | | | | | **451.77** | | | | | | **440.14** | | | | |

| | Previous submission | Latest submission | Difference | Difference(1) |
|---|---|---|---|---|
| | $CO_2$ equivalent (Gg) | | | (%) |
| Total $CO_2$ Equivalent Emissions with Land Use, Land-Use Change and Forestry | | 70 835.38 | | |
| Total $CO_2$ Equivalent Emissions without Land Use, Land-Use Change and Forestry | | 87 958.35 | | |

(1) Estimate the percentage change due to recalculation with respect to the previous submission (percentage change = 100 x [(LS-PS)/PS], where LS = latest submission and PS = previous submission. All cases of recalculation of the estimate of the source/sink category should be addressed and explained in table 8(b).

(2) Total emissions refer to total aggregate GHG emissions expressed in terms of $CO_2$ equivalent, excluding GHGs from the LULUCF sector. The impact of the recalculation on the total emissions is calculated as follows: impact of recalculation (%) = 100 x [(source (LS) - source (PS))/total emissions (LS)], where LS = latest submission, PS = previous submission.

(3) Total emissions refer to total aggregate GHG emissions expressed in terms of $CO_2$ equivalent, including GHGs from the LULUCF sector. The impact of the recalculation on the total emissions is calculated as follows: impact of recalculation (%) = 100 x [(source (LS) - source (PS))/total emissions (LS)], where LS = latest submission, PS = previous submission.

(4) Parties which previously reported $CO_2$ from soils in the Agriculture sector should note this in the NIR.

(5) Net $CO_2$ emissions/removals to be reported.

**Documentation box:**
Parties should provide detailed information on recalculations in Chapter 10: Recalculations and Improvements, and in the relevant sections of Chapters 3 to 9 (see section 2.5 of each of Chapters 3 - 9) of the NIR. Use this documentation box to provide references to relevant sections of the NIR if any additional information and further details are needed to understand the content of this table.

**TABLE 8(b) RECALCULATION - EXPLANATORY INFORMATION**
**(Sheet 1 of 1)**

Inventory 2007
Submission 2009 v1.1
AUSTRIA

| Specify the sector and source/sink category[1] where changes in estimates have occurred: | | GHG | RECALCULATION DUE TO | | | | |
|---|---|---|---|---|---|---|---|
| | | | CHANGES IN: | | | Addition/removal/ reallocation of source/sink categories | Other changes in data (e.g. statistical or editorial changes, correction of errors) |
| | | | Methods [2] | Emission factors [2] | Activity data [2] | | |
| | | | | | | | |

[1] Enter the identification code of the source/sink category (e.g. 1.B.1) in the first column and the name of the category (e.g. Fugitive Emissions from Solid Fuels) in the second column of the table. Note that the source categories entered in this table should match those used in table 8(a).
[2] Explain changes in methods, emission factors and activity data that have resulted in recalculation of the estimate of the source/sink as indicated in table 8(a). Include changes in the assumptions and coefficients in the Methods column.

**Documentation box:**

Parties should provide the full information on recalculations in Chapter 10: Recalculations and Improvements, and in the relevant sections of Chapters 3 to 9 (see section 2.5 of each of Chapters 3 to 9) of the NIR. Use this documentation box to provide references to relevant sections of the NIR if any additional information and further details are needed to understand the content of this table. References should point particularly to the sections of the NIR in which justifications of the changes as to improvements in the accuracy, completeness and consistency of the inventory are reported.

**TABLE 9(a) COMPLETENESS - INFORMATION ON NOTATION KEYS**
**(Sheet 1 of 1)**

Inventory 2007
Submission 2009 v1.1
AUSTRIA

| Sources and sinks not estimated (NE)[1] | | | |
|---|---|---|---|
| **GHG** | **Sector[2]** | **Source/sink category [2]** | **Explanation** |
| Carbon | 5 LULUCF | 5.D.1 Total | no sufficient data for estimates. |
| Carbon | 5 LULUCF | 5.E.1 Total | no sufficient data for estimates. |
| Carbon | 5 LULUCF | 5.D.1 Total | no sufficient data for estimates. |
| Carbon | 5 LULUCF | 5.E.1 Total | no sufficient data for estimates. |
| Carbon | 5 LULUCF | 5.D.1 Total | no sufficient data for estimates. |
| Carbon | 5 LULUCF | 5.D.1 Total | no sufficient data for estimates. |
| Carbon | 5 LULUCF | 5.E.1 Total | no sufficient data for estimates. |
| CH4 | 5 LULUCF | 5 Grassland converted to Other Land-Use Categories | No information available |
| CO2 | 5 LULUCF | 5.G Harvested Wood Products | Parties do not have to prepare estimates for this category contained in appendix 3a.1 of the IPCC good practice guidance for |
| N2O | 5 LULUCF | 5.B.2.1 Forest Land converted to Cropland | no sufficient data for estimates. |
| SF6 | 2 Industrial Processes | 2.F.8 2.F.8 Electrical Equipment | No information available |
| SF6 | 2 Industrial Processes | 2.F.8 2.F.8 Electrical Equipment | No information available |
| SF6 | 2 Industrial Processes | 2.F.8 2.F.8 Electrical Equipment | No information available |
| SF6 | 2 Industrial Processes | 2.F.8 2.F.8 Electrical Equipment | No information available |
| SF6 | 2 Industrial Processes | 2.F.8 2.F.8 Electrical Equipment | No information available |
| SF6 | 2 Industrial Processes | 2.F.P4 Destroyed amount | No information available |
| SF6 | 2 Industrial Processes | 2.F.9 Research and other use | No information available |
| SF6 | 2 Industrial Processes | 2.F.9 Research and other use | No information available |
| | | | |

| Sources and sinks reported elsewhere (IE)[3] | | | | |
|---|---|---|---|---|
| **GHG** | **Source/sink category** | **Allocation as per IPCC Guidelines** | **Allocation used by the Party** | **Explanation** |
| Carbon | Perennial converted to annual | Increase | Decrease | only net figures are reported. |
| Carbon | Total | Increase | Decrease | only net figures are reported. |
| Carbon | onverted to perennial cropland | | | |
| Carbon | Total | Increase | Decrease | only net figures are reported. |
| Carbon | opland converted to grassland | Increase | Decrease | only net figures are reported. |
| Carbon | Total | Increase | Decrease | only net figures are reported. |
| Carbon | Total | | | |
| Carbon | Total | Increase | Decrease | only net figures are reported. |
| Carbon | Annual remaining annual | Increase | Decrease | only net figures are reported. |
| Carbon | Annual converted to perennial | Increase | Decrease | only net figures are reported. |
| Carbon | opland converted to grassland | | | |
| Carbon | Total | 5 A 2 1 Cropland converted to Forest Land -Total - Decrease | onverted to Forest Land -Total - Increase | only net figures are reported. |
| Carbon | Total | 5 A 2 2 Grassland converted to Forest Land -Total - Decrease | onverted to Forest Land -Total - Increase | only net figures are reported. |
| Carbon | Total | 5 A 2 3 Wetlands converted to Forest Land -Total - Decrease | onverted to Forest Land -Total - Increase | only net figures are reported. |
| Carbon | Total | 5 A 2 5 Other Land converted to Forest Land -Total - Decrease | onverted to Forest Land -Total - Increase | only net figures are reported. |
| Carbon | l converted to annual cropland | | | |
| Carbon | Total | Organic Soils | Included in Mineral Soils | Included in Mineral Soils |
| CH4 | .A.2.2 Post-Mining Activities | 1 B 1 A 2 Coal Surface Mines/ Post Mining Activities | 2 Coal Surface Mines/ Mining Activities | Emissions from mining and post-mining activities are reported together. |
| CH4 | .B Solid Fuel Transformation | 1 B 1 B Solid Fuel Transformation | 1 A 2 a Iron and Steel | Emissions from coke ovens are included in 1 A 2 a Iron and Steel |
| CH4 | 1.B.2.A.1 Exploration | 1 B 2 A 1 Oil Exploration | 1 B 2 A 2 Oil Production | on fields are reported here (total figures are reported from the Association of Oil Industry). |
| CH4 | 1.B.2.A.3 Transport | 1 B 2 A 3 Oil Transport | 1 B 2 A 2 Oil Production | on fields are reported here (total figures are reported from the Association of Oil Industry). |
| CH4 | 1.B.2.B.1 Exploration | 1 B 2 A 3 Oil Transport | 1 B 2 A 2 Oil Production | on fields are reported here (total figures are reported from the Association of Oil Industry). |
| CH4 | 2.B.2 Production / Processing | 1 B 2 A 3 Oil Transport | 1 B 2 A 2 Oil Production | on fields are reported here (total figures are reported from the Association of Oil Industry). |
| CH4 | 1.B.2.C.1 Venting | 1.B.2.C.1 | 1 A 1 b Petroleum Refining | The emission declaration of the refinery includes all emissions from the plant. |
| CH4 | 1.B.2.C.1.1 Oil | 1 B 2 c Venting and Flaring | 1 B 2 A 4 Oil Refining/Storage | The emission declaration of the refinery includes all emissions from the plant. |
| CH4 | 1.B.2.C.1.2 Gas | 1 B 2 c Venting and Flaring | 1 B 2 A 4 Oil Refining/Storage | The emission declaration of the refinery includes all emissions from the plant. |
| CH4 | 1.B.2.C.1.3 Combined | 1 B 2 c Venting and Flaring | 1 B 2 A 4 Oil Refining/Storage | The emission declaration of the refinery includes all emissions from the plant. |
| CH4 | 1.B.2.C.2 Flaring | 1.B.2.C.1 | 1 A 1 b Petroleum Refining | The emission declaration of the refinery includes all emissions from all sources. |
| CH4 | 1.B.2.C.2.1 Oil | 1 B 2 c Venting and Flaring | 1 B 2 A 4 Oil Refining/Storage | The emission declaration of the refinery includes all emissions from the plant. |
| CH4 | 1.B.2.C.2.2 Gas | 1 B 2 c Venting and Flaring | 1 B 2 A 4 Oil Refining/Storage | The emission declaration of the refinery includes all emissions from the plant. |
| CH4 | 1.B.2.C.2.3 Combined | 1 B 2 c Venting and Flaring | 1 B 2 A 4 Oil Refining/Storage | The emission declaration of the refinery includes all emissions from the plant. |
| CH4 | 4.A Enteric Fermentation | 4 A Enteric Fermentation / Mules and Asses | 4 A Enteric Fermentation / Horses | In the national statistics mules, asses and horses are published together. |
| CH4 | 4.B Manure Management | 4 A Manure Managment / Mules and Asses | 4 A Manure Managment / Horses | In the national statistics mules, asses and horses are published together. |
| CH4 | 2.A.7.1 Glass Production | 2.A.7.1 Glass Production | 2A3 Limestone Use, 2A4 Soda ash use | emissions are reported under 2A3 Limestone and dolomite use and under 2A4 Soda ash use |
| CH4 | 2.C.1.1 Steel | 2 C 1 1 Steel | 1 A 2 a Iron and Steel | om all activities of integrated iron and steel plants are reported under 1 A 2 a Iron and Steel. |
| CH4 | 2.C.1.2 Pig Iron | 2 C 1 2 Pig Iron | 1 A 2 a Iron and Steel | om all activities of integrated iron and steel plants are reported under 1 A 2 a Iron and Steel. |
| CH4 | 2.C.1.3 Sinter | 2 C 1 3 Sinter | 1 A 2 a Iron and Steel | om all activities of integrated iron and steel plants are reported under 1 A 2 a Iron and Steel. |
| CH4 | 2.C.1.4 Coke | 2 C 1 4 Coke | 1 A 2 a Iron and Steel | om all activities of integrated iron and steel plants are reported under 1 A 2 a Iron and Steel. |
| CH4 | 4.F.1.2 Barley | 4 F 1 2 Barlay | 4 F 1 1 Wheat | Wheat includes cereals total |
| CH4 | 4.F.1.3 Maize | 4 F 1 3 Maize | 4 F 1 1 Wheat | Wheat includes cereals total |
| CH4 | 4.F.1.4 Oats | 4 F 1 4 Oats | 4 F 1 1 Wheat | Wheat includes cereals total |
| CH4 | 4.F.1.5 Rye | 4 F 1 5 Rye | 4 F 1 1 Wheat | Wheat includes cereals total |
| CH4 | 6.B.1 Industrial Wastewater | 6 B 1 Industrial Wastewater / Sludge | B 1 Industrial Wastewater / Wastewater | Emissions from sludge are reported together with emissions from wastewater |
| CH4 | nmercial (w/o human sewage) | 6 B 2 Dometic and Commercial Wastewater / Sludge | d Commercial Wastewater / Wastewater | Emissions from sludge are reported together with emissions from wastewater |
| CH4 | 1.AA.1.B Petroleum Refining | 1 A 1 b Petroleum Refining / Liquid Fuels. | 1 B 2 fugitive Emissions from fuels. | H4 emissions from fuel combustion are a minor source of total CH4 emissions from refinery. |
| CH4 | 1.AA.1.B Petroleum Refining | 1 A 1 b Petroleum Refining / Gaseous Fuels. | 1 B 2 fugitive Emissions from fuels. | H4 emissions from fuel combustion are a minor source of total CH4 emissions from refinery. |
| CO2 | .A.2.2 Post-Mining Activities | 1 B 1 A 2 Coal Surface Mines/ Post Mining Activities | 2 Coal Surface Mines/ Mining Activities | Emissions from mining and post-mining activities are reported together. |
| CO2 | .B Solid Fuel Transformation | 1 B 1 B Solid Fuel Transformation | 1 A 2 a Iron and Steel | Emissions from coke ovens are included in 1 A 2 a Iron and Steel |
| CO2 | 1.B.2.A.1 Exploration | 1 B 2 A 1 Oil Exploration | 1 B 2 A 2 Oil Production | on fields are reported here (total figures are reported from the Association of Oil Industry). |
| CO2 | 1.B.2.A.3 Transport | 1 B 2 A 3 Oil Transport | 1 B 2 A 2 Oil Production | on fields are reported here (total figures are reported from the Association of Oil Industry). |
| CO2 | 1.B.2.C.1 Venting | 1.B.2.C.1 | 1 A 1 b Petroleum Refining | The emission declaration of the refinery includes all emissions from the plant. |
| CO2 | 1.B.2.C.1.1 Oil | 1 B 2 c Venting and Flaring | 1 B 2 A 4 Oil Refining/Storage | The emission declaration of the refinery includes all emissions from the plant. |
| CO2 | 1.B.2.C.1.2 Gas | 1 B 2 c Venting and Flaring | 1 B 2 A 4 Oil Refining/Storage | The emission declaration of the refinery includes all emissions from the plant. |
| CO2 | 1.B.2.C.1.3 Combined | 1 B 2 c Venting and Flaring | 1 B 2 A 4 Oil Refining/Storage | The emission declaration of the refinery includes all emissions from the plant. |
| CO2 | 1.B.2.C.2 Flaring | 1.B.2.C.1 | 1 A 1 b Petroleum Refining | The emission declaration of the refinery includes all emissions from all sources. |
| CO2 | 1.B.2.C.2.1 Oil | 1 B 2 c Venting and Flaring | 1 B 2 A 4 Oil Refining/Storage | The emission declaration of the refinery includes all emissions from the plant. |
| CO2 | 1.B.2.C.2.2 Gas | 1 B 2 c Venting and Flaring | 1 B 2 A 4 Oil Refining/Storage | The emission declaration of the refinery includes all emissions from the plant. |
| CO2 | 1.B.2.C.2.3 Combined | 1 B 2 c Venting and Flaring | 1 B 2 A 4 Oil Refining/Storage | The emission declaration of the refinery includes all emissions from the plant. |
| CO2 | 2.A.4.1 Soda Ash Production | 2 A 4 1 Soda Ash Production | 1 A 2 c Chemicals | subcategory 1 A 2 c), that's why CO2 emissions of soda ash production is reported as "IE". |
| CO2 | 2.A.4.1 Soda Ash Production | 2 A 4 1 Soda Ash Production | 1 A 2 c Chemicals | subcategory 1 A 2 c), that's why CO2 emissions of soda ash production is reported as "IE". |
| CO2 | 2.A.5 Asphalt Roofing | 2 A 5 Asphalt Roofing | 3 Solvent Use | A5 Asphalt Roofing and 2A6 Road Paving with Asphalt are included in the Solvent Sector. |
| CO2 | A.6 Road Paving with Asphalt | 2 A 6 Road Paving | 3 Solvent Use | A5 Asphalt Roofing and 2A6 Road Paving with Asphalt are included in the Solvent Sector. |
| CO2 | 2.A.7.1 Glass Production | 2.A.7.1 Glass Production | 2A3 Limestone Use, 2A4 Soda ash use | emissions are reported under 2A3 Limestone and dolomite use and under 2A4 Soda ash use |
| CO2 | 2.C.1.3 Sinter | 2 C 1 3 Sinter | 1 A 2 a Iron and Steel | om all activities of integrated iron and steel plants are reported under 1 A 2 a Iron and Steel. |
| CO2 | 2.C.1.4 Coke | 2 C 1 4 Coke | 1 A 2 a Iron and Steel | om all activities of integrated iron and steel plants are reported under 1 A 2 a Iron and Steel. |
| CO2 | t Land remaining Forest Land | 5 A 1 Widfires | Forest Land remaining Forest land | stock change due to wildfires at forest land is included in figures of table 5.A Sektor 5.A.1. |
| CO2 | Cropland remaining Cropland | 5 B Cropland / lime application / Dolomite | 3 Cropland / lime application / Limestone | Emissions from dolomite liming include emissions from limestone liming |
| CO2 | rassland remaining Grassland | 5 C Grassland / lime application | 3 Cropland / lime application / Limestone | Emissions from cropland dolomite liming include emissions from grassland liming. |
| CO2 | rassland remaining Grassland | 5 C Grassland / lime application | 3 Cropland / lime application / Limestone | Emissions from cropland dolomite liming include emissions from grassland liming. |
| N2O | .B Solid Fuel Transformation | 1 B 1 B Solid Fuel Transformation | 1 A 2 a Iron and Steel | Emissions from coke ovens are included in 1 A 2 a Iron and Steel |
| N2O | 1.B.2.A.1 Exploration | 1 B 2 A 1 Oil Exploration | 1 B 2 A 2 Oil Production | on fields are reported here (total figures are reported from the Association of Oil Industry). |
| N2O | 1.B.2.C.2 Flaring | 1.B.2.C.1 | 1 A 1 b Petroleum Refining | The emission declaration of the refinery includes all emissions from all sources. |
| N2O | 1.B.2.C.2.1 Oil | 1 B 2 c Venting and Flaring | 1 B 2 A 4 Oil Refining/Storage | The emission declaration of the refinery includes all emissions from the plant. |
| N2O | 1.B.2.C.2.2 Gas | 1 B 2 c Venting and Flaring | 1 B 2 A 4 Oil Refining/Storage | The emission declaration of the refinery includes all emissions from the plant. |
| N2O | 1.B.2.C.2.3 Combined | 1 B 2 c Venting and Flaring | 1 B 2 A 4 Oil Refining/Storage | The emission declaration of the refinery includes all emissions from the plant. |
| N2O | 2.A.7.1 Glass Production | 2.A.7.1 Glass Production | 2A3 Limestone Use, 2A4 Soda ash use | emissions are reported under 2A3 Limestone and dolomite use and under 2A4 Soda ash use |
| N2O | 4.F.1.2 Barley | 4 F 1 2 Barlay | 4 F 1 1 Wheat | Wheat includes cereals total |
| N2O | 4.F.1.3 Maize | 4 F 1 3 Maize | 4 F 1 1 Wheat | Wheat includes cereals total |
| N2O | 4.F.1.4 Oats | 4 F 1 4 Oats | 4 F 1 1 Wheat | Wheat includes cereals total |
| N2O | 4.F.1.5 Rye | 4 F 1 5 Rye | 4 F 1 1 Wheat | Wheat includes cereals total |
| N2O | 6.B.1 Industrial Wastewater | 6 B 1 Industrial Wastewater / Sludge | B 1 Industrial Wastewater / Wastewater | Emissions from sludge are reported together with emissions from wastewater |
| N2O | nmercial (w/o human sewage) | 6 B 2 Dometic and Commercial Wastewater / Sludge | d Commercial Wastewater / Wastewater | Emissions from sludge are reported together with emissions from wastewater |
| SF6 | 2.F.P2.2 In products | 2 F P 2 2 Import in Products | 2 F P 2 1 Import in Bulk | ation is based on consumption data of halocarbons and SF6 or products (net import/export). |
| SF6 | 2.F.P3.1 In bulk | 2 F P 3 1 Export in Bulk | 2 F P 2 1 Import in Bulk | ation is based on consumption data of halocarbons and SF6 or products (net import/export). |
| SF6 | 2.F.P3.2 In products | 2 F P 3 2 Export in Products | 2 F P 2 1 Import in Bulk | ation is based on consumption data of halocarbons and SF6 or products (net import/export). |
| | | | | |

(1) Clearly indicate sources and sinks which are considered in the IPCC Guidelines but are not considered in the submitted inventory. Explain the reason for excluding these sources and sinks, in order to avoid arbitrary interpretations. An entry should be made for each
(2) Indicate omitted source/sink following the IPCC source/sink category structure (e.g. sector: Waste, source category: Waste-Water Handling).
(3) Clearly indicate sources and sinks in the submitted inventory that are allocated to a sector other than that indicated by the IPCC Guidelines. Show the sector indicated in the IPCC Guidelines and the sector to which the source or sink is allocated in the submitted

# TABLE 9(b) COMPLETENESS - INFORMATION ON ADDITIONAL GREENHOUSE GAS (Sheet 1 of 1)

Inventory 2007
Submission 2009 v1.1
AUSTRIA

| Additional GHG emissions reported[1] | | | | | | |
|---|---|---|---|---|---|---|
| GHG | Source category | Emissions (Gg) | Estimated GWP value (100-year horizon) | Emissions $CO_2$ equivalent (Gg) | Reference to the source of GWP value | Explanation |
| HFC-245fa | Hard Foam | 0.00 | 0.00 | 0.00 | anel on Climate Change | CHF2CH2CF3 |
| HFC-365mfc | Hard Foam | 0.00 | 0.00 | 0.00 | anel on Climate Change | CF3CH2CF2CH3 |

(1) Parties are encouraged to provide information on emissions of greenhouse gases whose GWP values have not yet been agreed upon by the COP. Include such gases in this table if they are considered in the submitted inventory. Provide additional information on the estimation methods used.

**Documentation box:**

Parties should provide detailed information regarding completeness of the inventory in the NIR (Chapter 1.8: General Assessment of the Completeness, and Annex 5). Use this documentation box to provide references to relevant sections of the NIR if any additional information and further details are needed to understand the content of this table.

**TABLE 10 EMISSION TRENDS**
**$CO_2$**
**(Part 1 of 2)**

Inventory 2007
Submission 2009 v1.1
AUSTRIA

| GREENHOUSE GAS SOURCE AND SINK CATEGORIES | Base year ( 1990 ) | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 |
|---|---|---|---|---|---|---|---|---|---|---|
| | (Gg) | (Gg) | (Gg) | (Gg) | (Gg) | (Gg) | (Gg) | (Gg) | (Gg) | (Gg) |
| **1. Energy** | **54 196.23** | **57 988.96** | **53 091.71** | **53 492.98** | **53 564.73** | **56 381.95** | **60 141.34** | **59 326.06** | **59 274.47** | **58 219.53** |
| A. Fuel Combustion (Sectoral Approach) | 54 094.21 | 57 877.94 | 52 971.69 | 53 380.96 | 53 437.20 | 56 254.93 | 60 070.31 | 59 205.55 | 59 132.64 | 58 049.00 |
| 1. Energy Industries | 13 792.26 | 14 622.47 | 11 481.05 | 11 466.09 | 11 761.38 | 12 918.63 | 13 804.54 | 13 885.39 | 12 993.72 | 12 841.59 |
| 2. Manufacturing Industries and Construction | 12 686.76 | 13 075.89 | 11 783.68 | 12 249.55 | 13 237.05 | 13 489.17 | 13 703.31 | 15 231.65 | 13 987.22 | 13 065.11 |
| 3. Transport | 13 768.78 | 15 231.97 | 15 205.42 | 15 338.40 | 15 388.86 | 15 670.92 | 17 220.21 | 16 244.14 | 18 347.08 | 17 808.03 |
| 4. Other Sectors | 13 811.39 | 14 910.52 | 14 467.86 | 14 287.51 | 13 008.35 | 14 143.65 | 15 303.36 | 13 807.28 | 13 762.22 | 14 292.70 |
| 5. Other | 35.01 | 37.09 | 33.68 | 39.41 | 41.57 | 32.56 | 38.90 | 37.09 | 42.40 | 41.57 |
| B. Fugitive Emissions from Fuels | 102.03 | 111.03 | 120.03 | 112.03 | 127.53 | 127.03 | 71.03 | 120.51 | 141.83 | 170.53 |
| 1. Solid Fuels | IE,NA,NO | IE,NA,NO | IE,NA,NO | IE,NA,NO | IE,NA,NO | IE,NA,NO | IE,NA,NO | IE,NA,NO | IE,NA,NO | IE,NA,NO |
| 2. Oil and Natural Gas | 102.03 | 111.03 | 120.03 | 112.03 | 127.53 | 127.03 | 71.03 | 120.51 | 141.83 | 170.53 |
| **2. Industrial Processes** | **7 579.11** | **7 425.25** | **6 938.52** | **6 853.28** | **7 183.49** | **7 382.43** | **7 081.29** | **7 670.77** | **7 314.65** | **7 162.44** |
| A. Mineral Products | 3 269.05 | 3 127.22 | 3 147.24 | 3 081.86 | 3 196.46 | 2 856.93 | 2 769.36 | 2 968.65 | 2 815.30 | 2 801.11 |
| B. Chemical Industry | 585.10 | 609.31 | 632.54 | 605.93 | 555.09 | 583.65 | 590.28 | 582.88 | 579.72 | 583.12 |
| C. Metal Production | 3 724.96 | 3 688.72 | 3 158.74 | 3 165.49 | 3 431.94 | 3 941.84 | 3 721.65 | 4 119.24 | 3 919.62 | 3 778.22 |
| D. Other Production | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| E. Production of Halocarbons and $SF_6$ | | | | | | | | | | |
| F. Consumption of Halocarbons and $SF_6$ | | | | | | | | | | |
| G. Other | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| **3. Solvent and Other Product Use** | 279.30 | 233.48 | 185.15 | 185.98 | 170.76 | 189.95 | 173.16 | 191.87 | 173.82 | 159.76 |
| **4. Agriculture** | | | | | | | | | | |
| A. Enteric Fermentation | | | | | | | | | | |
| B. Manure Management | | | | | | | | | | |
| C. Rice Cultivation | | | | | | | | | | |
| D. Agricultural Soils | | | | | | | | | | |
| E. Prescribed Burning of Savannas | | | | | | | | | | |
| F. Field Burning of Agricultural Residues | | | | | | | | | | |
| G. Other | | | | | | | | | | |
| **5. Land Use, Land-Use Change and Forestry[(2)]** | **-13 430.24** | **-19 335.92** | **-14 295.23** | **-18 177.16** | **-16 825.64** | **-16 266.77** | **-11 182.04** | **-20 113.92** | **-18 240.60** | **-22 629.50** |
| A. Forest Land | -15 913.42 | -21 954.88 | -16 890.81 | -20 864.41 | -19 544.99 | -18 604.71 | -13 635.79 | -22 488.35 | -20 388.33 | -24 780.25 |
| B. Cropland | 1 735.40 | 1 741.74 | 1 754.72 | 1 789.94 | 1 798.68 | 1 798.84 | 1 849.95 | 1 866.08 | 1 874.49 | 1 899.69 |
| C. Grassland | -1 021.55 | -1 011.04 | -1 001.89 | -994.52 | -1 011.76 | -1 134.84 | -1 157.09 | -1 179.37 | -1 200.72 | -1 210.87 |
| D. Wetlands | 199.73 | 215.89 | 232.04 | 248.19 | 254.13 | 255.80 | 281.84 | 287.56 | 272.72 | 283.06 |
| E. Settlements | 759.66 | 843.14 | 762.19 | 775.83 | 845.28 | 674.22 | 778.54 | 743.06 | 587.55 | 582.87 |
| F. Other Land | 809.95 | 829.23 | 848.52 | 867.80 | 833.03 | 743.93 | 700.51 | 657.10 | 613.68 | 596.00 |
| G. Other | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE |
| **6. Waste** | **26.89** | **23.40** | **10.86** | **10.60** | **10.65** | **10.97** | **11.30** | **11.62** | **11.94** | **12.26** |
| A. Solid Waste Disposal on Land | NA,NO | NA,NO | NA,NO | NA,NO | NA,NO | NA,NO | NA,NO | NA,NO | NA,NO | NA,NO |
| B. Waste-water Handling | | | | | | | | | | |
| C. Waste Incineration | 26.89 | 23.40 | 10.86 | 10.60 | 10.65 | 10.97 | 11.30 | 11.62 | 11.94 | 12.26 |
| D. Other | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| **7. Other *(as specified in Summary 1.A)*** | **NA** | **NA** | **NA** | **NA** | **NA** | **NA** | **NA** | **NA** | **NA** | **NA** |
| | | | | | | | | | | |
| **Total $CO_2$ emissions including net $CO_2$ from LULUCF** | **48 651.29** | **46 335.17** | **45 931.01** | **42 365.69** | **44 103.99** | **47 698.54** | **56 225.05** | **47 086.40** | **48 534.27** | **42 924.50** |
| **Total $CO_2$ emissions excluding net $CO_2$ from LULUCF** | **62 081.53** | **65 671.09** | **60 226.24** | **60 542.84** | **60 929.63** | **63 965.30** | **67 407.08** | **67 200.32** | **66 774.88** | **65 553.99** |
| | | | | | | | | | | |
| **Memo Items:** | | | | | | | | | | |
| **International Bunkers** | **885.97** | **993.88** | **1 077.44** | **1 139.98** | **1 185.65** | **1 327.42** | **1 466.42** | **1 525.57** | **1 578.21** | **1 541.67** |
| Aviation | 885.97 | 993.88 | 1 077.44 | 1 139.98 | 1 185.65 | 1 327.42 | 1 466.42 | 1 525.57 | 1 578.21 | 1 541.67 |
| Marine | NA,NO | NA,NO | NA,NO | NA,NO | NA,NO | NA,NO | NA,NO | NA,NO | NA,NO | NA,NO |
| **Multilateral Operations** | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| **$CO_2$ Emissions from Biomass** | 9 803.18 | 10 666.58 | 10 403.39 | 10 958.18 | 10 570.44 | 11 260.05 | 11 960.02 | 11 735.76 | 11 506.23 | 13 229.61 |

**Note:** All footnotes for this table are given at the end of the table on sheet 5.

**TABLE 10 EMISSION TRENDS**
**$CO_2$**
**(Part 2 of 2)**

Inventory 2007
Submission 2009 v1.1
AUSTRIA

| GREENHOUSE GAS SOURCE AND SINK CATEGORIES | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | Change from base to latest reported year |
|---|---|---|---|---|---|---|---|---|---|
| | (Gg) | (Gg) | (Gg) | (Gg) | (Gg) | (Gg) | (Gg) | (Gg) | % |
| **1. Energy** | **57 980.32** | **62 145.96** | **63 522.07** | **69 611.30** | **69 231.10** | **70 079.71** | **68 221.25** | **64 380.52** | **18.79** |
| A. Fuel Combustion (Sectoral Approach) | 57 815.79 | 61 963.22 | 63 355.03 | 69 378.26 | 69 021.07 | 69 874.67 | 67 989.22 | 64 143.48 | 18.58 |
| 1. Energy Industries | 12 352.81 | 14 127.97 | 13 670.35 | 16 116.27 | 16 351.64 | 16 095.33 | 15 545.20 | 13 928.60 | 0.99 |
| 2. Manufacturing Industries and Construction | 13 742.07 | 13 539.51 | 14 081.68 | 14 428.46 | 14 430.23 | 15 684.37 | 15 965.73 | 15 667.82 | 23.50 |
| 3. Transport | 18 792.82 | 20 025.42 | 21 932.44 | 23 744.69 | 24 355.12 | 24 995.31 | 23 652.66 | 23 922.60 | 73.75 |
| 4. Other Sectors | 12 887.28 | 14 228.96 | 13 628.65 | 15 046.38 | 13 841.05 | 13 056.09 | 12 781.56 | 10 579.85 | -23.40 |
| 5. Other | 40.80 | 41.36 | 41.91 | 42.47 | 43.03 | 43.56 | 44.06 | 44.61 | 27.44 |
| B. Fugitive Emissions from Fuels | 164.53 | 182.73 | 167.03 | 233.04 | 210.04 | 205.04 | 232.04 | 237.04 | 132.33 |
| 1. Solid Fuels | IE,NA,NO | IE,NA,NO | IE,NA,NO | IE,NA,NO | IE,NA,NO | IE,NA,NO | IE,NA,NO | IE,NA,NO | 0.00 |
| 2. Oil and Natural Gas | 164.53 | 182.73 | 167.03 | 233.04 | 210.04 | 205.04 | 232.04 | 237.04 | 132.33 |
| **2. Industrial Processes** | **7 766.11** | **7 693.74** | **8 260.57** | **8 205.30** | **8 153.75** | **8 696.86** | **9 104.76** | **9 535.22** | **25.81** |
| A. Mineral Products | 2 958.13 | 2 976.77 | 3 085.41 | 3 072.98 | 3 162.59 | 3 119.72 | 3 293.94 | 3 505.54 | 7.23 |
| B. Chemical Industry | 587.27 | 539.50 | 551.22 | 592.50 | 528.09 | 563.47 | 599.25 | 530.62 | -9.31 |
| C. Metal Production | 4 220.70 | 4 177.48 | 4 623.93 | 4 539.83 | 4 463.06 | 5 013.66 | 5 211.58 | 5 499.05 | 47.63 |
| D. Other Production | NA | NA | NA | NA | NA | NA | NA | NA | 0.00 |
| E. Production of Halocarbons and $SF_6$ | | | | | | | | | |
| F. Consumption of Halocarbons and $SF_6$ | | | | | | | | | |
| G. Other | NA | NA | NA | NA | NA | NA | NA | NA | 0.00 |
| **3. Solvent and Other Product Use** | 192.56 | 204.07 | 220.02 | 226.18 | 193.66 | 219.93 | 247.86 | 248.53 | -11.02 |
| **4. Agriculture** | | | | | | | | | |
| A. Enteric Fermentation | | | | | | | | | |
| B. Manure Management | | | | | | | | | |
| C. Rice Cultivation | | | | | | | | | |
| D. Agricultural Soils | | | | | | | | | |
| E. Prescribed Burning of Savannas | | | | | | | | | |
| F. Field Burning of Agricultural Residues | | | | | | | | | |
| G. Other | | | | | | | | | |
| **5. Land Use, Land-Use Change and Forestry[(2)]** | **-17 234.55** | **-19 926.85** | **-16 189.83** | **-17 569.35** | **-17 617.41** | **-17 421.59** | **-17 434.26** | **-17 397.91** | **29.54** |
| A. Forest Land | -19 339.66 | -22 013.93 | -18 195.26 | -19 647.35 | -19 620.30 | -19 593.24 | -19 566.19 | -19 539.13 | 22.78 |
| B. Cropland | 1 909.14 | 1 910.47 | 1 913.18 | 1 974.87 | 1 944.88 | 1 978.91 | 1 980.89 | 2 034.08 | 17.21 |
| C. Grassland | -1 220.98 | -1 207.83 | -1 268.54 | -1 259.15 | -1 291.15 | -1 265.56 | -1 288.27 | -1 265.62 | 23.89 |
| D. Wetlands | 293.40 | 301.63 | 309.87 | 318.10 | 326.65 | 318.79 | 337.67 | 371.78 | 86.14 |
| E. Settlements | 545.22 | 522.17 | 507.97 | 518.92 | 510.95 | 641.66 | 617.51 | 530.55 | -30.16 |
| F. Other Land | 578.31 | 560.63 | 542.95 | 525.26 | 511.56 | 497.85 | 484.15 | 470.44 | -41.92 |
| G. Other | NE | NE | NE | NE | NE | NE | NE | NE | 0.00 |
| **6. Waste** | **12.26** | **12.26** | **12.26** | **12.26** | **12.26** | **12.26** | **12.26** | **12.26** | **-54.39** |
| A. Solid Waste Disposal on Land | NA,NO | NA,NO | NA,NO | NA,NO | NA,NO | NA,NO | NA,NO | NA,NO | 0.00 |
| B. Waste-water Handling | | | | | | | | | |
| C. Waste Incineration | 12.26 | 12.26 | 12.26 | 12.26 | 12.26 | 12.26 | 12.26 | 12.26 | -54.39 |
| D. Other | NA | NA | NA | NA | NA | NA | NA | NA | 0.00 |
| **7. Other *(as specified in Summary 1.A)*** | **NA** | **NA** | **NA** | **NA** | **NA** | **NA** | **NA** | **NA** | **0.00** |
| | | | | | | | | | |
| **Total $CO_2$ emissions including net $CO_2$ from LULUCF** | **48 716.70** | **50 129.18** | **55 825.09** | **60 485.69** | **59 973.37** | **61 587.16** | **60 151.88** | **56 778.63** | **16.71** |
| **Total $CO_2$ emissions excluding net $CO_2$ from LULUCF** | **65 951.25** | **70 056.03** | **72 014.92** | **78 055.04** | **77 590.77** | **79 008.75** | **77 586.14** | **74 176.54** | **19.48** |
| | | | | | | | | | |
| **Memo Items:** | | | | | | | | | |
| **International Bunkers** | **1 695.58** | **1 651.28** | **1 540.85** | **1 452.97** | **1 724.93** | **1 959.83** | **2 048.88** | **2 175.79** | **145.58** |
| Aviation | 1 695.58 | 1 651.28 | 1 540.85 | 1 452.97 | 1 724.93 | 1 959.83 | 2 048.88 | 2 175.79 | 145.58 |
| Marine | NA,NO | NA,NO | NA,NO | NA,NO | NA,NO | NA,NO | NA,NO | NA,NO | 0.00 |
| **Multilateral Operations** | NO | NO | NO | NO | NO | NO | NO | NO | 0.00 |
| **$CO_2$ Emissions from Biomass** | 12 511.85 | 13 788.02 | 14 335.54 | 15 067.75 | 15 313.27 | 16 511.05 | 18 394.07 | 18 660.74 | 90.35 |

**Note:** All footnotes for this table are given at the end of the table on sheet 5.

**TABLE 10 EMISSION TRENDS**
**$CH_4$**
**(Part 1 of 2)**

Inventory 2007
Submission 2009 v1.1
AUSTRIA

| GREENHOUSE GAS SOURCE AND SINK CATEGORIES | Base year ( 1990 ) | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 |
|---|---|---|---|---|---|---|---|---|---|---|
| | (Gg) | (Gg) | (Gg) | (Gg) | (Gg) | (Gg) | (Gg) | (Gg) | (Gg) | (Gg) |
| **1. Energy** | 40.31 | 42.83 | 41.86 | 42.42 | 41.25 | 42.79 | 44.81 | 41.14 | 41.05 | 42.15 |
| A. Fuel Combustion (Sectoral Approach) | 21.99 | 23.84 | 22.03 | 21.69 | 19.86 | 20.31 | 21.07 | 16.52 | 15.90 | 15.98 |
| 1. Energy Industries | 0.16 | 0.19 | 0.16 | 0.16 | 0.15 | 0.16 | 0.18 | 0.19 | 0.18 | 0.17 |
| 2. Manufacturing Industries and Construction | 0.34 | 0.37 | 0.37 | 0.36 | 0.39 | 0.39 | 0.41 | 0.43 | 0.42 | 0.41 |
| 3. Transport | 3.09 | 3.38 | 3.39 | 3.39 | 3.22 | 3.00 | 2.72 | 2.45 | 2.36 | 2.08 |
| 4. Other Sectors | 18.40 | 19.90 | 18.12 | 17.78 | 16.10 | 16.76 | 17.76 | 13.45 | 12.93 | 13.31 |
| 5. Other | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| B. Fugitive Emissions from Fuels | 18.32 | 18.99 | 19.84 | 20.73 | 21.39 | 22.48 | 23.74 | 24.62 | 25.15 | 26.17 |
| 1. Solid Fuels | 0.52 | 0.45 | 0.37 | 0.36 | 0.29 | 0.28 | 0.24 | 0.24 | 0.24 | 0.24 |
| 2. Oil and Natural Gas | 17.80 | 18.54 | 19.46 | 20.37 | 21.10 | 22.21 | 23.50 | 24.38 | 24.91 | 25.93 |
| **2. Industrial Processes** | **0.71** | **0.70** | **0.67** | **0.70** | **0.71** | **0.69** | **0.70** | **0.71** | **0.74** | **0.70** |
| A. Mineral Products | IE,NA | IE,NA | IE,NA | IE,NA | IE,NA | IE,NA | IE,NA | IE,NA | IE,NA | IE,NA |
| B. Chemical Industry | 0.70 | 0.70 | 0.66 | 0.70 | 0.71 | 0.68 | 0.69 | 0.70 | 0.73 | 0.69 |
| C. Metal Production | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| D. Other Production | | | | | | | | | | |
| E. Production of Halocarbons and $SF_6$ | | | | | | | | | | |
| F. Consumption of Halocarbons and $SF_6$ | | | | | | | | | | |
| G. Other | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| **3. Solvent and Other Product Use** | | | | | | | | | | |
| **4. Agriculture** | **230.11** | **226.89** | **218.42** | **218.90** | **219.21** | **220.24** | **216.89** | **213.88** | **213.02** | **208.92** |
| A. Enteric Fermentation | 179.21 | 176.72 | 169.02 | 168.98 | 169.88 | 171.25 | 168.83 | 165.89 | 164.56 | 162.93 |
| B. Manure Management | 50.49 | 49.78 | 49.02 | 49.39 | 48.86 | 48.48 | 47.55 | 47.48 | 47.94 | 45.47 |
| C. Rice Cultivation | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| D. Agricultural Soils | 0.33 | 0.33 | 0.31 | 0.47 | 0.40 | 0.44 | 0.45 | 0.45 | 0.45 | 0.45 |
| E. Prescribed Burning of Savannas | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| F. Field Burning of Agricultural Residues | 0.07 | 0.07 | 0.07 | 0.06 | 0.07 | 0.07 | 0.07 | 0.07 | 0.07 | 0.07 |
| G. Other | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| **5. Land Use, Land-Use Change and Forestry** | **0.01** | **0.00** | **0.01** | **0.01** | **0.00** | **0.00** | **0.00** | **0.00** | **0.01** | **0.00** |
| A. Forest Land | 0.01 | 0.00 | 0.01 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.00 |
| B. Cropland | NA,NO | NA,NO | NA,NO | NA,NO | NA,NO | NA,NO | NA,NO | NA,NO | NA,NO | NA,NO |
| C. Grassland | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| D. Wetlands | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| E. Settlements | NA,NO | NA,NO | NA,NO | NA,NO | NA,NO | NA,NO | NA,NO | NA,NO | NA,NO | NA,NO |
| F. Other Land | NA,NO | NA,NO | NA,NO | NA,NO | NA,NO | NA,NO | NA,NO | NA,NO | NA,NO | NA,NO |
| G. Other | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| **6. Waste** | **166.17** | **165.86** | **161.63** | **159.46** | **151.13** | **143.04** | **135.32** | **128.78** | **123.91** | **118.71** |
| A. Solid Waste Disposal on Land | 160.79 | 160.48 | 156.27 | 154.09 | 145.77 | 137.79 | 130.36 | 124.17 | 119.61 | 114.61 |
| B. Waste-water Handling | 4.85 | 4.84 | 4.70 | 4.56 | 4.39 | 4.21 | 3.87 | 3.53 | 3.19 | 2.93 |
| C. Waste Incineration | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| D. Other | 0.52 | 0.55 | 0.65 | 0.82 | 0.98 | 1.04 | 1.09 | 1.08 | 1.12 | 1.18 |
| **7. Other *(as specified in Summary 1.A)*** | **NA** | **NA** | **NA** | **NA** | **NA** | **NA** | **NA** | **NA** | **NA** | **NA** |
| | | | | | | | | | | |
| **Total $CH_4$ emissions including $CH_4$ from LULUCF** | **437.30** | **436.29** | **422.58** | **421.49** | **412.32** | **406.76** | **397.72** | **384.50** | **378.72** | **370.48** |
| **Total $CH_4$ emissions excluding $CH_4$ from LULUCF** | **437.29** | **436.28** | **422.57** | **421.48** | **412.31** | **406.75** | **397.72** | **384.50** | **378.72** | **370.48** |
| | | | | | | | | | | |
| **Memo Items:** | | | | | | | | | | |
| **International Bunkers** | 0.01 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.03 | 0.03 | 0.03 |
| Aviation | 0.01 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.03 | 0.03 | 0.03 |
| Marine | NA,NO | NA,NO | NA,NO | NA,NO | NA,NO | NA,NO | NA,NO | NA,NO | NA,NO | NA,NO |
| **Multilateral Operations** | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| **$CO_2$ Emissions from Biomass** | | | | | | | | | | |

**Note:** All footnotes for this table are given at the end of the table on sheet 5.

**TABLE 10 EMISSION TRENDS**
**$CH_4$**
**(Part 2 of 2)**

Inventory 2007
Submission 2009 v1.1
AUSTRIA

| GREENHOUSE GAS SOURCE AND SINK CATEGORIES | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | Change from base to latest reported year |
|---|---|---|---|---|---|---|---|---|---|
| | (Gg) | (Gg) | (Gg) | (Gg) | (Gg) | (Gg) | (Gg) | (Gg) | % |
| **1. Energy** | 41.96 | 43.92 | 44.94 | 46.67 | 48.07 | 48.83 | 49.71 | 48.35 | 19.96 |
| A. Fuel Combustion (Sectoral Approach) | 15.03 | 16.60 | 16.52 | 17.69 | 16.98 | 16.87 | 16.43 | 14.76 | -32.86 |
| 1. Energy Industries | 0.16 | 0.20 | 0.21 | 0.24 | 0.27 | 0.23 | 0.30 | 0.29 | 80.12 |
| 2. Manufacturing Industries and Construction | 0.44 | 0.45 | 0.46 | 0.51 | 0.54 | 0.57 | 0.65 | 0.67 | 98.22 |
| 3. Transport | 1.90 | 1.76 | 1.69 | 1.57 | 1.41 | 1.27 | 1.11 | 0.99 | -67.94 |
| 4. Other Sectors | 12.54 | 14.20 | 14.16 | 15.37 | 14.75 | 14.80 | 14.36 | 12.81 | -30.36 |
| 5. Other | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 22.25 |
| B. Fugitive Emissions from Fuels | 26.93 | 27.32 | 28.42 | 28.98 | 31.10 | 31.96 | 33.28 | 33.59 | 83.35 |
| 1. Solid Fuels | 0.27 | 0.26 | 0.30 | 0.25 | 0.05 | 0.00 | 0.00 | IE,NA,NO | -100.00 |
| 2. Oil and Natural Gas | 26.66 | 27.07 | 28.11 | 28.74 | 31.05 | 31.96 | 33.28 | 33.59 | 88.74 |
| **2. Industrial Processes** | **0.70** | **0.67** | **0.71** | **0.70** | **0.70** | **0.75** | **0.92** | **0.91** | **28.42** |
| A. Mineral Products | IE,NA | IE,NA | IE,NA | IE,NA | IE,NA | IE,NA | IE,NA | IE,NA | 0.00 |
| B. Chemical Industry | 0.70 | 0.67 | 0.70 | 0.69 | 0.70 | 0.75 | 0.92 | 0.90 | 28.23 |
| C. Metal Production | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 88.15 |
| D. Other Production | | | | | | | | | |
| E. Production of Halocarbons and $SF_6$ | | | | | | | | | |
| F. Consumption of Halocarbons and $SF_6$ | | | | | | | | | |
| G. Other | NA | NA | NA | NA | NA | NA | NA | NA | 0.00 |
| **3. Solvent and Other Product Use** | | | | | | | | | |
| **4. Agriculture** | **206.69** | **204.53** | **200.17** | **198.49** | **196.72** | **195.40** | **194.57** | **195.73** | **-14.94** |
| A. Enteric Fermentation | 161.95 | 159.56 | 156.67 | 154.87 | 154.45 | 153.06 | 152.45 | 153.09 | -14.58 |
| B. Manure Management | 44.23 | 44.46 | 43.05 | 43.15 | 41.81 | 41.91 | 41.66 | 42.17 | -16.49 |
| C. Rice Cultivation | NO | NO | NO | NO | NO | NO | NO | NO | 0.00 |
| D. Agricultural Soils | 0.45 | 0.43 | 0.38 | 0.41 | 0.37 | 0.37 | 0.41 | 0.42 | 28.40 |
| E. Prescribed Burning of Savannas | NO | NO | NO | NO | NO | NO | NO | NO | 0.00 |
| F. Field Burning of Agricultural Residues | 0.06 | 0.07 | 0.07 | 0.06 | 0.09 | 0.06 | 0.06 | 0.06 | -14.46 |
| G. Other | NA | NA | NA | NA | NA | NA | NA | NA | 0.00 |
| **5. Land Use, Land-Use Change and Forestry** | **0.00** | **0.00** | **0.01** | **0.01** | **0.00** | **0.00** | **0.00** | **0.00** | **-81.50** |
| A. Forest Land | 0.00 | 0.00 | 0.01 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | -81.50 |
| B. Cropland | NA,NO | NA,NO | NA,NO | NA,NO | NA,NO | NA,NO | NA,NO | NA,NO | 0.00 |
| C. Grassland | NO | NO | NO | NO | NO | NO | NO | NO | 0.00 |
| D. Wetlands | NO | NO | NO | NO | NO | NO | NO | NO | 0.00 |
| E. Settlements | NA,NO | NA,NO | NA,NO | NA,NO | NA,NO | NA,NO | NA,NO | NA,NO | 0.00 |
| F. Other Land | NA,NO | NA,NO | NA,NO | NA,NO | NA,NO | NA,NO | NA,NO | NA,NO | 0.00 |
| G. Other | NA | NA | NA | NA | NA | NA | NA | NA | 0.00 |
| **6. Waste** | **113.57** | **109.30** | **107.18** | **109.40** | **102.74** | **96.80** | **91.95** | **86.22** | **-48.11** |
| A. Solid Waste Disposal on Land | 109.68 | 105.62 | 103.73 | 106.16 | 99.26 | 93.21 | 88.80 | 83.06 | -48.34 |
| B. Waste-water Handling | 2.68 | 2.43 | 2.18 | 1.95 | 1.96 | 1.97 | 1.49 | 1.49 | -69.25 |
| C. Waste Incineration | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | -90.13 |
| D. Other | 1.21 | 1.24 | 1.27 | 1.29 | 1.52 | 1.62 | 1.66 | 1.67 | 221.88 |
| **7. Other *(as specified in Summary 1.A)*** | **NA** | **NA** | **NA** | **NA** | **NA** | **NA** | **NA** | **NA** | **0.00** |
| | | | | | | | | | |
| **Total $CH_4$ emissions including $CH_4$ from LULUCF** | **362.93** | **358.42** | **353.01** | **355.27** | **348.24** | **341.79** | **337.15** | **331.22** | **-24.26** |
| **Total $CH_4$ emissions excluding $CH_4$ from LULUCF** | **362.93** | **358.42** | **353.00** | **355.26** | **348.24** | **341.79** | **337.14** | **331.22** | **-24.26** |
| | | | | | | | | | |
| **Memo Items:** | | | | | | | | | |
| **International Bunkers** | 0.03 | 0.03 | 0.03 | 0.04 | 0.04 | 0.04 | 0.04 | 0.04 | 195.58 |
| Aviation | 0.03 | 0.03 | 0.03 | 0.04 | 0.04 | 0.04 | 0.04 | 0.04 | 195.58 |
| Marine | NA,NO | NA,NO | NA,NO | NA,NO | NA,NO | NA,NO | NA,NO | NA,NO | 0.00 |
| **Multilateral Operations** | NO | NO | NO | NO | NO | NO | NO | NO | 0.00 |
| **$CO_2$ Emissions from Biomass** | | | | | | | | | |

**Note:** All footnotes for this table are given at the end of the table on sheet 5.

**TABLE 10 EMISSION TRENDS**
**$N_2O$**
**(Part 1 of 2)**

Inventory 2007
Submission 2009 v1.1
AUSTRIA

| GREENHOUSE GAS SOURCE AND SINK CATEGORIES | Base year ( 1990 ) | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 |
|---|---|---|---|---|---|---|---|---|---|---|
| | (Gg) | (Gg) | (Gg) | (Gg) | (Gg) | (Gg) | (Gg) | (Gg) | (Gg) | (Gg) |
| **1. Energy** | **1.78** | **2.00** | **1.96** | **2.02** | **2.03** | **2.09** | **2.20** | **2.16** | **2.29** | **2.32** |
| A. Fuel Combustion (Sectoral Approach) | 1.78 | 2.00 | 1.96 | 2.02 | 2.03 | 2.09 | 2.20 | 2.16 | 2.29 | 2.32 |
| 1. Energy Industries | 0.15 | 0.18 | 0.14 | 0.15 | 0.15 | 0.16 | 0.16 | 0.15 | 0.17 | 0.17 |
| 2. Manufacturing Industries and Construction | 0.26 | 0.28 | 0.27 | 0.29 | 0.30 | 0.31 | 0.35 | 0.36 | 0.37 | 0.41 |
| 3. Transport | 0.61 | 0.74 | 0.76 | 0.79 | 0.82 | 0.83 | 0.86 | 0.84 | 0.95 | 0.92 |
| 4. Other Sectors | 0.76 | 0.81 | 0.79 | 0.79 | 0.75 | 0.78 | 0.83 | 0.81 | 0.79 | 0.82 |
| 5. Other | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| B. Fugitive Emissions from Fuels | IE,NA | IE,NA | IE,NA | IE,NA | IE,NA | IE,NA | IE,NA | IE,NA | IE,NA | IE,NA |
| 1. Solid Fuels | IE,NA | IE,NA | IE,NA | IE,NA | IE,NA | IE,NA | IE,NA | IE,NA | IE,NA | IE,NA |
| 2. Oil and Natural Gas | IE,NA | IE,NA | IE,NA | IE,NA | IE,NA | IE,NA | IE,NA | IE,NA | IE,NA | IE,NA |
| **2. Industrial Processes** | **2.94** | **2.99** | **2.70** | **2.83** | **2.66** | **2.77** | **2.82** | **2.78** | **2.89** | **2.98** |
| A. Mineral Products | IE,NA | IE,NA | IE,NA | IE,NA | IE,NA | IE,NA | IE,NA | IE,NA | IE,NA | IE,NA |
| B. Chemical Industry | 2.94 | 2.99 | 2.70 | 2.83 | 2.66 | 2.77 | 2.82 | 2.78 | 2.89 | 2.98 |
| C. Metal Production | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| D. Other Production | | | | | | | | | | |
| E. Production of Halocarbons and $SF_6$ | | | | | | | | | | |
| F. Consumption of Halocarbons and $SF_6$ | | | | | | | | | | |
| G. Other | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| **3. Solvent and Other Product Use** | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 |
| **4. Agriculture** | **13.99** | **14.80** | **13.81** | **13.03** | **14.62** | **14.89** | **13.60** | **13.72** | **13.79** | **13.54** |
| A. Enteric Fermentation | | | | | | | | | | |
| B. Manure Management | 3.24 | 3.20 | 3.08 | 3.09 | 3.09 | 3.16 | 3.10 | 3.07 | 3.06 | 3.02 |
| C. Rice Cultivation | | | | | | | | | | |
| D. Agricultural Soils | 10.75 | 11.60 | 10.73 | 9.94 | 11.53 | 11.74 | 10.50 | 10.65 | 10.73 | 10.52 |
| E. Prescribed Burning of Savannas | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| F. Field Burning of Agricultural Residues | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| G. Other | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| **5. Land Use, Land-Use Change and Forestry** | **0.81** | **0.82** | **0.82** | **0.82** | **0.82** | **0.82** | **0.83** | **0.83** | **0.83** | **0.84** |
| A. Forest Land | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| B. Cropland | 0.81 | 0.82 | 0.82 | 0.82 | 0.82 | 0.82 | 0.83 | 0.83 | 0.83 | 0.84 |
| C. Grassland | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| D. Wetlands | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| E. Settlements | NA,NO | NA,NO | NA,NO | NA,NO | NA,NO | NA,NO | NA,NO | NA,NO | NA,NO | NA,NO |
| F. Other Land | NA,NO | NA,NO | NA,NO | NA,NO | NA,NO | NA,NO | NA,NO | NA,NO | NA,NO | NA,NO |
| G. Other | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| **6. Waste** | **0.43** | **0.43** | **0.42** | **0.43** | **0.49** | **0.54** | **0.60** | **0.63** | **0.68** | **0.73** |
| A. Solid Waste Disposal on Land | | | | | | | | | | |
| B. Waste-water Handling | 0.35 | 0.35 | 0.33 | 0.31 | 0.35 | 0.40 | 0.45 | 0.48 | 0.52 | 0.57 |
| C. Waste Incineration | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| D. Other | 0.08 | 0.08 | 0.09 | 0.12 | 0.14 | 0.14 | 0.15 | 0.15 | 0.15 | 0.16 |
| **7. Other *(as specified in Summary 1.A)*** | **NA** | **NA** | **NA** | **NA** | **NA** | **NA** | **NA** | **NA** | **NA** | **NA** |
| | | | | | | | | | | |
| **Total $N_2O$ emissions including $N_2O$ from LULUCF** | **20.71** | **21.79** | **20.47** | **19.88** | **21.37** | **21.87** | **20.80** | **20.87** | **21.23** | **21.16** |
| **Total $N_2O$ emissions excluding $N_2O$ from LULUCF** | **19.89** | **20.98** | **19.65** | **19.06** | **20.55** | **21.04** | **19.97** | **20.04** | **20.40** | **20.32** |
| | | | | | | | | | | |
| **Memo Items:** | | | | | | | | | | |
| **International Bunkers** | **0.03** | **0.03** | **0.04** | **0.04** | **0.04** | **0.05** | **0.05** | **0.05** | **0.06** | **0.05** |
| Aviation | 0.03 | 0.03 | 0.04 | 0.04 | 0.04 | 0.05 | 0.05 | 0.05 | 0.06 | 0.05 |
| Marine | NA,NO | NA,NO | NA,NO | NA,NO | NA,NO | NA,NO | NA,NO | NA,NO | NA,NO | NA,NO |
| **Multilateral Operations** | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| **$CO_2$ Emissions from Biomass** | | | | | | | | | | |

**Note:** All footnotes for this table are given at the end of the table on sheet 5.

**TABLE 10 EMISSION TRENDS**
**$N_2O$**
**(Part 2 of 2)**

Inventory 2007
Submission 2009 v1.1
AUSTRIA

| GREENHOUSE GAS SOURCE AND SINK CATEGORIES | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | Change from base to latest reported year |
|---|---|---|---|---|---|---|---|---|---|
| | (Gg) | (Gg) | (Gg) | (Gg) | (Gg) | (Gg) | (Gg) | (Gg) | % |
| **1. Energy** | **2.32** | **2.46** | **2.54** | **2.65** | **2.63** | **2.58** | **2.53** | **2.42** | **36.00** |
| A. Fuel Combustion (Sectoral Approach) | 2.32 | 2.46 | 2.54 | 2.65 | 2.63 | 2.58 | 2.53 | 2.42 | 36.00 |
| 1. Energy Industries | 0.17 | 0.20 | 0.20 | 0.23 | 0.25 | 0.22 | 0.24 | 0.26 | 66.02 |
| 2. Manufacturing Industries and Construction | 0.43 | 0.42 | 0.42 | 0.42 | 0.42 | 0.44 | 0.46 | 0.46 | 79.16 |
| 3. Transport | 0.94 | 0.97 | 1.05 | 1.08 | 1.07 | 1.03 | 0.95 | 0.91 | 48.10 |
| 4. Other Sectors | 0.78 | 0.86 | 0.86 | 0.91 | 0.89 | 0.90 | 0.88 | 0.80 | 5.44 |
| 5. Other | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 14.69 |
| B. Fugitive Emissions from Fuels | IE,NA | IE,NA | IE,NA | IE,NA | IE,NA | IE,NA | IE,NA | IE,NA | 0.00 |
| 1. Solid Fuels | IE,NA | IE,NA | IE,NA | IE,NA | IE,NA | IE,NA | IE,NA | IE,NA | 0.00 |
| 2. Oil and Natural Gas | IE,NA | IE,NA | IE,NA | IE,NA | IE,NA | IE,NA | IE,NA | IE,NA | 0.00 |
| **2. Industrial Processes** | **3.07** | **2.54** | **2.60** | **2.85** | **0.91** | **0.88** | **0.90** | **0.87** | **-70.39** |
| A. Mineral Products | IE,NA | IE,NA | IE,NA | IE,NA | IE,NA | IE,NA | IE,NA | IE,NA | 0.00 |
| B. Chemical Industry | 3.07 | 2.54 | 2.60 | 2.85 | 0.91 | 0.88 | 0.90 | 0.87 | -70.39 |
| C. Metal Production | NA | NA | NA | NA | NA | NA | NA | NA | 0.00 |
| D. Other Production | | | | | | | | | |
| E. Production of Halocarbons and $SF_6$ | | | | | | | | | |
| F. Consumption of Halocarbons and $SF_6$ | | | | | | | | | |
| G. Other | NA | NA | NA | NA | NA | NA | NA | NA | 0.00 |
| **3. Solvent and Other Product Use** | 0.75 | 0.71 | 0.67 | 0.64 | 0.60 | 0.56 | 0.53 | 0.52 | -31.07 |
| **4. Agriculture** | **13.05** | **13.02** | **12.93** | **12.43** | **12.07** | **12.08** | **12.24** | **12.38** | **-11.51** |
| A. Enteric Fermentation | | | | | | | | | |
| B. Manure Management | 2.98 | 2.95 | 2.89 | 2.87 | 2.86 | 2.83 | 2.82 | 2.83 | -12.67 |
| C. Rice Cultivation | | | | | | | | | |
| D. Agricultural Soils | 10.07 | 10.07 | 10.03 | 9.56 | 9.21 | 9.25 | 9.42 | 9.55 | -11.16 |
| E. Prescribed Burning of Savannas | NO | NO | NO | NO | NO | NO | NO | NO | 0.00 |
| F. Field Burning of Agricultural Residues | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | -14.52 |
| G. Other | NA | NA | NA | NA | NA | NA | NA | NA | 0.00 |
| **5. Land Use, Land-Use Change and Forestry** | **0.84** | **0.85** | **0.85** | **0.85** | **0.86** | **0.87** | **0.86** | **0.89** | **9.03** |
| A. Forest Land | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | -81.50 |
| B. Cropland | 0.84 | 0.85 | 0.85 | 0.85 | 0.86 | 0.87 | 0.86 | 0.89 | 9.05 |
| C. Grassland | NO | NO | NO | NO | NO | NO | NO | NO | 0.00 |
| D. Wetlands | NO | NO | NO | NO | NO | NO | NO | NO | 0.00 |
| E. Settlements | NA,NO | NA,NO | NA,NO | NA,NO | NA,NO | NA,NO | NA,NO | NA,NO | 0.00 |
| F. Other Land | NA,NO | NA,NO | NA,NO | NA,NO | NA,NO | NA,NO | NA,NO | NA,NO | 0.00 |
| G. Other | NA | NA | NA | NA | NA | NA | NA | NA | 0.00 |
| **6. Waste** | **0.82** | **0.91** | **0.91** | **0.92** | **1.01** | **1.07** | **1.13** | **1.14** | **166.92** |
| A. Solid Waste Disposal on Land | | | | | | | | | |
| B. Waste-water Handling | 0.65 | 0.74 | 0.74 | 0.74 | 0.79 | 0.85 | 0.90 | 0.90 | 157.67 |
| C. Waste Incineration | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | -74.43 |
| D. Other | 0.17 | 0.17 | 0.17 | 0.18 | 0.21 | 0.23 | 0.23 | 0.24 | 210.71 |
| **7. Other *(as specified in Summary 1.A)*** | **NA** | **NA** | **NA** | **NA** | **NA** | **NA** | **NA** | **NA** | **0.00** |
| | | | | | | | | | |
| **Total $N_2O$ emissions including $N_2O$ from LULUCF** | **20.85** | **20.49** | **20.51** | **20.33** | **18.07** | **18.05** | **18.20** | **18.22** | **-12.02** |
| **Total $N_2O$ emissions excluding $N_2O$ from LULUCF** | **20.01** | **19.63** | **19.66** | **19.48** | **17.21** | **17.18** | **17.34** | **17.33** | **-12.88** |
| | | | | | | | | | |
| **Memo Items:** | | | | | | | | | |
| **International Bunkers** | **0.06** | **0.06** | **0.05** | **0.05** | **0.06** | **0.07** | **0.07** | **0.07** | **135.63** |
| Aviation | 0.06 | 0.06 | 0.05 | 0.05 | 0.06 | 0.07 | 0.07 | 0.07 | 135.63 |
| Marine | NA,NO | NA,NO | NA,NO | NA,NO | NA,NO | NA,NO | NA,NO | NA,NO | 0.00 |
| **Multilateral Operations** | NO | NO | NO | NO | NO | NO | NO | NO | 0.00 |
| **$CO_2$ Emissions from Biomass** | | | | | | | | | |

**Note:** All footnotes for this table are given at the end of the table on sheet 5.

**TABLE 10 EMISSION TRENDS**
**HFCs, PFCs and $SF_6$**
**(Part 1 of 2)**

Inventory 2007
Submission 2009 v1.1
AUSTRIA

| GREENHOUSE GAS SOURCE AND SINK CATEGORIES | Base year ( 1990 ) | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 |
|---|---|---|---|---|---|---|---|---|---|---|
| | (Gg) | (Gg) | (Gg) | (Gg) | (Gg) | (Gg) | (Gg) | (Gg) | (Gg) | (Gg) |
| **Emissions of HFCs(3) - (Gg $CO_2$ equivalent)** | **23.03** | **45.21** | **48.68** | **157.34** | **206.83** | **267.34** | **346.84** | **427.42** | **494.89** | **542.20** |
| HFC-23 | NA,NE,NO | NA,NE,NO | NA,NE,NO | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| HFC-32 | IE,NA,NO | IE,NA,NO | IE,NA,NO | IE,NA,NO | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| HFC-41 | NA,NO | NA,NO | NA,NO | NA,NO | NA,NO | NA,NO | NA,NO | NA,NO | NA,NO | NA,NO |
| HFC-43-10mee | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| HFC-125 | IE,NA,NO | IE,NA,NO | IE,NA,NO | IE,NA,NO | 0.00 | 0.00 | 0.01 | 0.01 | 0.01 | 0.02 |
| HFC-134 | NA,NO | NA,NO | NA,NO | NA,NO | NA,NO | NA,NO | NA,NO | NA,NO | NA,NO | NA,NO |
| HFC-134a | 0.00 | 0.00 | 0.00 | 0.08 | 0.11 | 0.15 | 0.19 | 0.23 | 0.27 | 0.30 |
| HFC-152a | IE,NA,NO | IE,NA,NO | IE,NA,NO | 0.04 | 0.05 | 0.06 | 0.07 | 0.08 | 0.09 | 0.10 |
| HFC-143 | NA,NO | NA,NO | NA,NO | NA,NO | NA,NO | NA,NO | NA,NO | NA,NO | NA,NO | NA,NO |
| HFC-143a | IE,NA,NO | IE,NA,NO | IE,NA,NO | IE,NA,NO | IE,NA,NO | 0.00 | 0.00 | 0.01 | 0.01 | 0.01 |
| HFC-227ea | NA,NE,NO | NA,NE,NO | NA,NE,NO | NA,NE,NO | NA,NE,NO | NA,NE,NO | 0.00 | 0.00 | 0.00 | 0.00 |
| HFC-236fa | NA,NO | NA,NO | NA,NO | NA,NO | NA,NO | NA,NO | NA,NO | NA,NO | NA,NO | NA,NO |
| HFC-245ca | NA,NO | NA,NO | NA,NO | NA,NO | NA,NO | NA,NO | NA,NO | NA,NO | NA,NO | NA,NO |
| Unspecified mix of listed HFCs(4) - (Gg $CO_2$ equivalent) | 20.81 | 41.52 | 44.02 | 45.92 | 47.89 | 50.17 | 52.32 | 52.97 | 47.67 | 49.48 |
| | | | | | | | | | | |
| **Emissions of PFCs(3) - (Gg $CO_2$ equivalent)** | **1 079.24** | **1 087.08** | **462.67** | **52.90** | **58.61** | **68.69** | **66.20** | **96.75** | **44.65** | **64.44** |
| $CF_4$ | 0.14 | 0.14 | 0.05 | IE,NA,NO | IE,NA,NO | IE,NA,NO | IE,NA,NO | IE,NA,NO | IE,NA,NO | IE,NA,NO |
| $C_2F_6$ | 0.02 | 0.02 | 0.01 | IE,NA,NO | IE,NA,NO | IE,NA,NO | IE,NA,NO | IE,NA,NO | IE,NA,NO | IE,NA,NO |
| $C_3F_8$ | IE,NA,NO | IE,NA,NO | IE,NA,NO | IE,NA,NO | IE,NA,NO | IE,NA,NO | IE,NA,NO | IE,NA,NO | IE,NA,NO | IE,NA,NO |
| $C_4F_{10}$ | NA,NE,NO | NA,NE,NO | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| $c-C_4F_8$ | IE,NA,NO | IE,NA,NO | IE,NA,NO | IE,NA,NO | IE,NA,NO | IE,NA,NO | IE,NA,NO | IE,NA,NO | IE,NA,NO | IE,NA,NO |
| $C_5F_{12}$ | NA,NO | NA,NO | NA,NO | NA,NO | NA,NO | NA,NO | NA,NO | NA,NO | NA,NO | NA,NO |
| $C_6F_{14}$ | NA,NO | NA,NO | NA,NO | NA,NO | NA,NO | NA,NO | NA,NO | NA,NO | NA,NO | NA,NO |
| Unspecified mix of listed PFCs(4) - (Gg $CO_2$ equivalent) | 29.05 | 36.89 | 44.73 | 52.57 | 58.30 | 68.39 | 65.92 | 96.48 | 44.40 | 64.19 |
| | | | | | | | | | | |
| **Emissions of SF6(3) - (Gg $CO_2$ equivalent)** | **502.58** | **653.36** | **697.85** | **793.71** | **985.70** | **1 139.16** | **1 218.05** | **1 120.15** | **907.99** | **683.96** |
| $SF_6$ | 0.02 | 0.03 | 0.03 | 0.03 | 0.04 | 0.05 | 0.05 | 0.05 | 0.04 | 0.03 |

**Note:** All footnotes for this table are given at the end of the table on sheet 5.

**TABLE 10 EMISSION TRENDS**
**HFCs, PFCs and $SF_6$**
**(Part 2 of 2)**

Inventory 2007
Submission 2009 v1.1
AUSTRIA

| GREENHOUSE GAS SOURCE AND SINK CATEGORIES | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | Change from base to latest reported year |
|---|---|---|---|---|---|---|---|---|---|
| | (Gg) | (Gg) | (Gg) | (Gg) | (Gg) | (Gg) | (Gg) | (Gg) | % |
| **Emissions of HFCs[(3)] - (Gg $CO_2$ equivalent)** | **596.26** | **694.45** | **781.21** | **862.96** | **896.71** | **907.91** | **860.74** | **860.63** | **3 636.78** |
| HFC-23 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 100.00 |
| HFC-32 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.01 | 0.01 | 100.00 |
| HFC-41 | NA,NO | NA,NO | NA,NO | NA,NO | NA,NO | NA,NO | NA,NO | NA,NO | 0.00 |
| HFC-43-10mee | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 334.35 |
| HFC-125 | 0.02 | 0.03 | 0.03 | 0.04 | 0.05 | 0.05 | 0.06 | 0.06 | 100.00 |
| HFC-134 | NA,NO | NA,NO | NA,NO | NA,NO | NA,NO | NA,NO | NA,NO | NA,NO | 0.00 |
| HFC-134a | 0.31 | 0.33 | 0.35 | 0.37 | 0.35 | 0.33 | 0.29 | 0.28 | 20 840.33 |
| HFC-152a | 0.11 | 0.24 | 0.35 | 0.43 | 0.53 | 0.57 | 0.44 | 0.39 | 100.00 |
| HFC-143 | NA,NO | NA,NO | NA,NO | NA,NO | NA,NO | NA,NO | NA,NO | NA,NO | 0.00 |
| HFC-143a | 0.01 | 0.02 | 0.03 | 0.03 | 0.04 | 0.04 | 0.05 | 0.05 | 100.00 |
| HFC-227ea | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 100.00 |
| HFC-236fa | NA,NO | NA,NO | NA,NO | NA,NO | NA,NO | NA,NO | NA,NO | NA,NO | 0.00 |
| HFC-245ca | NA,NO | NA,NO | NA,NO | NA,NO | NA,NO | NA,NO | NA,NO | NA,NO | 0.00 |
| Unspecified mix of listed HFCs[(4)] - (Gg $CO_2$ equivalent) | 51.57 | 53.04 | 54.48 | 54.49 | 51.39 | 47.77 | 31.91 | 17.38 | -16.48 |
| | | | | | | | | | |
| **Emissions of PFCs[(3)] - (Gg $CO_2$ equivalent)** | **72.21** | **82.02** | **86.73** | **102.39** | **125.68** | **125.22** | **135.67** | **182.71** | **-83.07** |
| $CF_4$ | IE,NA,NO | IE,NA,NO | IE,NA,NO | IE,NA,NO | IE,NA,NO | IE,NA,NO | IE,NA,NO | IE,NA,NO | -100.00 |
| $C_2F_6$ | IE,NA,NO | IE,NA,NO | IE,NA,NO | IE,NA,NO | IE,NA,NO | IE,NA,NO | IE,NA,NO | IE,NA,NO | -100.00 |
| $C_3F_8$ | IE,NA,NO | IE,NA,NO | IE,NA,NO | IE,NA,NO | IE,NA,NO | IE,NA,NO | IE,NA,NO | IE,NA,NO | 0.00 |
| $C_4F_{10}$ | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 100.00 |
| c-$C_4F_8$ | IE,NA,NO | IE,NA,NO | IE,NA,NO | IE,NA,NO | IE,NA,NO | IE,NA,NO | IE,NA,NO | IE,NA,NO | 0.00 |
| $C_5F_{12}$ | NA,NO | NA,NO | NA,NO | NA,NO | NA,NO | NA,NO | NA,NO | NA,NO | 0.00 |
| $C_6F_{14}$ | NA,NO | NA,NO | NA,NO | NA,NO | NA,NO | NA,NO | NA,NO | NA,NO | 0.00 |
| Unspecified mix of listed PFCs[(4)] - (Gg $CO_2$ equivalent) | 71.98 | 81.80 | 86.52 | 102.20 | 125.49 | 125.04 | 135.50 | 182.55 | 528.36 |
| | | | | | | | | | |
| **Emissions of SF6[(3)] - (Gg $CO_2$ equivalent)** | **633.31** | **636.62** | **640.83** | **593.52** | **513.12** | **286.50** | **480.24** | **409.58** | **-18.51** |
| $SF_6$ | 0.03 | 0.03 | 0.03 | 0.02 | 0.02 | 0.01 | 0.02 | 0.02 | -18.51 |

**Note:** All footnotes for this table are given at the end of the table on sheet 5.

**TABLE 10 EMISSION TRENDS**
**SUMMARY**
**(Part 1 of 2)**

Inventory 2007
Submission 2009 v1.1
AUSTRIA

| GREENHOUSE GAS EMISSIONS | Base year ( 1990 ) | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 |
|---|---|---|---|---|---|---|---|---|---|---|
| | $CO_2$ equivalent (Gg) | $CO_2$ equivalent (Gg) | $CO_2$ equivalent (Gg) | $CO_2$ equivalent (Gg) | $CO_2$ equivalent (Gg) | $CO_2$ equivalent (Gg) | $CO_2$ equivalent (Gg) | $CO_2$ equivalent (Gg) | $CO_2$ equivalent (Gg) | $CO_2$ equivalent (Gg) |
| $CO_2$ emissions including net $CO_2$ from LULUCF | 48 651.29 | 46 335.17 | 45 931.01 | 42 365.69 | 44 103.99 | 47 698.54 | 56 225.05 | 47 086.40 | 48 534.27 | 42 924.50 |
| $CO_2$ emissions excluding net $CO_2$ from LULUCF | 62 081.53 | 65 671.09 | 60 226.24 | 60 542.84 | 60 929.63 | 63 965.30 | 67 407.08 | 67 200.32 | 66 774.88 | 65 553.99 |
| $CH_4$ emissions including $CH_4$ from LULUCF | 9 183.31 | 9 162.00 | 8 874.21 | 8 851.27 | 8 658.62 | 8 541.86 | 8 352.15 | 8 074.60 | 7 953.22 | 7 780.02 |
| $CH_4$ emissions excluding $CH_4$ from LULUCF | 9 183.05 | 9 161.93 | 8 874.04 | 8 851.12 | 8 658.55 | 8 541.81 | 8 352.11 | 8 074.58 | 7 953.10 | 7 780.01 |
| $N_2O$ emissions including $N_2O$ from LULUCF | 6 419.53 | 6 755.27 | 6 344.86 | 6 163.60 | 6 625.63 | 6 779.60 | 6 447.46 | 6 471.01 | 6 582.51 | 6 559.97 |
| $N_2O$ emissions excluding $N_2O$ from LULUCF | 6 167.40 | 6 502.52 | 6 091.46 | 5 909.39 | 6 370.62 | 6 523.93 | 6 190.88 | 6 213.50 | 6 324.22 | 6 300.60 |
| HFCs | 23.03 | 45.21 | 48.68 | 157.34 | 206.83 | 267.34 | 346.84 | 427.42 | 494.89 | 542.20 |
| PFCs | 1 079.24 | 1 087.08 | 462.67 | 52.90 | 58.61 | 68.69 | 66.20 | 96.75 | 44.65 | 64.44 |
| $SF_6$ | 502.58 | 653.36 | 697.85 | 793.71 | 985.70 | 1 139.16 | 1 218.05 | 1 120.15 | 907.99 | 683.96 |
| **Total (including LULUCF)** | **65 858.99** | **64 038.10** | **62 359.28** | **58 384.50** | **60 639.38** | **64 495.18** | **72 655.75** | **63 276.35** | **64 517.55** | **58 555.09** |
| **Total (excluding LULUCF)** | **79 036.84** | **83 121.20** | **76 400.94** | **76 307.31** | **77 209.93** | **80 506.24** | **83 581.17** | **83 132.73** | **82 499.73** | **80 925.20** |

| GREENHOUSE GAS SOURCE AND SINK CATEGORIES | Base year ( 1990 ) | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 |
|---|---|---|---|---|---|---|---|---|---|---|
| | $CO_2$ equivalent (Gg) | $CO_2$ equivalent (Gg) | $CO_2$ equivalent (Gg) | $CO_2$ equivalent (Gg) | $CO_2$ equivalent (Gg) | $CO_2$ equivalent (Gg) | $CO_2$ equivalent (Gg) | $CO_2$ equivalent (Gg) | $CO_2$ equivalent (Gg) | $CO_2$ equivalent (Gg) |
| 1. Energy | 55 594.99 | 59 509.54 | 54 579.42 | 55 009.32 | 55 058.97 | 57 929.50 | 61 763.26 | 60 859.25 | 60 846.33 | 59 823.96 |
| 2. Industrial Processes | 10 110.82 | 10 152.82 | 8 999.19 | 8 750.64 | 9 274.83 | 9 729.22 | 9 601.24 | 10 192.53 | 9 674.37 | 9 391.10 |
| 3. Solvent and Other Product Use | 511.80 | 465.98 | 417.65 | 418.48 | 403.26 | 422.45 | 405.66 | 424.37 | 406.32 | 392.26 |
| 4. Agriculture | 9 170.66 | 9 353.59 | 8 868.31 | 8 636.40 | 9 136.46 | 9 242.05 | 8 771.75 | 8 745.25 | 8 748.54 | 8 585.15 |
| 5. Land Use, Land-Use Change and Forestry(5) | -13 177.85 | -19 083.10 | -14 041.66 | -17 922.81 | -16 570.55 | -16 011.06 | -10 925.41 | -19 856.37 | -17 982.19 | -22 370.12 |
| 6. Waste | 3 648.57 | 3 639.26 | 3 536.38 | 3 492.47 | 3 336.42 | 3 183.01 | 3 039.25 | 2 911.33 | 2 824.18 | 2 732.74 |
| 7. Other | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| **Total (including LULUCF)(5)** | **65 858.99** | **64 038.10** | **62 359.28** | **58 384.50** | **60 639.38** | **64 495.18** | **72 655.75** | **63 276.35** | **64 517.55** | **58 555.09** |

(1) The column "Base year" should be filled in only by those Parties with economies in transition that use a base year different from 1990 in accordance with the relevant decisions of the COP. For these Parties, this different base year is used to calculate the percentage change in the final column of this table.

(2) Fill in net emissions/removals as reported in table Summary 1.A. For the purposes of reporting, the signs for removals are always negative (-) and for emissions positive (+).

(3) Enter actual emissions estimates. If only potential emissions estimates are available, these should be reported in this table and an indication for this be provided in the documentation box. Only in these rows are the emissions expressed as $CO_2$ equivalent emissions.

(4) In accordance with the UNFCCC reporting guidelines, HFC and PFC emissions should be reported for each relevant chemical. However, if it is not possible to report values for each chemical (i.e. mixtures, confidential data, lack of disaggregation), this row could be used for reporting aggregate figures for HFCs and PFCs, respectively. Note that the unit used for this row is Gg of $CO_2$ equivalent and that appropriate notation keys should be entered in the cells for the individual chemicals.

(5) Includes net $CO_2$, $CH_4$ and $N_2O$ from LULUCF.

**TABLE 10 EMISSION TRENDS**
**SUMMARY**
**(Part 2 of 2)**

Inventory 2007
Submission 2009 v1.1
AUSTRIA

| GREENHOUSE GAS EMISSIONS | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | Change from base to latest reported year |
|---|---|---|---|---|---|---|---|---|---|
| | $CO_2$ equivalent (Gg) | $CO_2$ equivalent (Gg) | $CO_2$ equivalent (Gg) | $CO_2$ equivalent (Gg) | $CO_2$ equivalent (Gg) | $CO_2$ equivalent (Gg) | $CO_2$ equivalent (Gg) | $CO_2$ equivalent (Gg) | (%) |
| $CO_2$ emissions including net $CO_2$ from LULUCF | 48 716.70 | 50 129.18 | 55 825.09 | 60 485.69 | 59 973.37 | 61 587.16 | 60 151.88 | 56 778.63 | 16.71 |
| $CO_2$ emissions excluding net $CO_2$ from LULUCF | 65 951.25 | 70 056.03 | 72 014.92 | 78 055.04 | 77 590.77 | 79 008.75 | 77 586.14 | 74 176.54 | 19.48 |
| $CH_4$ emissions including $CH_4$ from LULUCF | 7 621.48 | 7 526.86 | 7 413.20 | 7 460.65 | 7 313.00 | 7 177.62 | 7 080.13 | 6 955.65 | -24.26 |
| $CH_4$ emissions excluding $CH_4$ from LULUCF | 7 621.43 | 7 526.83 | 7 412.94 | 7 460.41 | 7 312.98 | 7 177.58 | 7 080.04 | 6 955.61 | -24.26 |
| $N_2O$ emissions including $N_2O$ from LULUCF | 6 464.21 | 6 351.19 | 6 358.94 | 6 302.05 | 5 602.96 | 5 594.62 | 5 643.28 | 5 648.19 | -12.02 |
| $N_2O$ emissions excluding $N_2O$ from LULUCF | 6 203.92 | 6 086.84 | 6 094.24 | 6 037.66 | 5 335.53 | 5 326.14 | 5 375.65 | 5 373.29 | -12.88 |
| HFCs | 596.26 | 694.45 | 781.21 | 862.96 | 896.71 | 907.91 | 860.74 | 860.63 | 3 636.78 |
| PFCs | 72.21 | 82.02 | 86.73 | 102.39 | 125.68 | 125.22 | 135.67 | 182.71 | -83.07 |
| $SF_6$ | 633.31 | 636.62 | 640.83 | 593.52 | 513.12 | 286.50 | 480.24 | 409.58 | -18.51 |
| **Total (including LULUCF)** | **64 104.18** | **65 420.31** | **71 106.01** | **75 807.26** | **74 424.84** | **75 679.03** | **74 351.94** | **70 835.38** | **7.56** |
| **Total (excluding LULUCF)** | **81 078.39** | **85 082.78** | **87 030.88** | **93 111.98** | **91 774.79** | **92 832.10** | **91 518.47** | **87 958.35** | **11.29** |

| GREENHOUSE GAS SOURCE AND SINK CATEGORIES | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | Change from base to latest reported year |
|---|---|---|---|---|---|---|---|---|---|
| | $CO_2$ equivalent (Gg) | $CO_2$ equivalent (Gg) | $CO_2$ equivalent (Gg) | $CO_2$ equivalent (Gg) | $CO_2$ equivalent (Gg) | $CO_2$ equivalent (Gg) | $CO_2$ equivalent (Gg) | $CO_2$ equivalent (Gg) | (%) |
| 1. Energy | 59 581.92 | 63 829.89 | 65 253.03 | 71 412.24 | 71 056.08 | 71 905.71 | 70 050.88 | 66 146.99 | 18.98 |
| 2. Industrial Processes | 10 034.18 | 9 907.41 | 10 591.37 | 10 662.20 | 9 984.86 | 10 306.44 | 10 880.85 | 11 277.19 | 11.54 |
| 3. Solvent and Other Product Use | 425.06 | 424.79 | 428.96 | 423.34 | 379.04 | 393.53 | 412.16 | 408.80 | -20.12 |
| 4. Agriculture | 8 386.35 | 8 331.73 | 8 211.12 | 8 020.07 | 7 872.85 | 7 848.10 | 7 880.47 | 7 949.49 | -13.32 |
| 5. Land Use, Land-Use Change and Forestry(5) | -16 974.21 | -19 662.47 | -15 924.88 | -17 304.72 | -17 349.95 | -17 153.07 | -17 166.53 | -17 122.97 | 29.94 |
| 6. Waste | 2 650.88 | 2 588.95 | 2 546.39 | 2 594.13 | 2 481.96 | 2 378.32 | 2 294.10 | 2 175.87 | -40.36 |
| 7. Other | NA | NA | NA | NA | NA | NA | NA | NA | 0.00 |
| **Total (including LULUCF)(5)** | **64 104.18** | **65 420.31** | **71 106.01** | **75 807.26** | **74 424.84** | **75 679.03** | **74 351.94** | **70 835.38** | **7.56** |

(1) The column "Base year" should be filled in only by those Parties with economies in transition that use a base year different from 1990 in accordance with the relevant decisions of the COP. For these Parties, this different base year is used to calculate the percentage change in the final column of this table.

(2) Fill in net emissions/removals as reported in table Summary 1.A. For the purposes of reporting, the signs for removals are always negative (-) and for emissions positive (+).

(3) Enter actual emissions estimates. If only potential emissions estimates are available, these should be reported in this table and an indication for this be provided in the documentation box. Only in these rows are the emissions expressed as $CO_2$ equivalent emissions.

(4) In accordance with the UNFCCC reporting guidelines, HFC and PFC emissions should be reported for each relevant chemical. However, if it is not possible to report values for each chemical (i.e. mixtures, confidential data, lack of disaggregation), this row could be used for reporting aggregate figures for HFCs and PFCs, respectively. Note that the unit used for this row is Gg of $CO_2$ equivalent and that appropriate notation keys should be entered in the cells for the individual chemicals.

(5) Includes net $CO_2$, $CH_4$ and $N_2O$ from LULUCF.

| Documentation box: |
|---|
| • Parties should provide detailed explanations on emissions trends in Chapter 2: Trends in Greenhouse Gas Emissions and, as appropriate, in the corresponding Chapters 3 - 9 of the NIR. Use this documentation box to provide references to relevant sections of the NIR if any additional information and further details are needed to understand the content of |
| • Use the documentation box to provide explanations if potential emissions are reported. |

# ANNEX 8: REPORTING UNDER KP ARTICLE 7

The information provided in this Annex follows in content and structure the "Guidelines for the preparation of the information required under Article 7 of the Kyoto Protocol" (Annex to decision 15/CMP.1, FCCC/KP/CMP/2005/8/Add.2 page 56 ff).

## PART D: Greenhouse gas inventory information

### 1) General information

#### Definition of forest

The National Forest Inventory (NFI) of Austria is the main data provider for the greenhouse gas reporting. Consequently and for reason of consistency, the applied forest definition for the reporting follows the definition used within the NFI. The selected parameters are presented in Table A 114.

*Table A 114: Selected parameters defining forest in Austria for the reporting which are the same as according to the NFI of Austria (FBVA, 2001).*

| Parameter | Range | Selected value |
|---|---|---|
| Minimum land area | 0.05–1 ha | 0.05 ha |
| Minimum crown cover | 10–30% | 30% |
| Minimum height | 2–5 m | 2 m |

#### Elected activities under Article 3.4

As reported in the Initial Report[1] Austria has decided not to elect any of the activities under Article 3.4 of the Kyoto Protocol.

#### Description of how the definitions of each activity under Article 3.3 have been implemented and applied consistently over time

The area of forest land reported for Afforestation/Reforestation and Deforestation under the Kyoto Protocol is equal to the area reported for Land use changes from and to forests in the UNFCCC greenhouse gas inventory taking the different time frame into account (see NIR Chapter 7.2.2 Land use changes to forest land - 5 A 2). All LUC from and to forests are considered to be human induced and AR activities will be reported together.

[1] http://unfccc.int/files/national_reports/initial_reports_under_the_kyoto_protocol/application/pdf/at-initial-report-200611-corr.pdf

The information about ARD areas is based on the NFI, which was carried out in the periods 1961-70, 1971-80, 1981-85, 1986-90, 1992-96 and 2000-02 (Federal Office and Research Center for Forests 2009). Since the NFI period 1981-85 the NFI uses a permanently marked grid system (see next chapter). For this reason ARD activities are assessed at the same grid points and sample plots at each inventory period. This guarantees consistency in the statistical approach and assessment over time. The next inventory period will be from 2007-09.

## 2) Land-related information

### Spatial assessment unit used for determining the area of the units of land under Article 3.3

A statistical approach is used to estimate the total area of ARD units following Reporting Method 1 of the GPG-LULUCF (2003). The spatial assessment unit for the submission of the Kyoto Protocol LULUCF tables 2009 covers the entire territory of Austria. The methodology for reporting is based on the National Forest Inventory which uses a permanently below ground marked 4 x 4 km grid across all of Austria with four permanent sample plots of 300 m² size at each grid point (Figure A 1). Details are described in SCHADAUER et al. (2007). ARD activities are accounted as long as the forest definition is met (minimum assessment unit 0.05 ha). At permanent sample plots with ARD adjacent to existing forests any ARD area is accounted, even at ARD areas smaller than 0.05 ha but larger than the minimum size (see below). At each permanent sample the ARD area is assessed. The sizes of the sub-areas with different land use at the permanent sample plots need to be larger than 1/10 (> 30 $m^2$) of the total sample plot area to be assessed. If this precondition is met the polygone that divides the different areas of land uses within the sub-plot is measured using polar-coordinates (see examples in Figure A 2). At site, sketches are drawn and the polygone data are entered into the geographic information system of the portable input device. If the former border line can be recognized in the follow-up NFI, it is kept. A new measurement of the border line is carried out if a minimum distance of 2 m between corner points of the lines is exceeded.

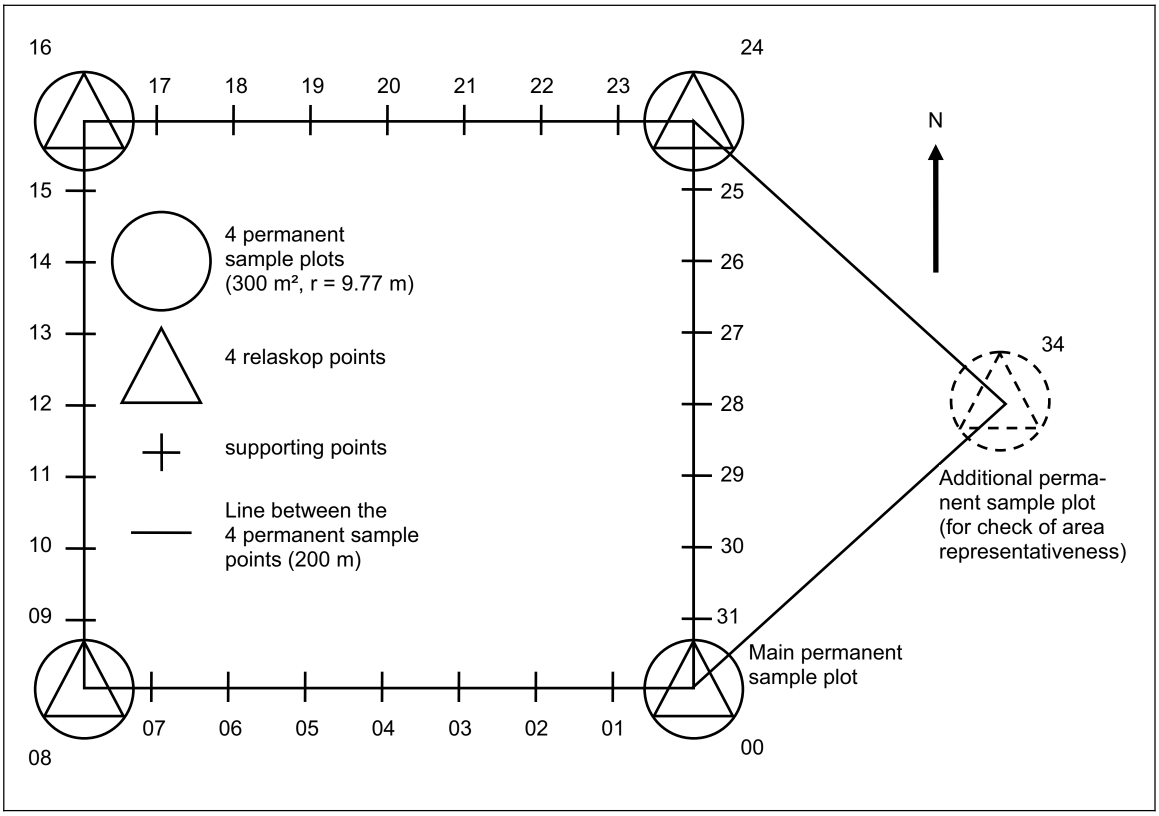


*Figure A 1: Scheme of permanent sample plots at each NFI grid point (SCHADAUER et al. 2007).*

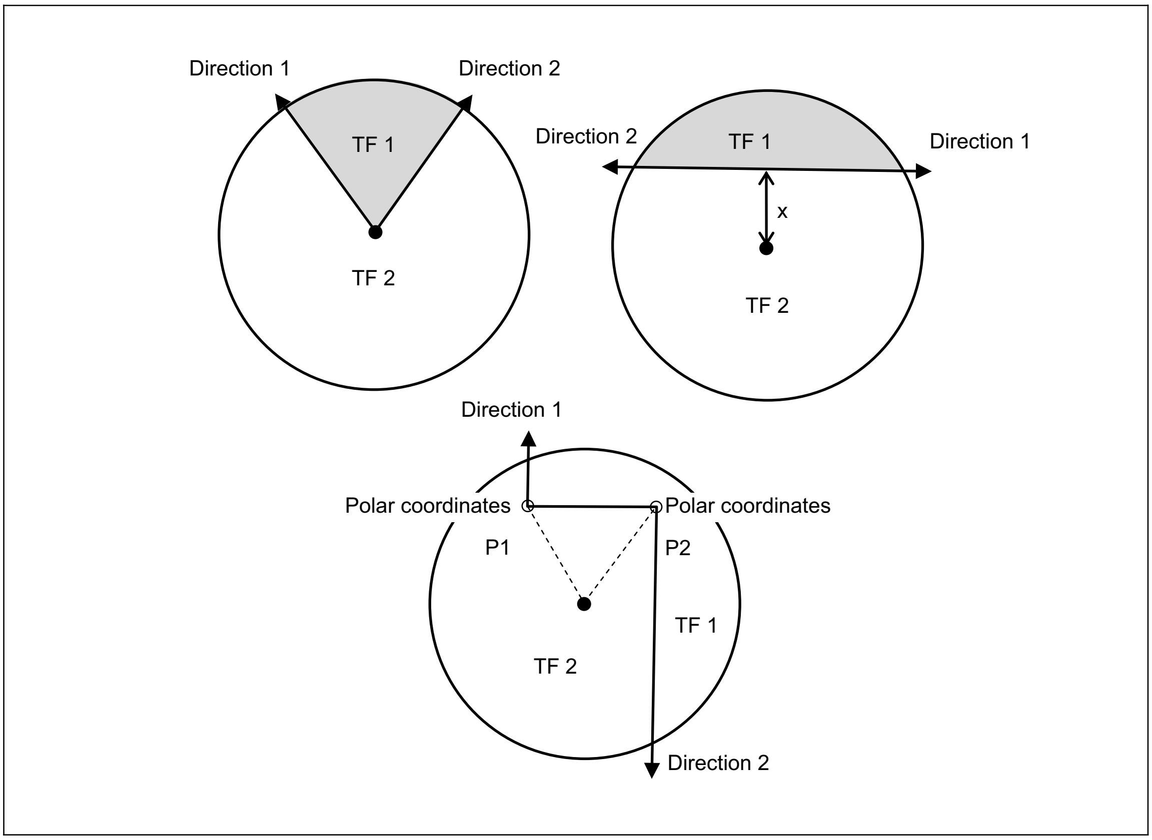


*Figure A 2: Examples for the measurement of polygones dividing permanent NFI sample plots according to different land uses (TF1, TF2), (SCHADAUER et al. 2007).*

### Methodology used to develop the land transition matrix in table NIR 2

The land transition matrix is based on the results of land use changes from and to forest derived from the NFI of the periods 1986/90, 1992/96 and 2000/02. The assessment methods at the NFI grid points are described above. The land uses at the sub-areas of the permanent sample plot are assessed according to the following sub-categories (forests with its sub-specifications; cropland: cropland, fallow, orchards and vineyards, energy plantations and wind belts, Christmas tree cultures; grassland: cutted pastures, grazing land and alpine pastures; wetlands: inshore waters, reeds, bogs; other natural areas: shrublands, screes and gravel areas, rocks, landslide areas, other natural areas; settlements: trade, industry and mining, traffic areas, landfills, touristic areas, houses and parking places, garden and parks). The results of the measured land-use changes from and to forests at the sample plots within an NFI are extrapolated statistically according to the representativeness of the NFI system for the whole area of Austria.

In the period from 1990-1995 the annual increase of AR area was on average 14 700 ha, between 1995 and 2001 on average 9 700 ha. In the same time periods the annual deforestation areas amounted to 7 000 ha and 4 500 ha on average. Further data will become available when the next NFI will have been finished in 2009.

## 3) Activity-specific information

### Methods for carbon stock changes and GHG emission and removal estimates

*<u>Description of the methodologies and the underlying assumptions used</u>*

The methodologies and assumptions used for the reporting under the Kyoto Protocol Art. 3.3. are described in detail in Austria's National Inventory Report, see Chapter 7.2.2 Land Use Changes to Forest Land - 5 A 2.

*<u>Justification when omitting any carbon pool or GHG emissions/removals from activities under Article 3.3</u>*

No carbon pool will be omitted although net carbon stock changes in litter will not be reported separately but will be included in the soil carbon pools. This secures that no double accounting of this carbon pool occurs.

With regard to deadwood it is currently estimated not to occur on AR area and to become part of the soil/litter pool at D area. More specific data on the occurance of deadwood at AR-areas will be available for the commitment period with the recent NFI. The new NFI assessment system of all biomasses and biomass losses at the ARD areas will detect any dead wood changes at ARD areas in the commitment period. However the likelihood for such an occurance is very low due to previous land uses of AR-areas in Austria.

There is no practice of biomass burning at ARD areas in Austria.

*<u>Information on whether or not indirect and natural GHG emissions and removals have been factored out</u>*

Indirect and natural GHG emissions/removals have **not** been factored out.

*Changes in data and methods since the previous submission (recalculations)*

No recalculations were performed since last submission.

*Uncertainty assessments*

A model based approach to assess the uncertainties of emissions/removals of the ARD units is planned for 2011.

*Information on other methodological issues*

The methods used to estimate emissions/removals from ARD activities are of the same tier method as those used for the UNFCCC reporting.

*For the purpose of accounting as required in paragraph 18 of the annex to draft decision -/CMP.1 (Land use, land-use change and forestry) attached to decision 11/CP.7, an indication of the year of the onset of an activity, if after 2008.*

Not relevant for this submission, as the latest reported year is 2007.

## Article 3.3

*Information that demonstrates that activities under Article 3.3 began on or after 1 January 1990 and before 31 December 2012 and are direct human-induced.*

Austria uses a statistical approach to detect ARD (more details are provided above). The NFIs covered the period which is under consideration. Therefore, the NFIs provide a good estimate for the ARD activities before and after 1$^{st}$ January 1990.

The NFI data in Austria provide for each period between two consecutive NFIs information on the average annual increase and loss of forest area. On that basis, all land use changes from and to forests since 1990 can be considered to be human induced.

*Information on how harvesting or forest disturbance that is followed by the re-establishment of forest is distinguished from deforestation*

In Austria temporarily unstocked areas (e.g. harvested area, disturbances) remain forests and are not accounted as deforestation. NFI teams are trained to distinguish between forest management changes and Land Use Changes (LUC).

*Afforestated areas*

fulfil the criteria for the forest definition of the Austrian NFI which are:

1. minimum forest area 500 m$^2$, ground coverage by woody species at least 30% and minimum width of 10 m.
2. In young stands where the ground coverage of 30% cannot be reached by the trees there is a defined species dependent maximum distance between the young trees.

*Deforested areas*

can be detected by two combined characteristics:

3. The forest definition of Austrian NFI has ceased to apply.

***and***

4. there are ***significant visible changes in soil structure or ground vegetation*** which do not go with the natural succession of a forest.

   (consequences of anthropogenic activities like ploughing, crop production, mowing or construction activities or natural abortion of the forest and its stand by e.g. landslides).

Exeptions are forest roads for forest management purposes within the forest. (Private roads at the forest edge and public roads within the forest are classified as non forest).

*Temporarily unstocked areas*

by forest management or forests with biotic and abiotic (windfall, fire, beetles) reduction of their crown coverage maintain the natural succession of ground vegetation and soil and therefore remain part of the forest.

It must be mentioned that the Austrian Forest Act forces stakeholders into guaranteeing the re-establishing the forests (according to the criteria of the forest definition) on such areas within a defined time span.

*<u>Information on emissions and removals of greenhouse gases from lands harvested during the first commitment period following AR on these units of land since 1990</u>*

Austria reports no occurrence of harvesting on AR areas since 1990. Primarily due to the low age of these stands, the growth conditions in Austria and legal aspects thinning and harvesting is not carried out in stands of the first age classes (age 1-20 years). In case, the new NFI assessment system of the biomasses and biomass losses at the ARD areas will detect any harvest at AR areas in the commitment period.

*<u>Information on the size and geographical location of forest areas that have lost forest cover but which are not yet classified as deforested</u>*

The Austrian NFI uses a grid of permanent plots. Information from these plots is extrapolated to the entire forest area. Therefore, geographical information would be only available for the permanent plots which – as each statistical approach – are only a low percentage of the Austrian forests.

## Information related to Article 6

There are no Article 6 activities concerning the LULUCF sector in Austria.

## Planned improvements

By means of the recently carried out NFI (2007-2009) additional and specified data (e.g. for dead wood, investigation at ARD sites) were recorded to better meet the reporting requirements for Art. 3.3. This information will be available for the NIR 2011.

## PART E: Information on Kyoto Protocol Units

The standard electronic format (SEF) for providing information on ERUs, CERs, tCERs, lCERs, AAUs and RMUs for the year 2008 is submitted together with this report (SEF_AT_2009_1_15-37-22 3-3-2009.xls).

Further information on KP units referring to the respective paragraphs of decision 15/CMP.1 is reported in the following list:

- Paragraph 12: No discrepances identified by the transaction log.
- Paragraph 13: No notifications directed to the Partry to replace lCERs in accordance with pararaph 49 of the annex to decision 5/CMP.1.
- Paragraph 14: No notifications directed to the Partry to replace lCERs in accordance with para 50 of the annex to decision 5/CMP.1.
- Paragraph 15: No issue of non-replacement.
- Paragraph 16: No KP Units that are not valid.
- Paragraph 17: No actions were necessary to correct any problem causing a discrepancy.
- Paragraph 18: Austria's commitment period reserve is unchanged compared to the value given in Austria's Initial Review Report[2]:

  309 479 408 tonnes $CO_2$ equivalent

  (based on Austria's assigned amounts of 343 866 009 tonnes $CO_2$ equivalent)

## PART F: Changes in the national system

The national system is unchanged compared to the description given in the Austrian Initial Report under the Kyoto Protocol[3].

[2] http://unfccc.int/resource/docs/2007/irr/aut.pdf

[3] http://unfccc.int/files/national_reports/initial_reports_under_the_kyoto_protocol/application/pdf/at-initial-report-200611-corr.pdf

## PART G: Changes in the national registry

### Introduction

According to Article 7 of the Kyoto Protocol each Party included in Annex I shall incorporate in its annual greenhouse gas inventory the necessary supplementary information for the purposes of ensuring compliance with Article 3 of the Kyoto Protocol. Decision 15/CMP.1 further specifies this supplementary information stating, among other things, that each Party included in Annex I with a commitment inscribed in Annex B shall include in its national inventory report information on any changes that have occurred in its national registry, compared with information reported in its last submission. What follows is a decription of the changes in the Austrian National Registry since the previous submission in April 2007.

### a) Registry Administrator

**The name and contact information of the registry administrator designated by the Party to maintain the national registry**

One member has left the Austrian team of registry administrators:

| | |
|---|---|
| Name | Umweltbundesamt GmbH |
| Address | Spittelauer Lände 5 |
| City | Vienna |
| Postcode | 1090 |
| Country | Austria |
| Telephone number | +43 1 31304 5930 |
| Facsimile number | +43 1 31304 5959 |
| E-mail | katrin.seuss@umweltbundesamt.at |
| | verena.kuschel@umweltbundesamt.at |

### b) Consolidated System with other Parties

**The names of the other Parties with which the Party cooperates by maintaining their national registries in a consolidated system**

There were no changes in the national registry.

### c) Database structure and capacity

**A description of the database structure of the national registry**

There were no changes in the national registry.

### d) Conformity with Data Exchange Standards

**A description of how the national registry conforms to the technical standards for data exchange between registry systems for the purpose of ensuring the accurate, transparent and efficient exchange of data between national registries, the clean development mechanism registry and the transaction log (decision 19/CP.7, paragraph 1)**

Implementation of Standard Electronic Format (SEF)

In autumn 2008 after the completion of the connection to the ITL, software development and tests in order to include the "Standard Electronic Format (SEF) for reporting of information on Kyoto Protocol units", as defined in decision 14/CMP.1, started in the Austrian registry software. The tables of the Standard Electronic Format (SEF), as described in decision 14/CMP.1, are not explained in terminology used in the data exchange standards (DES). Therefore, the SEF working group, coordinated by the UNFCCC, developed the document entitled "Standard Electronic Format (SEF) Technical Guidance", which was intended for registry administrators as well as registry software developers. Development of a new version 1.1.12.0 of the Austrian registry software was carried out in line with this technical guidance. The new release was tested with the UNFCCC Secretariat in December 2008[4]. The Secretariat issued a test certificate to confirm that version 1.1.12.0 of the Austrian registry software had been tested successfully and was authorized to go live with the ITL (page one – the test summary – is pictured in Figure A 3)[5]. Version 1.1.12.0 was rolled out to the production environment on 2 April 2009.

[4] The testing plan used was "SEF Coordinated Testing – Test Plan v.1.3", it is submitted together with this report: SEF_Coordinated_Testing_plan_1_3.doc

[5] the whole document is submitted together with this report: SEF-Certification-SmartTech.pdf

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FRAMEWORK CONVENTION ON CLIMATE CHANGE – Secretariat
CONVENTION - CADRE SUR LES CHANGEMENTS CLIMATIQUES – Secrétariat

## Standard Electronic Format (SEF) Test Certificate

| General information | | |
|---|---|---|
| Developer | SmartTech | |
| Registry/SEF reporting software version | Registry: Smart.Register 1.1.12.0<br>Reporting: Smart.Register 1.1.12.0 | |
| SEF Solution | ( X ) Transaction-History-based | ( ) Snapshot-based |
| Test period | 01 – 08 December 2008 | |
| SEF report submission dates: | 2008: 10-DEC-08, 10:21<br>2009: 10-DEC-08, 10:22<br>2010: 10-DEC-08, 10:22 | |
| Test plan reference | SEF Coordinated Testing plan v.1.3 | |
| Test results | The detailed test results can be found in the attached file. | |

**Test results summary**

**The registry SEF reporting software has been successfully tested.**

Bonn, 2 January 2009.

Jörg Kirschbaum

for the ITL Administrator

*Figure A 3: Test certificate for SEF reporting software v1.1.12.0.*

### e) Minimization of discrepancies

**A description of the procedures employed in the national registry to minimize discrepancies in the issuance, transfer, acquisition, cancellation and retirement of ERUs, CERs, tCERs, lCERs, AAUs and/or RMUs, and replacement of tCERs and lCERs, and of the steps taken to terminate transactions where a discrepancy is notified and to correct problems in the event of a failure in terminating the transactions**

There were no changes in the national registry.

### f) Overview of security measures

**An overview of security measures employed in the national registry to prevent unauthorized manipulations and to prevent operator error and of how these measures are kept up to date.**

There were no changes in the national registry.

### g) Publicly accessible information

**A list of the information publicly accessible by means of the user interface to the national registry**

Additional non-confidential information has been made accessible to the public in line with the requirements in the annex to decision 13/CMP.1, heading E "Publicly accessible information".

*Information according to paragraph 45 - 48 of the annex to decision 13/CMP.1:*

(a) Account name: the holder of the account

(b) Account type: the type of account (holding, cancellation or retirement)

(c) Commitment period: the commitment period with which a cancellation or retirement account is associated

(d) Representative identifier: the representative of the account holder, using the Party identifier (the two-letter country code defined by ISO 3166) and a number unique to that representative within the Party's registry

(e) Representative name and contact information: the full name, mailing address, telephone number, facsimile number and e-mail address of the representative of the account holder. According to Annex XVI of the EU Registry Regulation No 916/2007/EC this information is published unless the registry administrator allows account holders to request keeping all or some of this information confidential and the account holder requested the registry administrator in writing not to display all or some of this information.

The Information includes the following Article 6 project information, for each project identifier if the Party has issued ERUs for a project:

(a) Project name: a unique name for the project

(b) Project location: the Party and town or region in which the project is located

(c) Years of ERU issuance: the years in which ERUs have been issued as a result of the Article 6 project

(d) Reports: downloadable electronic versions of all publicly available documentation relating to the project, including proposals, monitoring, verification and issuance of ERUs, where relevant, subject to the confidentiality provisions in decision 9/CMP.1.

The information includes the following holding and transaction information relevant to the national registry, by serial number, for each calendar year:

(a) The total quantity of ERUs, CERs, AAUs and RMUs in each account at the beginning of the year (displayed in the year X+5, according to EU Registry Regulation No 916/2007/EC the information is confidential until the year X+5)

(b) The total quantity of AAUs issued on the basis of the assigned amount pursuant to Article 3, paragraphs 7 and 8 (displayed in the year X+1)

(c) The total quantity of ERUs issued on the basis of Article 6 projects (displayed in the year X+1)

(d) The total quantity of ERUs, CERs, AAUs and RMUs acquired from other registries and the identity of the transferring accounts and registries (displayed in the year X+5, according to EU Registry Regulation No 916/2007/EC the information is confidential until the year X+5)

(e) The total quantity of RMUs issued on the basis of each activity under Article 3, paragraphs 3 and 4 (displayed in the year X+1)

(f) The total quantity of ERUs, CERs, AAUs and RMUs transferred to other registries and the identity of the acquiring accounts and registries (displayed in the year X+5, according to EU Registry Regulation No 916/2007/EC the information is confidential until the year X+5)

(g) The total quantity of ERUs, CERs, AAUs and RMUs cancelled on the basis of activities under Article 3, paragraphs 3 and 4 (displayed in the year X+1)

(h) The total quantity of ERUs, CERs, AAUs and RMUs cancelled following determination by the Compliance Committee that the Party is not in compliance with its commitment under Article 3, paragraph 1 (displayed in the year X+1)

(i) The total quantity of other ERUs, CERs, AAUs and RMUs cancelled (displayed in the year X+1)

(j) The total quantity of ERUs, CERs, AAUs and RMUs retired (displayed in the year X+1)

(k) The total quantity of ERUs, CERs, and AAUs carried over from the previous commitment period (displayed in the year X+1)

(l) The Information does not include current holdings of ERUs, CERs, AAUs and RMUs in each account because this is confidential according to EU Registry Regulation No 916/2007/EC.

The information includes a list of legal entities authorized by the Party to hold ERUs, CERs, AAUs and/or RMUs under its responsibility.

### h) The Internet address of the interface to its national registry

There were no changes in the national registry.

### i) Disaster recovery

**A description of measures taken to safeguard, maintain and recover data in order to ensure the integrity of data storage and the recovery of registry services in the event of a disaster**

There were no changes in the national registry.

### j) Tests procedures

**The results of any test procedures that might be available or developed with the aim of testing the performance, procedures and security measures of the national registry undertaken pursuant to the provisions of decision 19/CP.7 relating to the technical standards for data exchange between registry systems**

In addition to the test procedures described under item d) for the implementation of the Standard Electronic Format (SEF), the Austrian registry carried out tests in the context of the connection to the International Transaction Log (ITL). The go-live with the ITL, which had been planned to take place in 2007, was postponed to 2008. Since several EU member states had already issued EU allowances in February 2008 a special go-live procedure for the registries in the EU Emissions Trading Scheme (EU ETS) had to be developed, which also required minor changes related to the go-live to software version 1.1.10.0, which had been initialised with the International Transaction Log (ITL) in 2007. Development of software version 1.1.11.0 of the

Austrian national registry software was completed in the first half of 2008. Software version 1.1.11.0 was tested successfully in the first and the second rehearsal for the go-live with the ITL, which were coordinated by the European Commission and the UNFCCC Secretariat[6]. On 12 August 2008, the Austrian national registry received the official authorization to go-live with the ITL via e-mail (see Figure A 4). In October 2008, the Austrian national registry went live with the ITL within the framework of the coordinated EU ETS go-live process.

Go Live Authorizationo for Austria_from ITL.txt

Von: Heidi McKenna [HMcKenna@unfccc.int] im Auftrag von International Transaction Log [ITL-Administrator@unfccc.int]
Gesendet: Dienstag, 12. August 2008 16:46
An: Seuss Katrin; Weigl Johann
Cc: Alwyn.Rowland@logicacmg.com; itl-Administrator@unfccc.int
Betreff: Go Live Authorizationo for Austria

Dear Katrin,

After reviewing the ITL-Operator's updated recommendation considering the materials submitted by the national registry of Austria, including the response to the CITL testing condition, on behalf of the ITL-Administrator I am pleased to announce that the registry of Austria is authorized to go live with the production environment of the ITL.

Congradulations and thank you for the hard work and careful preparation.

Best Regards,

Heidi McKenna

On behalf of the
International Transaction Log Administrator Climate Change Secretariat (UNFCCC) PO Box 260124, 53153 Bonn, Germany

Tel: +49 228 815 1000
Fax: +49 228 815 1999
Web: www.unfccc.int
Email: ITL-Administrator@unfccc.int

*Figure A 4: Test certificate for version 1.1.12.0 of the Austrian registry software.*

[6] test plan used for the second rehersal: Annex II to ETS Go-live with ITL: Procedures and Planning; Version 4.9 (15 July 2008); it is submitted together with this report: ETS-ITL go-live_Annex2, v4.9_final (15 Jul.2008 sk).doc

# ANNEX 9: CRF TABLES ART. 3.3 KP ACTIVITIES FOR 2007

This Annex includes the tables of the common reporting format for activities under article 3.3 of the Kyoto Protocol, as specified in Decision 17/CMP.1, for the year 2007. The submission in 2009 is not obligatory; Austria submits these tables voluntarily.

As Austria has not elected activities under article 3.4 of the Kyoto Protocol only the relevant tables are presented here:

NIR-1, NIR-2, 5(KP), 5(KP-I)A1.1, 5(KP-I)A1.2, 5(KP-I)A2, 5(KP-II)1, 5(KP-II)3, 5(KP-II)4, 5(KP-II)5, Accounting.

The full set of tables is submitted electronically together with this report.

**TABLE NIR 1. SUMMARY TABLE**
**Activity coverage and other information relating to activities under Article 3.3 and elected activities under Article 3.4**

Austria
2007
2009

| Activity | | Change in carbon pool reported[1] | | | | | Greenhouse gas sources reported[2] | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Above-ground biomass | Below-ground biomass | Litter | Dead wood | Soil | Fertilization[3] | Drainage of soils under forest management | Disturbance associated with land-use conversion to croplands | Liming | Biomass burning[4] | | |
| | | | | | | | $N_2O$ | $N_2O$ | $N_2O$ | $CO_2$ | $CO_2$ | $CH_4$ | $N_2O$ |
| Article 3.3 activities | Afforestation and Reforestation | R | R | IE | NO | R | NO | | | NO | NO | NO | NO |
| | Deforestation | R | R | IE | IE | R | | | NO | NO | NO | NO | NO |
| Article 3.4 activities | Forest Management | NA | NA | NA | NA | NA | NA | NA | | NA | NA | NA | NA |
| | Cropland Management | NA | NA | NA | NA | NA | | | NA | NA | NA | NA | NA |
| | Grazing Land Management | NA | NA | NA | NA | NA | | | | NA | NA | NA | NA |
| | Revegetation | NA | NA | NA | NA | NA | | | | NA | NA | NA | NA |

(1) Indicate R (reported), NR (not reported), IE (included elsewhere) or NO (not occurring), for each relevant activity under Article 3.3 or elected activity under Article 3.4. If changes in a carbon pool are not reported, it must be demonstrated in the NIR that this pool is not a net source of greenhouse gases. Indicate NA (not applicable) for each activity that is not elected under Article 3.4. Explanation about the use of notation keys should be provided in the text.

(2) Indicate R (reported), NE (not estimated), IE (included elsewhere) or NO (not occurring) for greenhouse gas sources reported, for each relevant activity under Article 3.3 or elected activity under Article 3.4. Indicate NA (not applicable) for each activity that is not elected under Article 3.4. Explanation about the use of notation keys should be provided in the text.

(3) $N_2O$ emissions from fertilization for Cropland Management, Grazing Land Management and Revegetation should be reported in the Agriculture sector. If a Party is not able to separate fertilizer applied to Forest Land from Agriculture, it may report all $N_2O$ emissions from fertilization in the Agriculture sector.

(4) If $CO_2$ emissions from biomass burning are not already included under changes in carbon stocks, they should be reported under biomass burning; this also includes the carbon component of $CH_4$. Parties that include $CO_2$ emissions from biomass burning in their carbon stock change estimates should report IE (included elsewhere).

**Table NIR 1.1 Additional information**
**Selection of parameters for defining "Forest"under the Kyoto Protocol**

| Parameter | Range | Selected value |
|---|---|---|
| Minimum land area | 0.05 - 1 ha | 0.05 |
| Minimum crown cover | 10 - 30 % | 30 |
| Minimum height | 2 - 5 m | 2 |

**Table NIR 2. LAND TRANSITION MATRIX**

**Area change between the previous and the current inventory year (1), (2), (3)**

Austria
2007
2009

| FROM... / TO... | | Article 3.3 activities: Afforestation and reforestation | Article 3.3 activities: Deforestation | Article 3.4 activities: Forest Management (if elected) | Article 3.4 activities: Cropland Management (if elected) | Article 3.4 activities: Grazing Land Management (if elected) | Article 3.4 activities: Revegetation (if elected) | Other | Total |
|---|---|---|---|---|---|---|---|---|---|
| | | (kha) | | | | | | | |
| Article 3.3 activities | Afforestation and Reforestation | 190.49 | NO | | | | | | 190.49 |
| | Deforestation | | 89.57 | | | | | | 89.57 |
| Article 3.4 activities | Forest Management (if elected) | | NA | NA | | | | | 0.00 |
| | Cropland Management[4] (if elected) | NA | NA | | NA | NA | NA | | 0.00 |
| | Grazing Land Management[4] (if elected) | NA | NA | | NA | NA | NA | | 0.00 |
| | Revegetation[4] (if elected) | NA | | | NA | NA | NA | | 0.00 |
| Other | | NA | NA | NA | NA | NA | NA | NA | 0.00 |
| Total area | | 190.49 | 89.57 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 280.06 |

(1) This table should be used to report land area and changes in land area subject to the various activities in the inventory year. For each activity it should be used to report area change between the previous year and the current inventory year. For example, the total area of land subject to Forest Management in the year preceeding the inventory year, and which was deforested in the inventory year, should be reported in the cell in column B and in the row of Forest Management.

(2) Some of the transitions in the matrix are not possible and the cells concerned have been shaded.

(3) In accordance with section 4.2.3.2 of the IPCC good practice guidance for LULUCF, the value of the reported area subject to the various activities under Article 3.3 and 3.4 for the inventory year should be that on 31 December of that year.

(4) Lands subject to Cropland Management, Grazing Land Management or Revegetation which, after 2008, are subject to activities other than those under Article 3.3 and 3.4, should still be tracked and reported under Cropland Management, Grazing Land Management or Revegetation, respectively.

**TABLE 5(KP) REPORT OF SUPPLEMENTARY INFORMATION FOR LAND USE, LAND-USE CHANGE AND FORESTRY ACTIVITIES UNDER THE KYOTO PROTOCOL [1], [2]**

Austria
2007
2009

| GREENHOUSE GAS SOURCE AND SINK ACTIVITIES | Net $CO_2$ emissions/ removals[3], [4] | $CH_4$ [5] | $N_2O$ [6] | Net $CO_2$ Equivalent emissions/removals [8] |
|---|---|---|---|---|
| | (Gg) | | | |
| **A. Article 3.3 activities** | | | | **-1229.59** |
| A.1. Afforestation and Reforestation [7] | -2413.03 | NO | NO | -2413.03 |
| A.1.1. Units of land not harvested since the beginning of the commitment period | -2413.03 | 0.00 | NO | -2413.03 |
| A.1.2. Units of land harvested since the beginning of the commitment period | 0.00 | NO | NO | 0.00 |
| A.2. Deforestation | 1183.45 | NO | NO | 1183.45 |
| **B. Article 3.4 activities** | | | | **0.00** |
| B.1. Forest Management (if elected) | 0.00 | 0.00 | 0.00 | 0.00 |
| B.2. Cropland Management (if elected) | 0.00 | 0.00 | 0.00 | 0.00 |
| B.3. Grazing Land Management (if elected) | 0.00 | 0.00 | 0.00 | 0.00 |
| B.4. Revegetation (if elected) | 0.00 | 0.00 | 0.00 | 0.00 |

| | | | | |
|---|---|---|---|---|
| **Information item [9]:** | | | | |
| A.1.2. Units of land harvested since the beginning of the commitment period | 0.00 | 0.00 | 0.00 | 0.00 |
| *[specify identification code]* | | | | 0.00 |

| **Documentation box** |
|---|
| Parties should provide detailed explanation on the land use, land-use change and forestry sector in the relevant annex of the NIR: Supplementary information on LULUCF activities under the Kyoto Protocol. Use this documentation box to provide references to relevant sections of the NIR if any additional details are needed to understand the content of this table. |
| |

(1) All estimates in this table include emissions and removals from projects under Article 6 hosted by the reporting Party.

(2) If Cropland Management, Grazing Land Management and/or Revegetation are elected, this table and all relevant tables should also be reported for the base year for these activities.

(3) According to the Revised 1996 IPCC Guidelines, for the purposes of reporting, the signs for removals are always negative (-) and for emissions positive (+). Net changes in carbon stocks are converted to $CO_2$ by

(4) $CO_2$ emissions from liming, biomass burning and drained organic soils, where applicable, are included in this column.

(5) $CH_4$ emissions reported here for Cropland Management, Grazing Land Management and Revegetation, if elected, include only emissions from biomass burning (with the exception of savannah burning and agricultural residue burning which are reported in the Agriculture sector). Any other $CH_4$ emissions from Agriculture should be reported in the Agriculture sector.

(6) $N_2O$ emissions reported here for Cropland Management, if elected, include only emissions from biomass burning (with the exception of savannah burning and agricultural residue burning which are reported in the Agriculture sector) and $N_2O$ from conversion to Cropland of lands other than Forest Land (Table 5(KP-II)3). Any other $N_2O$ emissions from Agriculture should be reported in the Agriculture sector.

(7) As both Afforestation and Reforestation under Article 3.3 are subject to the same provisions specified in the annex to draft decision -/CMP.1 (*Land use, land-use change and forestry*), attached to decision 11/CP.7, they can be reported together.

(8) This cell should be internally calculated based on values reported in columns A, B and C and the relevant GWP values.

(9) This section has been added to facilitate accounting of harvested land areas , according to decision 16 CMP.1.

**TABLE 5(KP-I)A.1.1. SUPPLEMENTARY BACKGROUND DATA ON CARBON STOCK CHANGES AND NET $CO_2$ EMISSIONS AND REMOVALS FOR LAND USE, LAND-USE CHANGE AND FORESTRY ACTIVITIES UNDER THE KYOTO PROTOCOL**

Austria
2007
2009

**Article 3.3 activities: Afforestation and Reforestation [(1), (2)]**

**Units of land not harvested since the beginning of the commitment period**

| GEOGRAPHICAL LOCATION [(3)] | ACTIVITY DATA | | IMPLIED CARBON STOCK CHANGE FACTORS [(7)] | | | | | | | | | Implied emission/ removal factor per area[(8)] | CHANGE IN CARBON STOCK [(7)] | | | | | | | | | Net $CO_2$ emissions/ removals [(8)] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Identification code | Subdivision[(4)] | Area subject to the activity | Carbon stock change in above-ground biomass per area[(5), (6)] | | | Carbon stock change in below-ground biomass per area[(5), (6)] | | | Net carbon stock change in litter per area[(5)] | Net carbon stock change in dead wood per area[(5)] | Net carbon stock change in soils per area[(5)] | | Carbon stock change in above-ground biomass[(5), (6)] | | | Carbon stock change in below-ground biomass[(5), (6)] | | | Net carbon stock change in litter [(5)] | Net carbon stock change in dead wood[(5)] | Net carbon stock change in soils[(5)] | |
| | | | Gains | Losses | Net change | Gains | Losses | Net change | | | | | Gains | Losses | Net change | Gains | Losses | Net change | | | | |
| | | (kha) | (Mg C/ha) | | | | | | | | | (Mg $CO_2$/ha) | (Gg C) | | | | | | | | | (Gg $CO_2$) |
| **Total for activity A.1.1** | | **200.25** | **1.00** | **0.00** | **1.00** | **0.18** | **0.00** | **0.18** | **0.00** | **0.00** | **2.10** | **-12.05** | **201.03** | **0.00** | **201.03** | **35.99** | **0.00** | **35.99** | **0.00** | **0.00** | **421.08** | **-2413.03** |
| *Austria* | | 200.25 | 1.00 | IE | 1.00 | 0.18 | IE | 0.18 | IE | NO | 2.10 | -12.05 | 201.03 | IE | 201.03 | 35.99 | IE | 35.99 | IE | NO | 421.08 | -2413.03 |
| | *AR-area* | 200.25 | 1.00 | IE | 1.00 | 0.18 | IE | 0.18 | IE | NO | 2.10 | -12.05 | 201.03 | IE | 201.03 | 35.99 | IE | 35.99 | IE | NO | 421.08 | -2413.03 |

| Documentation box |
|---|
| Parties should provide detailed explanation on the land use, land-use change and forestry sector in the relevant annex of the NIR: Supplementary information on LULUCF activities under the Kyoto Protocol. Use this documentation box to provide references to relevant sections of the NIR if any additional details are needed to understand the content of this table. |
| |

(1) Report here information on anthropogenic change in carbon stock for the inventory year for all geographical locations that encompass units of land subject to Afforestation and Reforestation under Article 3.3 not harvested since the beginning of the commitment period.

(2) As both Afforestation and Reforestation under Article 3.3 are subject to the same provisions specified in the annex to draft decision -/CMP.1 (*Land use, land-use change and forestry* ), attached to decision 11/CP.7, they can be reported together.

(3) Geographical location refers to the boundaries of the areas that encompass units of land subject to Afforestation and Reforestation.

(4) Activity data may be further subdivided according to climate zone, management system, soil type, vegetation type, tree species, ecological zone, national land classification or other criteria. Complete one row for each subdivision.

(5) The signs for estimates of gains in carbon stocks are positive (+) and of losses in carbon stocks are negative (-).

(6) In all cases where the good practice guidance methods used give separate estimates of gains and losses, these estimates should be reported.

(7) Note that net change corresponds to increase/decrease of carbon stock (see table 4.2.6a of the IPCC good practice guidance for LULUCF).

(8) According to the Revised 1996 IPCC Guidelines, for the purposes of reporting, the signs for removals are always negative (-) and for emissions positive (+). Net changes in carbon stocks are converted to $CO_2$ by multiplying C by 44/12 and changing the sign for net $CO_2$ removals to be negative (-) and for net $CO_2$ emissions to be positive (+).

**TABLE 5(KP-I)A.1.2. SUPPLEMENTARY BACKGROUND DATA ON CARBON STOCK CHANGES AND NET $CO_2$ EMISSIONS AND REMOVALS FOR LAND USE, LAND-USE CHANGE AND FORESTRY ACTIVITIES UNDER THE KYOTO PROTOCOL**

**Article 3.3 activities: Afforestation and Reforestation [(1), (2)]**

**Units of land harvested since the beginning of the commitment period**

Austria
2007
2009

| GEOGRAPHICAL LOCATION [3] | ACTIVITY DATA | | IMPLIED CARBON STOCK CHANGE FACTORS[7] | | | | | | | | | Implied emission/ removal factor per area[8] | CHANGE IN CARBON STOCK[7] | | | | | | | | | Net $CO_2$ emissions/ removals[8] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Identification code | Subdivision[4] | Area subject to the activity | Carbon stock change in above-ground biomass per area[5], [6] | | | Carbon stock change in below-ground biomass per area [5], [6] | | | Net carbon stock change in litter per area[5] | Net carbon stock change in dead wood per area[5] | Net carbon stock change in soils per area[5] | | Carbon stock change in above-ground biomass[5], [6] | | | Carbon stock change in below-ground biomass[5], [6] | | | Net carbon stock change in litter[5] | Net carbon stock change in dead wood[5] | Net carbon stock change in soils[5] | |
| | | | Gains | Losses | Net change | Gains | Losses | Net change | | | | | Gains | Losses | Net change | Gains | Losses | Net change | | | | |
| | | (kha) | (Mg C/ha) | | | | | | | | | (Mg $CO_2$/ha) | (Gg C) | | | | | | | | | (Gg $CO_2$) |
| Total for activity A.1.2 | | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| *Austria* | | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| | *AR-area* | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |

**Documentation box**

Parties should provide detailed explanation on the land use, land-use change and forestry sector in the relevant annex of the NIR: Supplementary information on LULUCF activities under the Kyoto Protocol. Use this documentation box to provide references to relevant sections of the NIR if any additional details are needed to understand the content of this table.

(1) Report here information on anthropogenic change in carbon stock for the inventory year for all geographical locations that encompass units of land subject to Afforestation and Reforestation under Article 3.3 harvested since the beginning of the commitment period.

(2) As both Afforestation and Reforestation under Article 3.3 are subject to the same provisions specified in the annex to draft decision -/CMP.1 (*Land use, land-use change and forestry* ), attached to decision 11/CP.7, they can be reported together.

(3) Geographical location refers to the boundaries of the areas that encompass units of land subject to Afforestation and Reforestation.

(4) Activity data may be further subdivided according to climate zone, management system, soil type, vegetation type, tree species, ecological zone, national land classification or other criteria. Complete one row for each subdivision.

(5) The signs for estimates of gains in carbon stocks are positive (+) and of losses in carbon stocks are negative (-).

(6) In all cases where the good practice guidance methods used give separate estimates of gains and losses, these estimates should be reported.

(7) Note that net change corresponds to increase / decrease of carbon stock (see table 4.2.6a of the IPCC good practice guidance for LULUCF).

(8) According to the Revised 1996 IPCC Guidelines, for the purposes of reporting, the signs for removals are always negative (-) and for emissions positive (+). Net changes in carbon stocks are converted to $CO_2$ by multiplying C by 44/12 and changing the sign for net $CO_2$ removals to be negative (-) and for net $CO_2$ emissions to be positive (+).

**TABLE 5(KP-I)A.2. SUPPLEMENTARY BACKGROUND DATA ON CARBON STOCK CHANGES AND NET $CO_2$ EMISSIONS AND REMOVALS FOR LAND USE, LAND-USE CHANGE AND FORESTRY ACTIVITIES UNDER THE KYOTO PROTOCOL**

**Article 3.3 activities: Deforestation [(1)]**

Austria
2007
2009

| GEOGRAPHICAL LOCATION[(2)] | ACTIVITY DATA | | IMPLIED CARBON STOCK CHANGE FACTORS [(6)] | | | | | | | | | Implied emission/ removal factor per area[(7)] | CHANGE IN CARBON STOCK [(6)] | | | | | | | | | Net $CO_2$ emissions/ removals[(7)] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Carbon stock change in above-ground biomass per area[(4), (5)] | | | Carbon stock change in below-ground biomass per area[(4), (5)] | | | Net carbon stock change in litter per area[(4)] | Net carbon stock change in dead wood per area[(4)] | Net carbon stock change in soils per area[(4)] | | Carbon stock change in above-ground biomass[(4), (5)] | | | Carbon stock change in below-ground biomass[(4), (5)] | | | Net carbon stock change in litter[(4)] | Net carbon stock change in dead wood[(4)] | Net carbon stock change in soils[(4)] | |
| Identification code | Subdivision[(3)] | Area subject to the activity | Gains | Losses | Net change | Gains | Losses | Net change | | | | | Gains | Losses | Net change | Gains | Losses | Net change | | | | |
| | | (kha) | (Mg C/ha) | | | | | | | | | (Mg $CO_2$/ha) | (Gg C) | | | | | | | | | (Gg $CO_2$) |
| **Total for activity A.2.** | | **94.12** | **NO** | **-0.81** | **-0.81** | **0.00** | **-0.21** | **-0.21** | **0.00** | **0.00** | **-2.41** | **12.57** | **NO** | **-76.42** | **-76.42** | **0.00** | **-19.65** | **-19.65** | **0.00** | **0.00** | **-226.70** | **1183.45** |
| *Austria* | | 94.12 | NO | -0.81 | -0.81 | NO | -0.21 | -0.21 | IE | NO | -2.41 | 12.57 | NO | -76.42 | -76.42 | NO | -19.65 | -19.65 | IE | NO | -226.70 | 1183.45 |
| | *D-area* | 94.12 | NO | -0.81 | -0.81 | NO | -0.21 | -0.21 | IE | NO | -2.41 | 12.57 | NO | -76.42 | -76.42 | NO | -19.65 | -19.65 | IE | NO | -226.70 | 1183.45 |

| Documentation box |
|---|
| Parties should provide detailed explanation on the land use, land-use change and forestry sector in the relevant annex of the NIR: Supplementary information on LULUCF activities under the Kyoto Protocol. Use this documentation box to provide references to relevant sections of the NIR if any additional details are needed to understand the content of this table. |
| |

(1) Report here information on anthropogenic change in carbon stock for the inventory year for all geographical locations that encompass units of land subject to Deforestation under Article 3.3.
(2) Geographical location refers to the boundaries of the areas that encompass units of land subject to Deforestation.
(3) Activity data may be further subdivided according to climate zone, management system, soil type, vegetation type, tree species, ecological zone, national land classification or other criteria. Complete one row for each subdivision.
(4) The signs for estimates of gains in carbon stocks are positive (+) and of losses in carbon stocks are negative (-).
(5) In all cases where the good practice guidance methods used give separate estimates of gains and losses, these estimates should be reported.
(6) Note that net change corresponds to increase / decrease of carbon stock (see table 4.2.6a of the IPCC good practice guidance for LULUCF).
(7) According to the Revised 1996 IPCC Guidelines, for the purposes of reporting, the signs for removals are always negative (-) and for emissions positive (+). Net changes in carbon stocks are converted to $CO_2$ by multiplying C by 44/12 and changing the sign for net $CO_2$ removals to be negative (-) and for net $CO_2$ emissions to be positive (+).

**TABLE 5(KP-II)1 SUPPLEMENTARY BACKGROUND DATA FOR LAND USE, LAND-USE CHANGE AND FORESTRY ACTIVITIES UNDER THE KYOTO PROTOCOL**

**Direct $N_2O$ emissions from N fertilization [(1), (2)]**

Austria
2007
2009

| Identification code of geographical location | ACTIVITY DATA | IMPLIED EMISSION FACTOR | EMISSIONS |
|---|---|---|---|
| | Total amount of fertilizer applied (Gg N/year) | $N_2O$-N emissions per unit of fertilizer (kg $N_2O$-N/kg N) [(3)] | $N_2O$ (Gg) |
| **A.1.1. Afforestation/Reforestation: units of land not harvested since the beginning of the commitment period [(4)]** | **NO** | **NO** | **NO** |
| *Austria* | NO | NO | NO |
| **A.1.2. Afforestation/Reforestation: units of land harvested since the beginning of the commitment period [(4)]** | **NO** | **NO** | **NO** |
| *Austria* | NO | NO | NO |
| **B.1. Forest Management (if elected) [(5)]** | **0.00** | **0.00** | **0.00** |
| *[specify identification code]* | | 0.00 | |

| **Documentation box** |
|---|
| Parties should provide detailed explanation on the land use, land-use change and forestry sector in the relevant annex of the NIR: Supplementary information on LULUCF activities under the Kyoto Protocol. Use this documentation box to provide references to relevant sections of the NIR if any additional details are needed to understand the content of this table. |
| |

(1) $N_2O$ emissions from fertilization for Cropland Management, Grazing Land Management and Revegetation should be reported in the Agriculture sector. If a Party is not able to separate fertilizer applied to Forest Land from Agriculture, it may report all N2O emissions from fertilization in the Agriculture sector. This should be explicitly indicated in the documentation box.

(2) Direct $N_2O$ emissions from fertilization are estimated following section 3.2.1.4.1 of the IPCC good practice guidance for LULUCF based on the amount of fertilizer applied to land under Forest Management. The indirect N2O emissions from Afforestation and Reforestation and land under Forest Management are estimated as part of the total indirect emissions in the Agriculture sector based on the total amount of fertilizer used in the country. Parties should show that double counting of N2O emissions from fertilization with Agriculture sector estimates has been avoided.

(3) In the calculation of the implied emission factor, $N_2O$ emissions are converted to $N_2O$-N by multiplying by 28/44.

(4) Geographical location refers to the boundaries of the areas that encompass units of land subject to Afforestation and Reforestation.

(5) Geographical location refers to the boundaries of the areas that encompass land subject to Forest Management (if elected).

**TABLE 5(KP-II)3 SUPPLEMENTARY BACKGROUND DATA FOR LAND USE, LAND-USE CHANGE AND FORESTRY ACTIVITIES UNDER THE KYOTO PROTOCOL**

Austria

**$N_2O$ emissions from disturbance associated with land-use conversion to cropland [(1), (2)]**

2007
2009

| Identification code of geographical location | ACTIVITY DATA<br>Land area converted<br>(kha) | IMPLIED EMISSION FACTOR<br>$N_2O$-N per area converted [(5)]<br>(kg $N_2O$-N/ha) | EMISSIONS<br>$N_2O$<br>(Gg) |
|---|---|---|---|
| **A.2. Deforestation [(3), (6)]** | **0.00** | **0.00** | **0.00** |
| ***Total organic soils*** | 0.00 | 0.00 | 0.00 |
| ***Total mineral soils*** | 0.00 | 0.00 | 0.00 |
| *Austria* | NO | NO | NO |
| Organic soils [(7)] | NO | NO | NO |
| Mineral soils [(7)] | NO | NO | NO |
| **B.2. Cropland Management (if elected) [(4), (8)]** | **0.00** | **0.00** | **0.00** |
| ***Total organic soils*** | 0.00 | 0.00 | 0.00 |
| ***Total mineral soils*** | 0.00 | 0.00 | 0.00 |
| *[specify identification code]* | 0.00 | 0.00 | 0.00 |
| Organic soils [(7)] | | 0.00 | |
| Mineral soils [(7)] | | 0.00 | |
| **Information items [(9)]** | | | |
| **A.2.1. Deforestation: units of land otherwise subject to elected activities under Article 3.4 [(6)]** | **NA** | | |
| ***Total organic soils*** | NA | | |
| ***Total mineral soils*** | NA | | |
| *Austria* | NA | | |
| Organic soils [(7)] | NA | | |
| Mineral soils [(7)] | NA | | |

| **Documentation box** |
|---|
| Parties should provide detailed explanation on the land use, land-use change and forestry sector in the relevant annex of the NIR: Supplementary information on LULUCF activities under the Kyoto Protocol. Use this documentation box to provide references to relevant sections of the NIR if any additional details are needed to understand the content of this table. |
| |

(1) Methodologies for $N_2O$ emissions from disturbance associated with land-use conversion to Croplands are found in section 3.3.2.3.1.1 of the IPCC good practice guidance for LULUCF. N2O emissions from fertilization in the preceding land use and new land use should not be reported here. Parties should avoid double counting with N2O emissions from drainage and from cultivation of organic soils reported in Agriculture under Cultivation of Histosols.

(2) According to the IPCC good practice guidance for LULUCF $N_2O$ emissions from disturbance of soils are only relevant for land conversions to Cropland. $N_2O$ emissions from Cropland Management when Cropland is remaining Cropland are included in the Agriculture sector.

(3) Geographical location refers to the boundaries of the areas that encompass units of land subject to Deforestation.

(4) Geographical location refers to the boundaries of the areas that encompass land subject to Cropland Management, if elected.

(5) In the calculation of the implied emission factor, $N_2O$ emissions are converted to $N_2O$-N by multiplying by 28/44.

(6) $N_2O$ emissions associated with Deforestation followed by the establishment of Cropland should be reported under Deforestation even if Cropland Management is not elected under Article 3.4.

(7) Parties may separate data for organic and mineral soils, if they have data available.

(8) This includes $N_2O$ emissions in land subject to Cropland Management from disturbance of soils due to the conversion to Cropland of lands other than Forest Lands.

(9) Units of land subject to Deforestation under Article 3.3 otherwise subject to elected activities under Article 3.4 are implicitly included under A.2. They are reported here for transparency and to fulfil the requirement of paragraph 6 (b) (ii) of the annex to draft decision -/CMP.1 (Article 7), attached to decision 22/CP.7.

**TABLE 5(KP-II)4 SUPPLEMENTARY BACKGROUND DATA FOR LAND USE, LAND-USE CHANGE AND FORESTRY ACTIVITIES UNDER THE KYOTO PROTOCOL**

**Carbon emissions from lime application** [(1)]

Austria
2007
2009

| Identification code of geographical location [(2)] | ACTIVITY DATA | IMPLIED EMISSION FACTOR | EMISSIONS |
|---|---|---|---|
| | Total amount of lime applied (Mg/year) | Carbon emission per unit of lime (Mg C/Mg) | Carbon (Gg) |
| **A.1.1. Afforestation/Reforestation: units of land not harvested since the beginning of the commitment period** [(2), (8), (9)] | **0.00** | **0.00** | **0.00** |
| ***Total for limestone*** | 0.00 | 0.00 | 0.00 |
| ***Total for dolomite*** | 0.00 | 0.00 | 0.00 |
| *Austria* | NO | NO | NO |
| Limestone ($CaCO_3$) | NO | NO | NO |
| Dolomite ($CaMg(CO_3)_2$) | NO | NO | NO |
| **A.1.2. Afforestation/Reforestation: units of land harvested since the beginning of the commitment period** [(2), (8), (9)] | **0.00** | **0.00** | **0.00** |
| ***Total for limestone*** | 0.00 | 0.00 | 0.00 |
| ***Total for dolomite*** | 0.00 | 0.00 | 0.00 |
| *Austria* | NO | NO | NO |
| Limestone ($CaCO_3$) | NO | NO | NO |
| Dolomite ($CaMg(CO_3)_2$) | NO | NO | NO |
| **A.2. Deforestation** [(3), (8), (9)] | **0.00** | **0.00** | **0.00** |
| ***Total for limestone*** | 0.00 | 0.00 | 0.05 |
| ***Total for dolomite*** | 0.00 | 0.00 | 30.00 |
| *Austria* | NO | NO | NO |
| Limestone ($CaCO_3$) | NO | NO | NO |
| Dolomite ($CaMg(CO_3)_2$) | NO | NO | NO |
| **B.1. Forest Management (if elected)** [(4), (8), (9)] | **0.00** | **0.00** | **0.00** |
| ***Total for limestone*** | 0.00 | 0.00 | 0.00 |
| ***Total for dolomite*** | 0.00 | 0.00 | 0.00 |
| *[specify identification code]* | 0.00 | 0.00 | 0.00 |
| Limestone ($CaCO_3$) | | 0.00 | |
| Dolomite ($CaMg(CO_3)_2$) | | 0.00 | |
| **B.2. Cropland Management (if elected)** [(5), (8), (9)] | **0.00** | **0.00** | **0.00** |
| ***Total for limestone*** | 0.00 | 0.00 | 0.00 |
| ***Total for dolomite*** | 0.00 | 0.00 | 0.00 |
| *[specify identification code]* | 0.00 | 0.00 | 0.00 |
| Limestone ($CaCO_3$) | | 0.00 | |
| Dolomite ($CaMg(CO_3)_2$) | | 0.00 | |
| **B.3. Grazing Land Management (if elected)** [(6), (8), (9)] | **0.00** | **0.00** | **0.00** |
| ***Total for limestone*** | 0.00 | 0.00 | 0.00 |
| ***Total for dolomite*** | 0.00 | 0.00 | 0.00 |
| *[specify identification code]* | 0.00 | 0.00 | 0.00 |
| Limestone ($CaCO_3$) | | 0.00 | |
| Dolomite ($CaMg(CO_3)_2$) | | 0.00 | |
| **B.4. Revegetation (if elected)** [(7), (8), (9)] | **0.00** | **0.00** | **0.00** |
| ***Total for limestone*** | 0.00 | 0.00 | 0.00 |
| ***Total for dolomite*** | 0.00 | 0.00 | 0.00 |
| *[specify identification code]* | 0.00 | 0.00 | 0.00 |
| Limestone ($CaCO_3$) | | 0.00 | |
| Dolomite ($CaMg(CO_3)_2$) | | 0.00 | |

**Documentation box**

Parties should provide detailed explanation on the land use, land-use change and forestry sector in the relevant annex of the NIR: Supplementary information on LULUCF activities under the Kyoto Protocol. Use this documentation box to provide references to relevant sections of the NIR if any additional details are needed to understand the content of this table.

(1) Carbon emissions from agricultural lime application are addressed in sections 3.3.1.2.1.1 and 3.3.2.1.1.1 of the IPCC good practice guidance for LULUCF.
(2) Geographical locations refers to the boundaries of the areas that encompass units of land subject to Afforestation and Reforestation.
(3) Geographical locations refers to the boundaries of the areas that encompass units of land subject to Deforestation.
(4) Geographical locations refers to the boundaries of the areas that encompass land subject to Forest Management, if elected.
(5) Geographical locations refers to the boundaries of the areas that encompass land subject to Cropland Management, if elected.
(6) Geographical locations refers to the boundaries of the areas that encompass land subject to Grazing Land Management, if elected.
(7) Geographical locations refers to the boundaries of the areas that encompass land subject to Revegetation, if elected.
(8) If Parties are not able to separate lime application for different geographical locations, they should include liming for all geographical locations in the total.
(9) A Party may report aggregate estimates for total lime applications when data are not available for limestone and dolomite.

**TABLE 5(KP-II)5 SUPPLEMENTARY BACKGROUND DATA FOR LAND USE, LAND-USE CHANGE AND FORESTRY ACTIVITIES UNDER THE KYOTO PROTOCOL**
**GHG emissions from biomass burning**

Austria
2007
2009

| Identification code of geographical location | ACTIVITY DATA | | | IMPLIED EMISSION FACTOR | | | EMISSIONS | | |
|---|---|---|---|---|---|---|---|---|---|
| | Description[7] | Unit | Values | $CO_2$ | $CH_4$ | $N_2O$ | $CO_2$ [8] | $CH_4$ [8] | $N_2O$ |
| | Area (AB) or biomass burned (BB) | ha or kg dm | | (Mg/activity data unit) | | | (Gg) | | |
| **A.1.1. Afforestation/Reforestation: units of land not harvested since the beginning of the commitment period[1],[9]** | **ab** | **ha** | **NO** | **NO** | **NO** | **NO** | **0.00** | **0.00** | **0.00** |
| ***Total for controlled burning*** | ab | ha | NO | NO | NO | NO | 0.00 | 0.00 | 0.00 |
| ***Total for wildfires*** | ab | ha | NO | NO | NO | NO | 0.00 | 0.00 | 0.00 |
| *Austria* | ab | ha | NO | NO | NO | NO | NO | NO | NO |
| Controlled burning | ab | ha | NO | NO | NO | NO | NO | NO | NO |
| Wildfires | ab | ha | NO | NO | NO | NO | NO | NO | NO |
| **A.1.2. Afforestation/Reforestation: units of land harvested since the beginning of the commitment period[1], [9]** | **ab** | **ha** | **NO** | **NO** | **NO** | **NO** | **NO** | **NO** | **NO** |
| ***Total for controlled burning*** | ab | ha | NO | NO | NO | NO | NO | NO | NO |
| ***Total for wildfires*** | ab | ha | NO | NO | NO | NO | NO | NO | NO |
| *Austria* | ab | ha | NO | NO | NO | NO | NO | NO | NO |
| Controlled burning | ab | ha | NO | NO | NO | NO | NO | NO | NO |
| Wildfires | ab | ha | NO | NO | NO | NO | NO | NO | NO |
| **A.2. Deforestation[2], [9]** | **ab** | **ha** | **NO** | **NO** | **NO** | **NO** | **NO** | **NO** | **NO** |
| ***Total for controlled burning*** | ab | ha | NO | NO | NO | NO | NO | NO | NO |
| ***Total for wildfires*** | ab | ha | NO | NO | NO | NO | NO | NO | NO |
| *Austria* | ab | ha | NO | NO | NO | NO | NO | NO | NO |
| Controlled burning | ab | ha | NO | NO | NO | NO | NO | NO | NO |
| Wildfires | ab | ha | NO | NO | NO | NO | NO | NO | NO |
| **B.1. Forest Management (if elected) [3], [9]** | **0.00** | | | | | | **0.00** | **0.00** | **0.00** |
| ***Total for controlled burning*** | 0.00 | | | | | | 0.00 | 0.00 | 0.00 |
| ***Total for wildfires*** | 0.00 | | | | | | 0.00 | 0.00 | 0.00 |
| *[specify identification code]* | | | | | | | 0.00 | 0.00 | 0.00 |
| Controlled burning | | | | 0.00 | 0.00 | 0.00 | | | |
| Wildfires | | | | 0.00 | 0.00 | 0.00 | | | |
| **B.2. Cropland Management (if elected) [4], [9], [10]** | **0.00** | | | | | | **0.00** | **0.00** | **0.00** |
| ***Total for controlled burning*** | 0.00 | | | | | | 0.00 | 0.00 | 0.00 |
| ***Total for wildfires*** | 0.00 | | | | | | 0.00 | 0.00 | 0.00 |
| *[specify identification code]* | | | | | | | 0.00 | 0.00 | 0.00 |
| Controlled burning | | | | 0.00 | 0.00 | 0.00 | | | |
| Wildfires | | | | 0.00 | 0.00 | 0.00 | | | |
| **B.3. Grazing Land Management (if elected) [5], [9], [11]** | **0.00** | | | | | | **0.00** | **0.00** | **0.00** |
| ***Total for controlled burning*** | 0.00 | | | | | | 0.00 | 0.00 | 0.00 |
| ***Total for wildfires*** | 0.00 | | | | | | 0.00 | 0.00 | 0.00 |
| *[specify identification code]* | | | | | | | 0.00 | 0.00 | 0.00 |
| Controlled burning | | | | 0.00 | 0.00 | 0.00 | | | |
| Wildfires | | | | 0.00 | 0.00 | 0.00 | | | |
| **B.4. Revegetation (if elected) [6], [9]** | **0.00** | | | | | | **0.00** | **0.00** | **0.00** |
| ***Total for controlled burning*** | 0.00 | | | | | | 0.00 | 0.00 | 0.00 |
| ***Total for wildfires*** | 0.00 | | | | | | 0.00 | 0.00 | 0.00 |
| *[specify identification code]* | | | | | | | 0.00 | 0.00 | 0.00 |
| Controlled burning | | | | 0.00 | 0.00 | 0.00 | | | |
| Wildfires | | | | 0.00 | 0.00 | 0.00 | | | |

**Documentation box**

Parties should provide detailed explanation on the land use, land-use change and forestry sector in the relevant annex of the NIR: Supplementary information on LULUCF activities under the Kyoto Protocol. Use this documentation box to provide references to relevant sections of the NIR if any additional details are needed to understand the content of this table.

[1] Geographical locations refers to the boundaries of the areas that encompass units of land subject to Afforestation and Reforestation.
[2] Geographical location refers to the boundaries of the areas that encompass units of land subject to Deforestation.
[3] Geographical location refers to the boundaries of the areas that encompass land subject to Forest Management, if elected
[4] Geographical location refers to the boundaries of the areas that encompass land subject to Cropland Management, if elected
[5] Geographical location refers to the boundaries of the areas that encompass land subject to Grazing Land Management, if elected
[6] Geographical location refers to the boundaries of the areas that encompass land subject to Revegetation, if elected
[7] For each activity, activity data should be selected between area burned (AB) or biomass burned (BB). Units will be ha for area burned, and kg dm for biomass burned. The implied emission factor with an automatic change in the units.
[8] If $CO_2$ emissions from biomass burning are not already included in Tables 5(KP-I)A.1.1 to 5(KP-I)B.4, they should be reported here. This also includes the carbon component of $CH_4$. This should be clearly documented in the documentation box and in the NIR. Parties that include all carbon stock changes in the carbon stock tables (5(KP-I)A.1.1 to 5(KP-I)B.4) should report IE (included elsewhere) in the CO2 column.

[9] Parties should report controlled/prescribed burning and wildfires emissions separately, where appropriate.
[10] Burning of agricultural residues is included in the Agriculture sector.
[11] Greenhouse gas emissions from prescribed savannah burning are reported in the Agriculture sector.

**ACCOUNTING FOR ACTIVITIES UNDER ARTICLES 3.3 AND 3.4 OF THE KYOTO PROTOCOL**

Austria
2007
2009

***Number of the reported year in the commitment period:*** 1

| GREENHOUSE GAS SOURCE AND SINK ACTIVITIES | | Net emissions/removals [1] | | | | | | Accounting Parameters [2] | Accounting Quantity [3] |
|---|---|---|---|---|---|---|---|---|---|
| | BY[4] | 2008 | 2009 | 2010 | 2011 | 2012 | Total[5] | | |
| | (Mt $CO_2$ equivalent) | | | | | | | | |
| **A. Article 3.3 activities** | | | | | | | | | -1.23 |
| **A.1. Afforestation & Reforestation [a]** | | | | | | | | | -2.41 |
| A.1.1. Units of land not harvested since the beginning of the commitment period[b] | | -2.41 | | | | | -2.41 | | -2.41 |
| A.1.2. Units of land harvested since the beginning of the commitment period[c] | | | | | | | | | 0.00 |
| *[specify identification code]* | | | | | | | 0.00 | | 0.00 |
| **A.2. Deforestation [e]** | | 1.18 | | | | | 1.18 | | 1.18 |
| **B. Article 3.4 activities** | | | | | | | | | 0.00 |
| **B.1. Forest Management (if elected) [f]** | | | | | | | 0.00 | | 0.00 |
| FM cap[g] | | | | | | | | | 0.00 |
| 3.3 offset[h] | | | | | | | | 0.00 | 0.00 |
| **B.2. Cropland Management (if elected)[i]** | | | | | | | 0.00 | 0.00 | 0.00 |
| **B.3. Grazing Land Management (if elected)[i]** | | | | | | | 0.00 | 0.00 | 0.00 |
| **B.4. Revegetation (if elected)[i]** | | | | | | | 0.00 | 0.00 | 0.00 |

(1) All values are as reported in table 5(KP) of the CRF for the relevent inventory year as reported in the current submission, converted to Mt $CO_2$ eq.

(2) Accounting parameters apply for the calculation of the accounting quantity for Article 3, paragraph 4, activities as follows:

(g) Value as recorded for the Party in the appendix to decision 16/CMP.1, converted to Mt $CO_2$ eq. and multiplied by five.

(h) In accordance with paragaragraph 10 of the annex to decision 16/CMP.1, when a Party's total $CO_2$ eq. net emissions/removals to date for activities under Article 3, paragraph 3, are positive, the Party may issue the equivalent number of additional RMUs under forest management up to a limit of 165 Mt $CO_2$ eq. over the commitment period. If the sum of the accounting quantities for article 3, paragraph 3, activities is negative, then the 3.3 offset equals zero. If the sum of these Article 3, paragraph 3, accounting quantities is positive, then the 3.3 offset equals the lesser of this sum and 165;

(i) Net emissions and removals in the base year for the activity, multiplied by the year of the commitment period (cell J5).

(3) The total quantity of units to be added to or subtracted from a Party's assigned amount for a particular activitity, calculated as follows:

(a) The sum of the accounting quantity for A.1.1 and the accounting quantity for A.1.2

(b) The accounting quantity for A.1.1 equals the total net emissions and removals

(c) The sum of the accounting quantities for each individual land unit under category A.1.2

(d) For each individual unit of land under category A.1.2, if total net emissions and removals are positive, than the accounting quantity equals zero. Otherwise the accounting quantity equals the total net emissions and removals.

(e) The accounting quantity for A.2 equals the total net emissions and removals.

(f) The accounting quantiy for B.1 equals the sum of the accounting quantity up to the FM Cap, and any accounting quantity for the 3.3 offset.

(g) If total net emissions and removals to date are negative, the accounting quantity toward the FM cap equals the negative of the lesser of the absolute value of net emissions and removals or its forest management cap. If net emissions and removals are positive, then the accounting quantity toward the FM cap equals the lesser of the net emissions and removals to date or the forest management cap.

(h) If total net emissions and removals to date are negative and the absolute value of net emissions and removals exceeds the forest management cap, then the accounting quantity for the 3.3. offset equals the negative of the lesser of the difference of the absolute value of net emissions and removals minus the forest management cap, and 165. Otherwise, the accounting quantity for the 3.3 offset equals zero.

(i) The accounting quantity for category B.2, B.3 and B.4 equals the cumulative net emissions and removals for all years of the commitment period to date, minus the accounting parameter for that category.

(4) Net emissions and removalsys in the Party's baseyear, as established in decision 9/CP.2

(5) Cumulative net emissions and removals for all years of the commitment period reported in the current submission.

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Der National Inventory Report 2009 (NIR 2009) präsentiert eine genaue Methodikbeschreibung der Österreichischen Luftschadstoff-Inventur für die Treibhausgase Kohlendioxid, Methan und Lachgas sowie für Industriegase (HFKW, FKW, $SF_6$). Damit erfüllt Österreich die Anforderungen an die transparente und nachvollziehbare Dokumentation, die für die englische Berichterstattung zur Klimarahmenkonvention bzw. zum Kyoto-Protokoll notwendig ist.

Der vorliegende Bericht enthält sektorspezifische Emissionen von 1990 bis 2007, Emissionsfaktoren und Basisdaten für Emissionsberechnungen sowie Informationen für die Berichterstattung unter dem Kyoto-Protokoll. Zudem dokumentiert das Umweltbundesamt im NIR 2009 das Nationale Inventursystem und die Qualitätssicherung im Rahmen der gemäß ISO/IEC 17020 akkreditierten Überwachungsstelle Emissionsbilanzen.

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